FOREWORD

If you follow our results in the last years and if you have had a look on the page "Foreword", you could notice every time that foreword was looking to explain to the reader the state of our emotions in close connection with the events mentioned in the report. This year we would like that this foreword creates no impediment to the reader by inducing suggestions by us or worse, by entreaties like "here please enjoy" or "now it is time to be serious" or even "now you must be sorrowful !" Now freed of such constraints, the reader will be objective and he will feel free to express their own point of view. Information in this report are natural presented, in a defined structure, including identification data of ICPE-CA, with a brief presentation of our leading bodies, of the economic and financial situation, the structure of our human resources, our research equipment investment; we'll find brief descriptions of the researchers results, measures taken to increase our visibility in Romania and worldwide, our professional prestige and emphasized of medium and long-term priorities, too. Not missing from the report observations of our auditor's reports.

SOP IEC project, having the acronym PROMETEU, which is developing new laboratories and upgrading other already existing in our institute, in the field of energy, will be completed in 2015.

Beyond these, if we think at the year 2014, we can admire the work of our colleagues in promoting new projects on NPRDI II or other national and international Programme, of which we should mention HORIZON 2020, STAR, Clean Sky, ESA, SEE, EEA, CEA and others. We must not forget bilateral scientific cooperations with countries in Europe, Asia, Africa, America.

We kindly ask the reader of these thoughts to note the changing character of our contracts spectrum: if we assign to the economic contracts spectrum lines with small wave length, situated near us, that the reader must deserve a movement of the spectral lines to our position in the spectrum, to short wave length, to contracts with increased economic character. The project FAIR, other engagements signed with customers from JINR Dubna, Russian Federation, are on the origin of this shift.

Dear colleagues, employees or colleagues transferred temporarily, we would like to thank you for what you have achieved in 2014. Together we must express our gratitude to all our collaborators from outside the Institute who helped us in our achievements, both from home and abroad.

I conclude this foreword by thanking the members of the Administrative Council Board, with which I have drafted our strategy and they approved it, they have promoted and monitored it; also the Scientific Council of ICPE-CA, but not at least, members of the Directory Board, with whom I assured the daily coordination of the ICPE-CA effort.

Bucharest, March 26, 2015

Wilhelm Kappel
General Director

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Financing: National Programme of Research, Development and Innovation PNCDI II, PN-II-PT-PCCA-2013-4-0128, contract no. 147/2014 (4311/2014
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Head of the project: Eng. Christu Țârdei, CS III 86
Direct laser printing of polymer-graphene composites
Financing: National Programme of Research, Development and Innovation PNCDI II, contract no. 146/2012 (7091/2012)
Head of the project: Dr. Eng. Ion Ioana, CS III 90
Permanent magnet with low rare earth
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Financing: Nucleu Programme, contract no. 0935-5103/2009; Joint Scientific Cooperation Programme Romania - Russia, ICPE-CA Bucharest - JINR Dubna, contract no. 29/2013 and Capacities Programme - module III - Joint Scientific Cooperation Romania – Republic of Moldova, contract no. 691/2013 (4298/2013) – STORM
Project Responsible: Dr. Eng. Phys. Eros Pătroi, CS II 94
Superparamagnetic oxide nanoparticles (Fe_3O_4 and /γF_2O_3) for applications in magnetic ferrofluids based on vegetable oils
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Financing: Nucleu Programme, contract no. PN 09-35-03-03/2012
Head of the project: Dr. Eng. Mălăeru Teodora, CS I 96

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Intelligent system for the analysis and diagnosis of collagen-based artefacts
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Head of the project: Dr. Chem. Petru Budrugeac, CS I, Head of the Laboratory for Evaluation of Thermal Behavior of Products and Materials 100

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Head of the project: Eng. Adrian Dobre, IDT II 106

Power generation system which uses a double - effect wind turbine in order to ensure the energy autonomy in specific applications
Financing: National Programme of Research, Development and Innovation PNCDI II, contract no. 39/2012 (4285/2012)
Head of the project: Dr. Eng. Sergiu Nicolaie, IDT I, Head of Department for Efficiency in Energy Conversion and Consumption 107

Linear electromagnetic generator type harvesting for ambient vibration energy conversion into electrical energy by electromagnetic induction
Financing: Nucleu Programme, contract no. PN 09-35-01-01/2009, (5101/2009)
Head of the project: PhDs. Eng. Cătănescu Alexandru-Laurențiu, CS 110

Innovative electric power grid protection device against low power factor electronic loads
Financing: National Programme of Research, Development and Innovation PNCDI II, contract no. 60/2014 (7105/2014)
Head of the project: Dr. Eng. Marin Dorian, CS III 114

Increasing the efficiency of the driving systems in the pumping equipments of the progressive cavity pumps used in the exploitation of oil and gas
Financing: Nucleu Programme, contract no. PN 09350201/2014 (F9/2014)
Head of the project: PhDs. Eng. Nuşa Mitraşcă, IDT I 116

Membranes designed for forward osmosis process
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Financing: Nucleu Programme, contract no. PN 09350201/2014
Head of the project: Dr. Eng. Gabriela Hristea, CS I 118

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Financing: National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 34/2012 (7090/2012)
Head of the project: Dr. Eng. Violeta Tsakiris, CS II 124

Environment energy harvesting hybrid system by photovoltaic and piezoelectric conversion, DC/DC transformation with MEMS integration and adaptive storage
Financing: National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 63/2014 (4312/2014)
Head of the project: Dr. Eng. Pîslaru-Dănescu Lucian, IDT II 127

Micro Electro-Mechanical Components and Systems (MEMS) developed by specific technologies with applications in medicine, micro fluidics and micro electrical machines and micro – actuators execution
Financing: Nucleu Programme, contract no. PN 09-35-01-01 (5101/2009)
Head of the project: PhDs. Eng. Marius Popa, CS III 129

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Environmental issues specific to the oil industry: waste management and recovery/ recycling solutions
Financing: Nucleu Programme, contract no. PN 09350303/2009

Head of the project: PhDs Eng. Georgeta Stoianovici, CS 132
Innovative aeration system of water used by hydraulic turbines, for preservation of the aquatic life
Financing: National Programme of Research, Development and Innovation PNCDI II - Partnerships in priority areas, contract no. 88 / 2014 (4314/2014)
Head of the project: Dr. Eng. Bunea Florentina, CS III 134
APPLICATIONS IN ELECTRICAL ENGINEERING
Installation and technology for recycling wastes through selective disassembly using high voltage pulses
Financing: National Programme of Research, Development and Innovation PNCDI II - Partnerships PCCA 2013, contract no. 84/2014 (4307/2014)
Head of the project: Dr. Eng Mihai Bădic, CS I 137
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Financing: PCCA Programme, contract no. 100/2014 (4313/2014)
Head of the project: Dr. Eng. Lingvay Iosif, Scientific Secretary, CS I 139
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Financing: National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 204 (4284) /2012)
Head of the project : Dr. Phys. Jenica Neamțu, CS I 143
Polymeric insulations of high performance for rotating electrical machines. Technology and modelling methods
Financing: National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 262/2014 (7106/2014)
Head of the project: PhDs. Eng. Gabriela Telipan, IDT I 146
ESD fabrics realized from fibres with conductive core knitted bilayer
Financing: National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 179/2012 (7089/2012)
Head of the project: PhDs. Eng. Gabriela Telipan, IDT I 149
Magnetic nanofluids and fluids magnetizable nano-micro composites with high magnetization. Applications for high pressure rotary seals and heavy duty operation, respectively magnetorheological control devices
Financing: National Programme of Research, Development and Innovation PNCDI II, contract no. 157/2012 (7087/2012)
Head of the project: Dr. Chem. Traian Zaharescu, CS I 152
Electrical machines with increased efficiency, by using advanced technical solutions, based on the predetermination of the magnetic properties of sheets
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Head of the project: PhDs. Eng. Georgeta Velciu, IDT I 158
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Hybrid vertical axis wind turbine
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Head of the project: Dr. Eng. Sergiu Nicolaie, IDT I 163
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Financing: National Programme of Research, Development and Innovation - PNCDI II, contract PCCA no 245/2014 (7099/2014)
Head of the project: Dr. Phys. Jenica Neamțu, CS I 165

High temperature intelligent sensor with silicon carbide (SiC) diodes for industrial applications in harsh environments
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Head of the project: Dr. Phys. Jenica Neamțu, CS I 167
HTS Superconductive magnet for nuclear magnetic moments measurement
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Head of the project: Dr. Eng. Ion Dobrin, CS II 170
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Fabrication of dipolar superferric electromagnets and magnets and field sources for FAIR particle accelerators
Financing: Nucleus Programme, contract no. 35N 0102/2014 (50102/2014)
Head of the project: Dr. Eng. Ion Dobrin, CS II 176
Advanced Composite Structures for Space Applications
Financing: Research-Development-Innovation for Space Technology and Advanced Research Programme - STAR, contract no. 9/2012 (7094/2012)
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Financing: contract with third parties no. 284/2014 (1086/2014)
Contract Responsible: Dr. Eng. Alina Ruxandra Caramitu, IDT I 188
Services Research on determination of physico-chemical properties of carbon-polymer hybrid layers
Financing: contract with third parties no. 227/2014 (1084/2014)
Contract Responsible: Dr. Eng. Alina Ruxandra Caramitu, IDT I 192
Technical knowledge: Technical documentation on the methods and schemes for achieving Salisbury and Jaumann electromagnetic shields
Financing: contract with third parties no. 1089 / 2014, beneficiary: SC ALL GREEN SRL Romania
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Head of the project: PhDs Eng. Phys. Virgil Marinescu, CS 199
Renergy - Regional strategies for energy conscious communities
Financing: service contract no. 1068/2012
Head of the project: Eng. Ivan Ion, IDT I 200
Study about the network connection of a screw turbine turbogenerator group in the case of operation with an installed power of 180 kW in island mode and network

connected mode. Specific technical conditions for the cases: start, long operation at constant speed of turbogenerators and variable speed respectively, in the limit of ± 10%, stop and damage cases.
Financing: extrabugetary sources, contract no. 153/2014 (1090/2014)
Beneficiary: INCD TURBOMOTOARE COMOTI Bucharest, Romania
Head of the project: Dr. Eng. Lucian Pîslaru-Dănescu, IDT II 200
Obtaining specimens of thermoplastic polymer composite powder nanoconductive on specialized equipment and integrated analysis of mechanical, chemical and thermal specimens results
Financing: extrabudgetary - service contract with third parties, contract no. 1111/2014 (1079/2014)
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Head of the project: Dr. Eng. Cristiana Diana Cîrstea, CS 226
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Head of the project: Dr. Eng. Mirela Maria Codescu, CS I 223
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The institute in brief

The institute in brief

2.1. History

Since August 24, 2004, by Romanian Government Decision no. 1282, SC ICPE-Advanced Researches SA (company set up in 2001) was reorganized as **National Institute for Research and Development in Electrical Engineering ICPE-CA Bucharest (acronym INCDIE ICPE-CA)**.

ICPE-CA has an experience of over 64 years and has managed to impose itself as one of the most competitive research and development entity in the country, but also to integrate into the significant European entities chain focused on advanced researches in electrical engineering field.

All these were due to expansion of areas of multidisciplinary research fields and continuously focus on applied research. At the same time, an important place in the ICPE-CA activity was due to the involving in international projects, our institute being an active participant in both EU Programmes (*SOP IEC, FP6 and FP7*), and territorial cooperation programmes with other European countries (*Black Sea Basin Joint Operational Programme, Romania – Bulgaria Cross-Border Cooperation Programme, South-East Europe Transnational Cooperation Programme, Competitiveness and Innovation Framework Programme*).

ICPE-CA is accredited and is coordinated by the **Ministry of Education and Scientific Research - National Authority for Scientific Research and Innovation**, currently having the following areas:

- basic and applied research in the field of electrical engineering;
- technical support and consultancy in the field of electrical engineering;
- information, documentation and staff training in the field of electrical engineering;
- technology transfer.

Vision INCDIE ICPE-CA

INCDIE ICPE-CA will become the promoter of progress based on knowledge in the field of *electrical engineering*.

Mission INCDIE ICPE-CA

INCDIE ICPE-CA promotes and carries out applied research in national and international background in electrical engineering field (materials, electrotechnologies, new energy sources, micro- and nano-electrotechnologies, electromagnetic compatibility a.o) for private and public companies, in the benefit of the whole society.

Developing technological innovation for customers, ICPE-CA increases their competitiveness both in Romania and in Europe. Research activities promote economic development of society and lead to social welfare, closely connected with the environment.

For institute employees, ICPE-CA offers personal development professional qualification which will enable them to occupy positions of responsibility at the level of the institute, industry and other scientific fields.

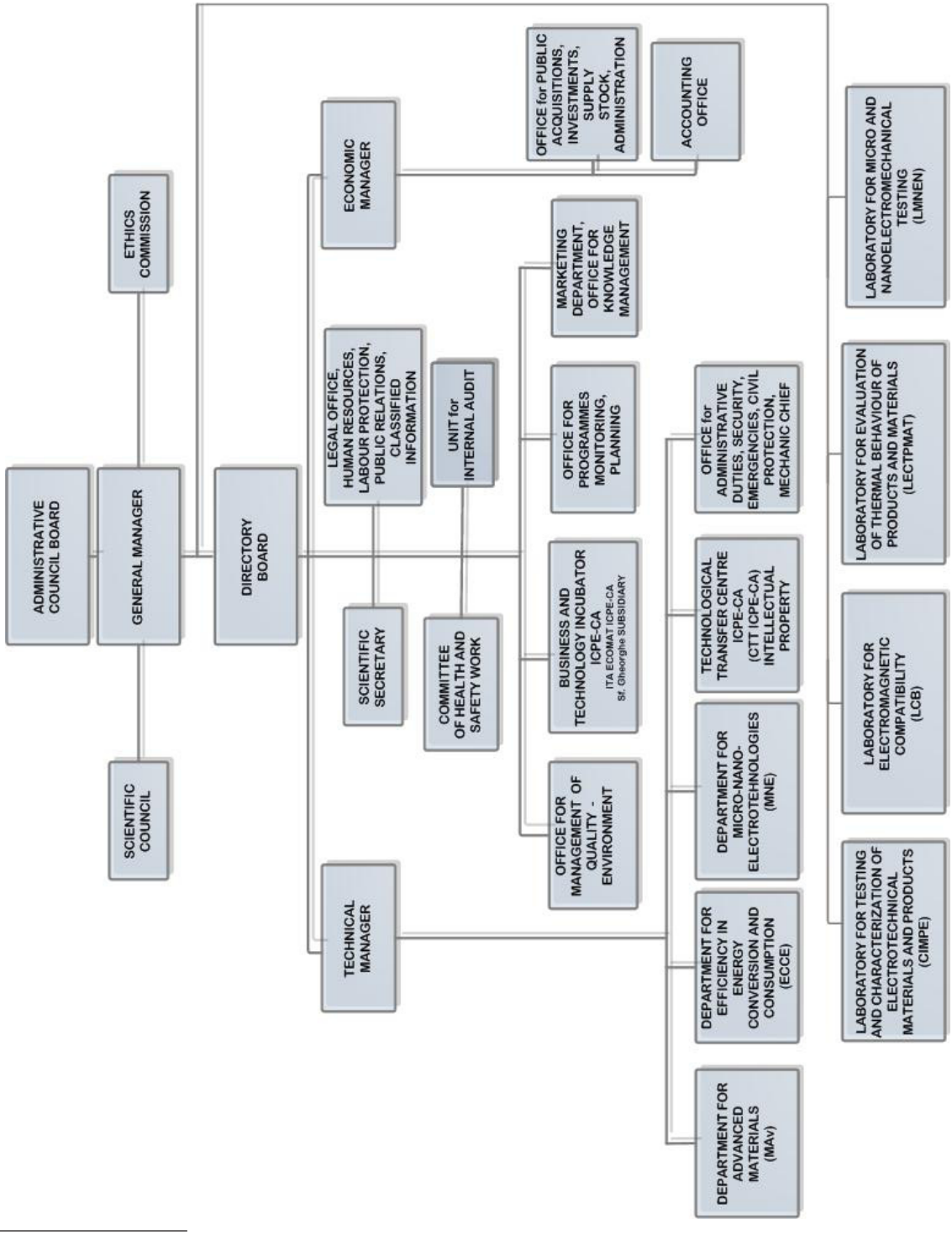
The mission is defined, achievable (due ICPE-CA skills and creativity of employees), informative, accurate, reflects reality (values and culture) of ICPE-CA, and is oriented towards customers.

In strategy developed by the institute during the period 2007 - 2015, research activities have contributed to:

- reach the level of compatibility and competitiveness necessary for integration into the European research area;
- participation in RDT Framework Programme 7 of the European Union for the period 2007-2015;
- developing social, economic, competitive and dynamic, oriented high-tech fields, able to meet the strategic long-term development in the globalized economy.

2.2. Organizational structure of INCDIE ICPE-CA (organizational chart, branches[1], subsidiaries[2], working offices)

In 2014 the institute has functioned on organizational chart approved by the Ministry of Education, Research, Youth and Sports no. 3676/22.04.2010. The organizational chart is shown below.



[1] entity with legal status
[2] entity without legal status

2.3. Specialized field of INCDIE ICPE-CA (according to UNESCO and NACE classification)

a. according to NACE classification:
Main activity as coding:
7219 – Research – development on natural sciences and engineering
Secondary activities as coding:
7211 - Research – development in biotechnology
7220 – Research – development in social sciences and humanities
3250 – Manufacture of medical and dental instruments and supplies

b. according to UNESCO classification:
3306 – Electrical Engineering and Technology
3312 – Technology of materials

2.4. Research area

a. main research area:
Research – development on natural sciences and engineering

The institute is involved in 3 main research areas:
- advanced materials: functional / multifunctional, crystalline and nanostructured materials and composites;
- new sources of energy (wind energy, solar energy, fuel cells, hydrogen storage): conversion, economy and recovery;
- microelectromechanical technologies and systems.

b. secondary research areas:
Research – development in biotechnology
Research – development in social sciences and humanities
Manufacture of medical and dental instruments and supplies

Description of activity:
a) basic and applied research in the field of electrical engineering;
b) technical support and consultancy in the field of electrical engineering;
c) information, documentation and staff training in the field of electrical engineering.

c. services / technology transfer

INCDIE ICPE-CA provides specialized activities of technology transfer and assistance in the implementation of technology transfer of research results in the field of electrical engineering for economy, through the Pilot Stations (Functional Materials Pilot Station; Carbon Materials Pilot Station; Magnetic Materials Pilot Station; Ceramic Materials Pilot Station), the Centre for Technology Transfer CTT ICPE-CA Bucharest and the Business and Technology Incubator ITA ECOMAT ICPE-CA located in Sf.Gheorghe city.

Also, INCDIE ICPE-CA provides technical support, supplying of scientific and technological services for companies or any interested customers, by testing laboratories:

- Laboratory for Testing and Characterization of Electrotechnical Materials and Products;
- Laboratory for Electromagnetic Compatibility;
- Laboratory for Evaluation of Thermal Behaviour of Products and Materials;
- Laboratory for MEMS and NEMS Testing.

The technology transfer from research to the business as the main method of stimulating the economic growth, applied in the world, is performed by INCDIE ICPE-CA by establishing/development of spin-offs: SC ROMNEOMAG SRL.

Another important channel of technology transfer is the Enterprise Europe Network in which INCDIE ICPE-CA is partner (within the BisNET Transylsania-1 project).

The development of partnership with scientific and technology parks is another goal that our institute has developed. Thus, by the Order of Delegated Minister for Higher Education, Scientific Research and Technological Development no. 4901MD from August 27, 2013, was approved to operate the Romanian-Chinese Scientific and Technology Park *International Green Innovation Park – IGIP*; the founding members are INCDIE ICPE-CA, Avrig City Hall and Chinese partner, Beijing Chengtong Reorient Investment Consultancy Co.Ltd.

IGIP Park headquarters is INCDIE ICPE-CA, 313 Splaiul Unirii, sector 3, Bucharest, Romania.

2.5. Strategic changes in organizing and functioning of INCDIE ICPE-CA[3]:

The desire to achieve goals of National RDI Plan and to achieve the energy projects, INCDIE ICPE-CA has increased the research area including conventional energy such as oil and gas. In this regard, ICPE-CA has continued to transfer temporarily the employees ***IPCUP Ploiești*** in 2014, too.

[3] ex.: mergers, divisions, transformation etc.

General information

General information

INCDIE ICPE-CA is a national institute with a long tradition on Romanian market, set up in 1950 and reorganized in 2004 under Romanian Government Decision no. 1282/24.08.2004 in *National Institute for Research and Development in Electrical Engineering ICPE-CA*, being in the coordination of the *Ministry of Education and Scientific Research – National Authority for Scientific Research and Innovation*.

The patrimony of the institute consists of private ownership of state assets, which it has under management, and of their goods.

The institute has an important scientific basis in the field, INCDIE ICPE-CA occupies a well-defined national position, being among the most active and efficient research units.

This has been certified by the *Excellence Award for the most efficient promotion of research results*, awarded by NASR in 2008, by the *Award for assimilation into industrial manufacturing of a series of synchronous generators for wind micro turbines*, *Biogas unit for rural area households, Highly stable polymeric materials for manufacturing sealing products used in nuclear power plants,* awarded by the AGIR (General Association of Engineers in Romania) in 2010; *Award in the field of "Electrical Engineering" for the product "Carbon bipolar plate for fuel cells with electrolyte polymer",* awarded by the AGIR in 2011; *Award in the field of "Materials Engineering" for the product "Granular synthetic product for applications in oral surgery (PG beta-TCP, 500-1000μm)",* awarded by the AGIR in 2012.

ASOCIAȚIA GENERALĂ A INGINERILOR DIN ROMÂNIA

PREMIUL AGIR
2010

În domeniul "Ingineria mediului"

Se acordă realizatorului:
INCDIE ICPE - CA - Institutul Național de Cercetare - Dezvoltare pentru Inginerie Electrică
pentru lucrarea: *Instalație de biogaz pentru gospodării individuale*

14.09.2011

Președinte,
Mihai MIHAIȚĂ

ASOCIAȚIA GENERALĂ A INGINERILOR DIN ROMÂNIA

PREMIUL AGIR
2010

În domeniul "Ingineria materialelor"

Se acordă realizatorului:
INCDIE ICPE - CA - Institutul Național de Cercetare - Dezvoltare pentru Inginerie Electrică
pentru lucrarea: *Materiale polimerice de înaltă stabilitate pentru fabricarea produselor de etanșare utilizate în centralele nuclearo-electrice.*

14.09.2011

Președinte,
Mihai MIHAIȚĂ

ASOCIAȚIA GENERALĂ A INGINERILOR DIN ROMÂNIA

PREMIUL AGIR
2011

În domeniul "Inginerie electrică"

Se acordă realizatorului:
INCDIE ICPE - CA - Institutul Național de Cercetare - Dezvoltare pentru Inginerie Electrică
pentru lucrarea: *Placă bipolară carbonică pentru pilele cu combustibili cu electrolit polimer*
Producător S.C. Roseal, după concepție INCDIE ICPE-CA

14.09.2012

Președinte,
Mihai MIHAIȚĂ

ASOCIAȚIA GENERALĂ A INGINERILOR DIN ROMÂNIA

PREMIUL AGIR
2012

În domeniul "Ingineria materialelor"

Se acordă realizatorului:
INCDIE ICPE - CA - Institutul Național de Cercetare - Dezvoltare pentru Inginerie Electrică
pentru lucrarea: *Produs granular sintetic pentru aplicații în chirurgia oralo-maxilofacială (PG β-TCP, 500-1000μm).*

06.09.2013

Președinte,
Mihai MIHAIȚĂ

With a special opening to applied research in electrical engineering, over the years the institute has approached those projects to develop the scientific, economic and social environment.

From the beginning until now, the institute has continued its programme of cooperation and partnership with entities from its field. Thus, we can mention a large number of scientific articles published in ISI journals (33 ISI papers and 18 papers published in ISI conference proceedings/publications in 2014), scientific / technical papers published in other journals non-quoted ISI (20 non-ISI papers), scientific papers presented at international conferences (99 papers), products (134), procedures (51) and services resulting from research, important technological transfer (1) made by institute, all these meaning continuous scientific, technological, economic and social progress.

As technical and technological success, must be highlighted and attending in various national and international trade fairs and exhibitions with most successful achievements of the institute for economy and industry (International Exhibition of Inventions – Geneva – Switzerland, International Salon Brussels – EUREKA – Belgium, Romanian Research Exhibition 2014 and INVENTIKA 2014 – Bucharest - Romania, International Innovation Exhibition ARCA 2014 - Zagreb – Croatia, International Conference and Exhibition of Hydraulics

and Pneumatics "HERVEX 2014" - Călimănești–Căciulata – Romania, International Salon Brussels – EUREKA - Brussels - Belgium), as well as organizing of 4 scientific events which increased the scientific visibility of our institute.

The Institute is well represented in the field of intellectual property through 16 patents granted by OSIM (Romanian State Office for Inventions and Trademarks), 11 patents submitted in 2014 at OSIM and continuous attending at main international Inventions shows, being awarded with many national and international medals and awards (27 awards obtained in 2014).

ROMÂNIA
MINISTERUL EDUCAȚIEI NAȚIONALE

AUTORIZAȚIE DE FUNCȚIONARE

Se autorizează funcționarea parcului științific și tehnologic „International Green Innovation Park - IGIP", administrat de Societatea de Administrare a Parcului IGIP SRL cu sediul în municipiul București, strada Splaiul Unirii, nr.313, sector 3, înregistrată la Registrul Comerțului sub nr. J40/7858/2013.

Prezenta AUTORIZAȚIE DE FUNCȚIONARE a fost eliberată în baza Ordinului Ministrului delegat pentru învățământ superior, cercetare științifică și dezvoltare tehnologică nr. 4901MD din 27.08.2013.

MINISTRU DELEGAT
MIHNEA COSMIN COSTOIU

Nr. 8
București, 28.08.2013

The development of partnership with scientific and technology parks is another goal that our institute has developed. Thus, by the Order of Delegated Minister for Higher Education, Scientific Research and Technological Development no. 4901MD from August 27, 2013, was approved to operate the Romanian-Chinese Scientific and Technology Park *International Green Innovation Park – IGIP*; the founding members are INCDIE ICPE-CA, Avrig City Hall and Chinese partner, Beijing Chengtong Reorient Investment Consultancy Co.Ltd.

IGIP Park headquarters is INCDIE ICPE-CA, 313 Splaiul Unirii, sector 3, Bucharest, Romania.

Certainly, these achievements have led to reach the strategic objectives required by the institute mission, namely, research and development in the field of electrical engineering, supporting the progress based on knowledge, for the benefit of the whole society.

The Institute is involved in 3 main research areas, organized in 3 great departments:

- Department for Advanced Materials: functional / multifunctional, crystalline and nanostructured materials and composites;
- Department for Efficiency in Energy Conversion and Consumption (wind, solar, fuel cells, hydrogen storage): conversion, saving and recovery;
- Department for Micro-Nano-Electro-Technologies,

and 4 testing laboratories:

- Laboratory for Electrical Materials and Products Characterization;
- Laboratory for Electromagnetic Compatibility;
- Laboratory for Determination of Thermal Analysis (RENAR accreditation certificate *LI 685 / 2013);*
- Laboratory for Micro and Nano-Electro-Mechanics.

The desire to achieve goals of National RDI Plan and to achieve the energy projects, INCDIE ICPE-CA has increased the research area including conventional energy such as oil and gas. In this regard, ICPE-CA has continued to transfer temporarily the employees ***IPCUP Ploiești*** in 2014, too.

The main research groups in the INCDIE ICPE-CA are focused on the following areas of interest:

- **Advanced Materials:**
  - **development of research in obtaining and characterization of materials and components for energy area;**
  - **development of research in obtaining and characterization of materials and components for electrical engineering area;**
  - **development of research in obtaining and characterization of biomaterials and bio-based products; certification of granular product PG-beta-TCP;**

- **development of research in obtaining and characterization of materials for special and/or environmental applications;**
- **development of interdisciplinary researches in the field of surface functionalizing and study of interface properties;**
- **development of research on structural changes in bulk materials and thin layers subjected to stress;**
- **characterization of metallic, ceramic, magnetic, carbon, polymer materials;**

- **Efficiency in Energy Conversion and Consumption:**
  - renewable energy sources and energy efficiency;
  - electromechanical design – mechanical and microprocessing;
  - applications of superconductivity and cryogenics in electrical engineering;
  - physico-chemical and electrochemical systems and devices with applications in energy;
  - other applications in electrical engineering;

- **Micro-Nano-Electro-Technologies:**
  - micro and nanoelectromechanical;
  - applications in aeronautics;
  - micro and nanostructures of thin layers and oxide nanoparticles;
  - microsystems for magnetic multulayers with GMR and TMR effect for spintronics;
  - technology transfer of electromechanical systems;
  - micromotors and generators of very high speed;
  - Training Centre in Scientific Research for Young Olympics - ECYO.

- **Characterization and testing of electrical materials and products;**
- **Electromagnetic compatibility;**
- **Evaluation of thermal behaviour of products and materials;**
- **Testing for micro and nanoelectromechanics;**
- **Management of quality / environment;**
- **Research-development of oilfield equipment.**

INCDIE ICPE-CA working through its representative as member of the European platforms: ***EuMaT*** – Steering Committee; ***High Energy Storage Ring HESR; International Facility for Antiproton and Ion Research FAIR,*** and national: ***EuMaT Platform in Romania***; ***National Group of Reflectance EuMaT***; ***Electrotechnical Regional Cluster ETREC*** – Brașov; ***Măgurele High Tech Cluster MHTC*** – Bucharest – county Ilfov; ***Mechatronics Cluster MECHATREC*** – Bucharest – county Ilfov, as well as other professional associations: ***WEB Romanian National Committee of the World Energy Council; Institute of Professional Representatives – European Patent Office***, Germany; ***International Atomic Energy Agency***; ***SRMM*** *(Romanian Society of Magnetic Materials)*; ***"Theodor Segărceanu" Romanian Society of Materials***; ***Romanian Society of Powder Metallurgy SRMP***; ***Romanian Society of Carbonic Materials SRMC***; ***Romanian Society of Ceramic CEROM***; ***Romanian Society of Biomaterials SRB***; ***Romanian Society of Physics***; ***Romanian Federation of Biomedical Engineering FRIB***; ***Electrochemical Society ECS***; ***Romanian Society of Chemistry***; ***Romanian Welding Society ASR***; ***Romanian Society of Materials ARM***; ***Romanian Committee of Electrical Engineering CER***; ***General Association of the Engineers in Romania AGIR***; ***Society for Promotion of Renewable, Inexhaustible and New Energies SPERIN***; ***European Society for Applied Superconductivity ESAS***; ***Romanian Society for Protection against Non-ionising Radiation SRPRNI***; ***International Association for Hydro-Environment Engineering and Research IAHR***; ***Verein Deutscher Ingenieure VDI***; ***Romanian Association of Electronics and Software ARIES***; ***Chamber of Commerce and Industry of Bucharest CCIB***; ***Romanian EMC Association ACER***; ***Professional Association of New Energy Sources SUNE***; ***Romanian Association of Quality Assurance SRAC***; ***Technical Standards Committee ASRO:*** TC 1 "Rotating Machinery"; TC 19 "Terms, classification, environment testing and standardization of environment aspects for electrical and electronic products and systems. Energy management"; TC 20 "Magnetic components and ferrites materials"; TC 22 "Electromedical equipment"; TC 25 "Magnetic materials"; TC 30 "Electromagnetic compatibility and radio interference"; TC 32 "Technical ceramics"; TC 34 "Superconductivity"; TC 78 "Road vehicles"; TC 89 "Industrial valves"; TC 109 "Gas meters"; TC 133 "Hydraulic turbines"; TC 135 "Capacitors and resistors for electronic equipment"; TC 169 "Materials, equipment and offshore structure for petroleum, petrochemical and natural gas"; TC 174 "Wind turbine systems"; TC 279 "Electromagnetic fields in the human environment"; TC 333 "Electrical road vehicles and electric industrial trucks"; TC 378 "Nanotechnologies"; **Commission for the EU Ecolabel**; **National Network of Promoters, Facilitators and Experts in the EU Strategy for the Danube Region *PROFEX***; ***Egyptian Corrosion Society***; ***MTA (Hungarian Academy of Sciences)***; ***Romanian Association of Drilling Contractors***

(ACFR); Romanian Committee for Fittings Industry (CRIA); ***Oil and Gas Employers' Federation; Employers Union of Research-Development and Design Organizations in Romania***; ***Romanian CO_2 Club***; ***IEEE Society – USA,*** thus contributing to the harmonization of the Romanian research policy with the European ones.

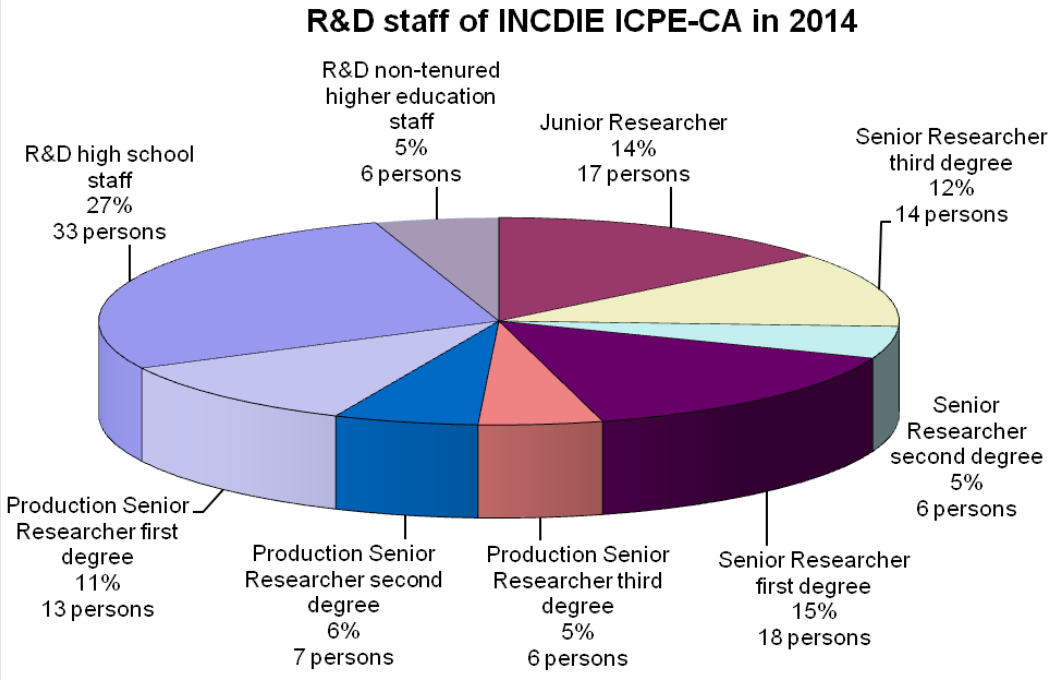


Fig. 1

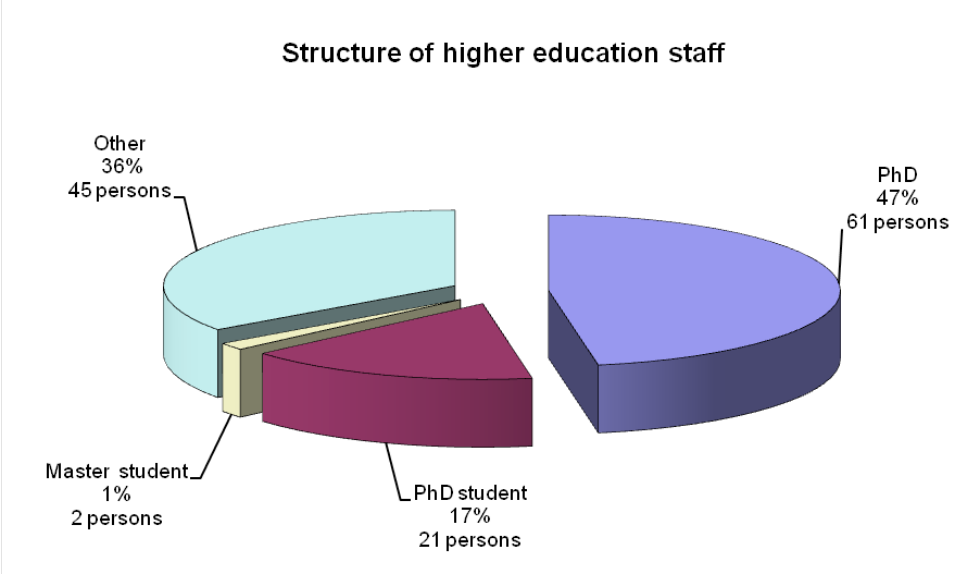


Fig. 2

Institute staff in 2014, as can be seen from the chart above (fig. 1 and 2), is composed of high-class specialists who have a high potential for assimilation of the latest technologies in the field and always adapting to the market requirements. Thus, in proportion of 72% of those 173 employees with higher education, 61 are PhD, 21 are PhD students having quite different fields of study (physics, chemistry, electrotechnics, metallurgy, mechanics, and biology) and 2 are master students.

About 31% of the 52 employees from IPCUP Ploiesti, which were transferred temporarily for 2014, are higher education, of which 1 PhD and 4 PhD students. IPCUP Ploiesti fields of study are mechanical, oil equipment, drilling and production, environmental protection, metallurgy, control and product expertise, automation.

Financing of its activities is done mainly by the Nucleus Programme, the PN-II National Research-Development-Innovation Programmes, Sectoral Operational Programme, and in the framework of grants and projects financed from EU Programmes.

Evolution of turnover for the last eight years (fig. 3) is represented in figure 1. By significant reduction of research funds in 2009, 2010, 2011, 2012 and respectively 2013, the turnover dropped to 16,787,169 lei in 2012. Compared to year 2013, the turnover increased with 14%.

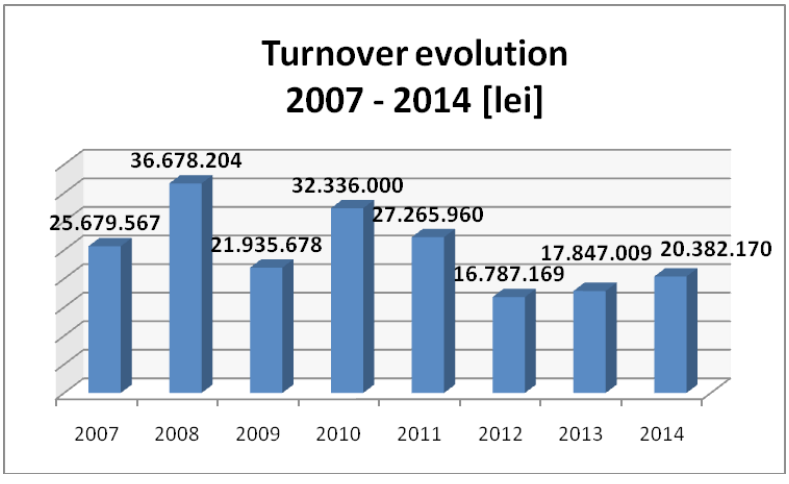


Fig. 3

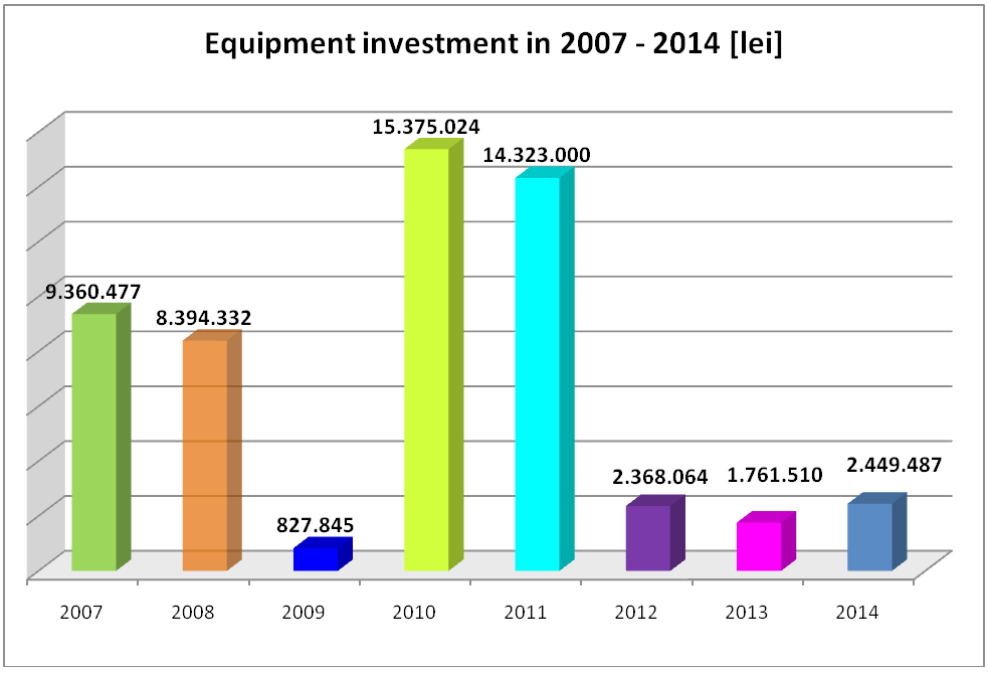


Fig. 4

Increasing the investment, both for its own and attracted funding sources, and from budgetary sources, as it is presented in Fig. 4, allowed the institute and the research staff, on the one hand, the new directions of research, on the other hand, to increase the quality of research.

Activities and contracts in progress:

- Basic and applied research in the National Nucleus Programme and National NPRDI-II Programme, as well as research grants and projects financed from EU Programmes, as follows:
  - 19 projects as coordinator and 23 projects as partner in National NPRDI-II Programme; 14 projects in the National Nucleus Programme;
  - 3 projects in National Programme of R&D&I for Space Technology and Advanced Research STAR: *"Advanced composite structures for space applications"*, *"Nanocomposite magnetic materials for high speed electrical motors" and "New types of actuators specific to space applications"*;
  - 1 contract for scientific events organized by our institute;
  - 1 grant for scientific and technical literature;
  - 12 projects of bilateral cooperation with JINR (Joint Institute for Nuclear Research) - Dubna, Russia;
  - 1 international project as partner in FAIR (*Facility for Antiproton and Ion Research*) – Germany, "*Normal conducting magnets and power supplies – in-kind contribution to the FAIR project*";
  - 1 project financed by Competitiveness & Innovation Framework Programme, ENT/CIP/07/0001a "*Business Innovation Support Network Transylvania* " EEN 225 559 BISNet Transylvania-1;
  - 1 project FP7-MNT ERA NET 7-053/2012 "*Technology for development of mini-supercapacitors based on electroactive networks polymer - CNT/CNF"*;
  - 1 project in Sectoral Operational Programme "Increasing of Economic Competitiveness" (SOP IEC Programme), priority axis II - Research, Technological Development and Innovation for competitiveness, the area of intervention 2.2, Operation 2.2.1, "*Infrastructure to promote competitiveness through innovation in electrical engineering for sustainable growth of energy security - acronym PROMETEU*" ("*Infrastructură pentru promovarea competitivității prin inovare în inginerie electrică destinată creșterii durabile a securității energetice" – acronim PROMETEU);*
  - 1 project in Romania-Bulgaria Cross-Border Cooperation Programme 2007-2013: "*Clean access in Calarasi-Silistra cross-border area"* – MIS-ETC CODE 118;
  - 1 project financed by EU within Black Sea Basin Programme 2007-2013, "*Integrated hotspots management and saving the living Black Sea ecosystem*" – HOT BLACK SEA" - MIS-ETC CODE 2303;
  - 1 projects financed by EU within South-East Europe Transnational Cooperation Programme *„Promotion of Financing Innovation in South-East Europe"*– PROFIS;
  - 1 project financed by European Space Agency Programme (ESA) – ESTEC (European Space Research and Technology Centre), "*Planar heater based on electroconductive carbon fibbers designed for satellite thermal management*";
  - 7 bilateral cooperation projects within Capacities Programme - Module III – Joint Scientific Programme Romania – China, Romania – Italy, Romania – Turkey, Romania – France, Romania – Hungary and Romania – Moldova;
  - 3 projects on the preparation ELI-NP and FAIR experiments within Romania-CERN Programme: "*Characterization of quality for HESR normal conductors electromagnets field, as preparatory action for the experiment PANDA"*; "*HTS superconducting magnet for measurement of nuclear magnetic moments*", "*Laboratory for developing and testing of accelerating structures, transport and charged particle beam diagnostic*".

In 2014 ***IPCUP Ploiești*** employees, which have been transferred temporarily to ICPE-CA, were carried out projects financed by National NPRDI-II Programme, as well as: 5 service contracts signed with CONFIND Câmpina, SC IPM Partners Romania SA, AMPLO SA (2), National R&D Institute for Gas Turbines COMOTI – Bucharest, Romania; 1 applied research contract.

The institute was involved in another 22 non-budgetary applied research contracts in areas such as: new energy sources, materials for electrical engineering, environmental protection, electromagnetic compatibility, micro and nano electrotechnologies, oil operating and rotation equipment, oil drilling, as well as 7 small-scale manufacturing of some complex applications: sensors, actuators, magnetic couplings, transducers, protection equipment to control against electrochemical corrosion, stand/systems for monitoring, verification and control of electrical and environmental parameters; techniques application of vacuum thin layers deposition; testing and characterization of materials; CEM measurements; evaluation of thermal behaviour of products and materials; MEMS measurements; consulting in the field of intellectual property.

- Practical application of research results and patents through technological transfers, sales license (within the Technological Transfer Centre ICPE-CA ***CTT*** - ***ICPE-CA***);

- Practical application through the development of spin-off:
  S.C. ROMNEOMAG S.R.L.;

- Technical and logistical support for incubation and development of business (by SMEs) in the field of electrical engineering by the Incubation Office - ***ITA ECOMAT ICPE-CA*** – having the headquarter in Sf. Gheorghe city;

- Consultancy, know-how transfer and development of partnerships to support the implementation of the *"LOCAL ENERGY" Programme - local contribution to combat the climate change - Integrated model for communities with energy efficiency by exploiting the renewable energy resources* for the Avrig City Hall, Sibiu County, by ITA ECOMAT ICPE-CA – located in Mârșa city;
- Small-scale manufacturing of materials processed in different shapes and sizes, at customer demand;
- Small-scale manufacturing of some complex applications: sensors, actuators, magnetic couplings, transducers, protection equipment to control against electrochemical corrosion, stand/systems for monitoring, verification and control of electrical and environmental parameters;
- Techniques application of vacuum thin layers deposition by: magnetron sputtering, e-beam and their characterization in terms of thickness (ellipsometry) and mechanical and tribological properties;
- Characterization and testing of materials in RENAR (Romanian Accreditation Association) certified laboratories: magnetic properties investigations (analysis of remanence magnetization, analysis of coercive magnetic field, analysis of maximum energetic product, analysis of power losses, analysis of magnetic polarization and the relative, permanent and reversible permeability), physical testing (density determination through hydrostatic method, phase qualitative analysis), mechanical testing (Vickers hardness testing); investigations of material's composition (atomic absorption spectrometer SOLAAR type, laser ablation mass spectrometer ELAN DRC type, X-ray diffractometer D8 ADVANCE type and D8 DISCOPER type), surface properties investigations (atomic force microscope AFM Veeco, scanning tunnelling microscope STM-Ntegra, scanning electron microscope FESEM-FIB Auriga Zeiss);
- Expertise and certification for fixed wells platform probe PFS4, respectively Report on the findings the mast and drilling rigs F320- EA-DEA;
- Consulting in the field of intellectual property;
- Import-Export;
- International cooperation;
- Organization of scientific events, fairs and exhibitions;
- Certification.

Management structure of INCDIE ICPE-CA

Management structure of INCDIE ICPE-CA

1. Administrative Council Board

Administrative Council Board of INCDIE ICPE-CA

Kappel Wilhelm	President	General Director of INCDIE ICPE-CA
Tănăsescu Florin Teodor	Vice-president	Expert, Romanian Electrotechnical Committee
Gavrilă Horia	Member	President of Scientific Council
Bala Gheorghe	Member (up to the date 17.04.2014)	Representative of Ministry of Education and Scientific Research
Grec Gina	Member (from the date 17.04.2014)	Representative of Ministry of Education and Scientific Research
Tudor Tatiana	Member	Representative of Ministry of Public Finance
Ancuţa Adrian Silviu	Member	Representative of Ministry of Labour, Family and Social Protection
Opriş Marcel	Member	Expert, Director of Special Telecommunication Service
Popescu Mihai Octavian	Member	Prof. Dr. Eng., Director of DB-FIM, Politehnica University of Bucharest
Marin Georgiana	Member	Dr. Eng., General Director of IPCUP Ploieşti

2. General Director

Prof. Dr. Wilhelm KAPPEL

3. Scientific Council

SCIENTIFIC COUNCIL OF INCDIE ICPE-CA

Horia Gavrilă	Prof. Dr. Eng., President of Scientific Council (up to the date 14.11.2014)	INCDIE ICPE-CA
Iosif Lingvay	Dr. Eng., Vice-president of Scientific Council	Scientific Secretary of INCDIE ICPE-CA
Florin Filip	Acad. Prof. Dr. Eng., Honorary Member	Romanian Academy

Emil Burzo	Acad. Prof. Dr. Phys., Honorary Member	Romanian Academy
Petru Noţingher	Prof. Dr. Eng., Honorary Member	UPB – Faculty of Electrical Engineering
Nicolae Olariu	Prof. Dr. Eng., Honorary Member	Valahia University – Târgovişte
Teodor Vişan	Prof. Dr. Eng., Honorary Member	UPB – Faculty of Chemistry
Alexandru Morega	Prof. Dr. Eng., Honorary Member	UPB – Faculty of Electrical Engineering
Nicolae Vasile	Prof. Dr. Eng., Honorary Member	Member of Academy of Technical Sciences
Georgeta Alecu	Dr. Eng., Member	INCDIE ICPE-CA
Constantin Bâlă	Prof. Dr. Eng., Member	INCDIE ICPE-CA
Petru Budrugeac	Dr. Chem., Member	INCDIE ICPE-CA
Mircea Ignat	Dr. Eng., Member	INCDIE ICPE-CA
Cristinel Ilie	Eng., Member	INCDIE ICPE-CA
Mariana Lucaci	Dr. Eng., Member	INCDIE ICPE-CA
Mihai Mihăiescu	Dr. Eng., Member	INCDIE ICPE-CA
Jenica Neamţu	Dr. Phys., Member	INCDIE ICPE-CA
Eros Alexandru Pătroi	Dr. Eng. Phys., Member (from the date 12.03.2014 up to the date 15.07.2014)	INCDIE ICPE-CA
Gheorghe Samoilescu	Prof. Dr. Eng., Member	INCDIE ICPE-CA
Wilhelm Kappel	Prof. Dr., Member	General Director of INCDIE ICPE-CA
Elena Enescu	Dr. Eng., Member	Technical Director of INCDIE ICPE-CA
Adela Băra	Dr. Eng., Secretary of Scientific Council (up to the date 30.07.2014)	INCDIE ICPE-CA

This Scientific Council functioned until April 2014.
Since April 2014 we have a newly elected Scientific Council:

Georgeta Alecu	Dr. Eng., President of Scientific Council (from the date 14.11.2014)	INCDIE ICPE-CA
Mihai Bădic	Dr. Eng., Member	INCDIE ICPE-CA
Adela Băra	Dr. Eng., Member	INCDIE ICPE-CA
Petru Budrugeac	Dr. Chem., Member	INCDIE ICPE-CA
Mirela Maria Codescu	Dr. Eng., Member	INCDIE ICPE-CA
Ionel Chiriţă	Dr. Eng., Member	INCDIE ICPE-CA
Gabriela Georgescu	Dr. Eng., Member	INCDIE ICPE-CA
Gabriela Hristea	Dr. Eng., Member	INCDIE ICPE-CA
Mariana Lucaci	Dr. Eng., Member (from the date 03.12.2014)	INCDIE ICPE-CA
Teodora Mălăeru	Dr. Eng., Member	INCDIE ICPE-CA
Sergiu Nicolaie	Dr. Eng., Member	INCDIE ICPE-CA
Gimi Aurelian Rîmbu	Dr. Eng., Member	INCDIE ICPE-CA
Violeta Tsakiris	Dr. Eng., Member	INCDIE ICPE-CA
Wilhelm Kappel	Prof. Dr., Member	General Director of INCDIE ICPE-CA
Elena Enescu	Dr. Eng., Member	Technical Director of INCDIE ICPE-CA
Iosif Lingvay	Dr. Eng., Member	INCDIE ICPE-CA
Gabriela Oprina	Dr. Eng., Secretary of Scientific Council (from the date 06.08.2014)	INCDIE ICPE-CA

3.1 Ethics Commission

Prof. Dr. Eng. Florin Tănăsescu
Dr. Eng. Georgeta Alecu
Eng. Cristinel Ilie
Dr. Eng. Mirela Codescu
Legal Adviser Mariana Lungu

4. Directory Board

DIRECTORY BOARD OF INCDIE ICPE-CA

General Director, Prof. Dr. Wilhelm KAPPEL	President
Technical Director, Dr. Eng. Elena ENESCU	Vice-president
Scientific Secretary, Dr. Eng. Iosif LINGVAY	Member
Economic Director, Ec. Livia STAN	Member (up to the date 13.06.2014)
Economic Director, Ec. Mariana CÎRSTEA	Member (from the date 13.06.2014)
Head of Department for Advanced Materials, Dr. Eng. Mariana LUCACI	Member
Head of Department for Efficiency in Energy Conversion and Consumption, Dr. Eng. Sergiu NICOLAIE	Member
Head of Department for Micro-Nano-Electrotechnologies, Dr. Eng. Mircea IGNAT	Member (up to the date 01.04.2014)
Temporary Head of Department for Micro-Nano-Electrotechnologies, Dr. Eng. Teodora MĂLĂERU	Member (from the date 01.04.2014 up to the date 01.07.2014)
Head of Legal Office, Human Resources, *Legal Adviser* Mariana LUNGU	Member
Head of Office for Programmes Monitoring, Ec. Dorina DOBRIN	Member

Departments/Laboratories/Services/ Offices of INCDIE ICPE-CA

LEGAL OFFICE, HUMAN RESOURCES, LABOUR PROTECTION, CLASIFIED INFORMATION

Head Office: Legal Adviser, Mariana LUNGU
E-mail: mariana.lungu@icpe-ca.ro
Phone: (+40-21)346.82.97 / 136
Fax: (+40-21)346.82.99

FIELDS OF ACTIVITY

- legal assistance;
- evidence of human resources;
- evidence of classified documents;
- monitoring of work protection.

UNIT for INTERNAL AUDIT

Public Internal Auditor: Ec. Valentin COSTINESCU
E-mail: valentin.costinescu@icpe-ca.ro
Phone: (+40-21)346.72.31/309
Fax: (+40-21)346.82.99

FIELDS OF ACTIVITY

- public internal audit – assurance and counselling.

OFFICE for MANAGEMENT of QUALITY - ENVIRONMENT

Head Office: Dr. Eng. Georgeta ALECU
E-mail: georgeta.alecu@icpe-ca.ro
Phone: (+40-21)346.72.31 / 112
Fax: (+40-21)346.82.99

RESEARCH AREA

- monitoring the Quality Assurance & Quality Technical Control and environment protection in INCDIE ICPE-CA;
- maintaining to the high performance of integrated Management System for Quality – Environment, according to EU requirements;
- support materials for certification/training in the management systems of the institute as support in the education process for quality of managerial and operative staff;
- real-time analysis system of environmental and health risk factors;

- management and conservation of natural resources based on ecological principles, especially to materials recycling;
- improvement of environment quality through deployment of technical, economic, legal and administrative measures at the institute level;
- determination of organic pollutants in air, water, soil (volatile and semi-volatile organic compounds, petroleum hydrocarbons, polycyclic aromatic hydrocarbons);
- determination the concentration of greenhouse gases (CH_4, CO_2, chlorofluorocarbons, SF_6);
- analysis of dielectric oils from electrical and electronic equipment;
- determination of persistent organic pollutants (pesticides, herbicides, polychlorinated biphenyls) from water, soil, agricultural products;
- qualitative and quantitative chemical analysis of organic compounds for technological processes to obtaining biofuels (biogas, bioethanol, biodiesel);
- monitoring of anaerobic fermentation processes in biogas units; biomass and biogas analysis;
- determination of environmental and industrial noise;
- determination of meteorological parameters (wind direction and speed; temperature in the range -40 … +60°C and relative humidity in the range 0 … 100%; atmospheric pressure in the range 825 – 1050 mbar).

MARKETING DEPARTMENT, TECHNICAL LIBRARY, MANAGEMENT of KNOWLEDGE and INFORMATION / PUBLIC RELATIONS

Head of Department: Eng. Ciprian Viorel ONICĂ
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FIELDS OF ACTIVITY

- standard and electronic (internet) marketing for the institute;
- developing of the laboratories interconnection for communications, reports and dissemination of information;
- developing of interconnection with other entities, research networks, consortium to obtain partnerships, regional programmes, databases;
- developing the own base of information through acquisition of books and subscriptions to specialized journals;
- organizing of scientific events; participation at fairs and exhibitions;
- marketing for promoting of the patents, products, equipment and services developed by the institute.

OFFICE for KNOWLEDGE and INFORMATION MANAGEMENT / PUBLIC RELATIONS

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FIELDS OF ACTIVITY

- public relations;
- mass-media for ICPE-CA products and services;
- management of knowledge and information from ICPE-CA;
- ICPE-CA Technical Library.

BUSINESS and TECHNOLOGY INCUBATOR ICPE-CA ITA ECOMAT ICPE-CA Sf. Gheorghe SUBSIDIARY

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FIELDS OF ACTIVITY

- supporting the establishment and development of SMEs in industry and services in the field of electrical engineering, advanced materials, new energy sources, ecological technologies, IT;
- promoting business partnerships, technology transfer and research;
- consultancy for intellectual and industrial property;
- consultancy for accessing the European financing programmes;
- increasing the use of research results and patents;
- creating new jobs, regional economic development;
- improvement of SMEs access to information, consulting services, financing sources as well as R&D services and equipment.

OFFICE for PROGRAMMES MONITORING, PLANNING

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FIELDS OF ACTIVITY

- monitoring the research projects;
- monitoring of services and small-scale production contracts;
- planning of income / expenditure;
- planning / monitoring of staff overcharge;
- billing operations;
- elaboration of analysis / reports / specific statistics.

OFFICE for PUBLIC ACQUISITIONS, INVESTMENTS, SUPPLY STOCK, ADMINISTRATION

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FIELDS OF ACTIVITY

- public acquisitions: development of procedures for investment of equipment, products and materials;
- investments: tendering, drafting the offers, contracts, as well as other related documents during the specific proceedings;
- supply: request for offers and purchase of products, raw materials and materials necessary for research activities;
- administration: monitoring, reception of products, raw materials and materials purchased.

ACCOUNTING OFFICE

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FIELDS OF ACTIVITY

- organizing and updating of entering records of the Institute, compliance with its integrity and firmly apply the preventive financial control.

DEPARTMENT for ADVANCED MATERIALS

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RESEARCH AREA

Research areas of the Department comprise:

- development of research in obtaining and characterization of materials and components for energy;
- development of research in obtaining and characterization of materials and components for electrical engineering;
- development of research in obtaining and characterization of biomaterials and products based biomaterials; certification of granular product PG β TCP;
- development of research in obtaining and characterization of materials for special and/or environmental applications;
- development of interdisciplinary research in surface functionalizing and study of interface properties;
- development of research on structural changes in bulk materials and thin layers subjected to stress;
- characterization of metallic, ceramics, magnetic, carbon, polymeric materials.

Applications of these materials and products mentioned above aimed at structural, functional and multifunctional applications.

FIELDS OF ACTIVITY

Activities grouped by research fields and types of application include processing and characterization of all types of materials: metallic, ceramics, carbon and polymeric, as well as development of interdisciplinary research in surface functionalizing, the study of interface properties and structural changes in bulk materials and thin layers subjected to stress.

- **materials and components for energy areas:**
  - **structural materials:** carbon fiber; carbon nanotube (CNT); graphene; carbon materials resistant to thermal-mechanical shock; carbon-polymer nanocomposite reinforced with CNT; C-C composite reinforced with carbon fiber; metallic coatings; amorphous alloys; nanostructured composite materials with amorphous matrix; high mixing entropy alloys; metallic foams and metallic and ceramics porous materials;
  - **functional materials:** functionalized carbon nanofibers; electrospun nanofibers; magnetic metallic microwires for permanent magnets with low Nd; magnetic composite and nanocomposite for permanent magnets; metal hydrides-based materials for hydrogen storage; NiAlCrB materials for deposition having the role of thermal barrier; electro-insulating ceramic materials; AlN non-oxide ceramic and AlN-SiC, SiC-Si3N4 composites;
  - **multifunctional materials:** radiant heating systems; thin-layer advanced ceramic materials for SOFC; Al thin films doped with nanostructured ZnO; ZnO nanofibers; advanced thermoelectric materials with perovskite structure for applications in recovery of wasted thermal energy;
  - **integration of materials in products and technologies:** electrodes for rechargeable batteries Ni-MH; equipment for thermal-chemical energy storage; technology for carbon material – steel joint; advanced technical solutions for high efficiency electrical machines based on predetermination of magnetic properties of steel sheets; heat pipes with porous structure; aerial electrical conductor with self-protection to frost/ice; innovative afterburning equipment for gas turbine cogenerative units with conventional and unconventional gaseous fuels; energy harvesting systems using piezoelectric structures;
- **materials and components for electrical engineering area:**
  - **functional materials:** soft magnetic cores of iron-based composite materials; products from sintered heavy alloys; carbon-ceramic composites for volume resistors; ceramic sparking plugs for Diesel engines; zirconia's ceramic for arc-extinction and electrical resistance supports; dense cordierite-based ceramic electro-insulating materials for

arc-extinction; AlN non-oxide ceramic for electronics; polymeric membranes for displacement actuators; composite powders from silver nanoparticles laid-down on ZnO and SnO2 powders for sintered conducting materials; plated materials for electrical contacts; FePtNbB heavy magnetic nano-crystalline powders; Ti(Ni, Cu, Fe, Nb) shape memory materials; Al(Ni, Co) intermetallic compounds with ferromagnetic properties; electrical contacts for air and vacuum switching; Al and Al-Mg alloys for electronic and communications equipment; Ag-SnO2 contact materials doped with Bi2O3 and CuO; WC Ag and W Ag nanostructured materials for electrical contacts; cellulosic securing composites with ferromagnetic microwires; FeBSi ferromagnetic microwires; oxide semiconductors-based piezoelectric nanostructures; magnetic nano-crystalline materials based on Fe and FeNi; Co and CoNi nanopowders; magnetic composite material which provides protection to low frequency electromagnetic fields and radiofrequency; ferromagnetic materials obtained from industrial wastes for protection in the field of microwave (800 – 10000 MHz); carbon-ceramic composite materials for electromagnetic shielding; ferrosilicium concrete-based materials for protection at electromagnetic radiations; roasted pyrite-based composite materials for electromagnetic shielding; flexible thin materials for protection at electromagnetic radiations; polymeric matrix composite material reinforced with metallic or carbon fibers for protection at electromagnetic radiations; ferromagnetic microwires for miniaturized power generator;

- **multifunctional materials:** nano-crystalline and planar anisotropy magnetic materials with low rare earths; ceramic microspheres-based ecological paint for electrical and thermal insulating coatings; NdFeB magnetic materials with high magnetic stability; NdFeB and SmCo agglomerated permanent magnets; isotropic nanocomposite magnets based on rare earths; microwires from Cu and FeBSi; insulating materials from steatic ceramics; piezoelectric materials for micromotors with low rpm and high axial loads; textile composites with amorphous microwires for protection at electromagnetic radiations; natural inhibitors from plant extracts to prevent corrosion and deposition of thermal plants;
- **integration of materials in products and technologies:** piezoceramic elements-based acceleration sensor; polymer composites-based resistive sensors; aluminium nitride thin layers deposited on copper or aluminium supports; conductive carbon fiber; polyamide insulation for medium voltage wires resistant to ionizing radiations; polar and non-polar magnetic nanofluid with applications to rotating seals with high pressure and hard operating conditions; technology for development of mini-supercapacitors based on electroactive networks polymer-CNT/CNF; advanced composite structures based on polymer matrix reinforced with carbon fiber for protection of electronic satellites components; W-Cu/Ag electrical contacts for low voltage miniaturized contactors for switching vacuum; polymer-graphene composite materials for laser direct writing;

biomaterials:

- **structural materials:** ceramic materials based on calcium phosphate; porous ceramic materials obtained by organic precursors;
- **functional materials:** silver colloidal solutions for bactericidal applications; iron-saccharine magnetic nanocomposites; natural antioxidants obtained from plants; breathable superhydrophobe nanostructures based on nanopowders of Ag deposited on TiO2 and ZnO; materials for tactile sensors – polymeric composites with nanomaterials additions;
- **multifunctional materials:** biocompatible ceramic materials based on fluoro and hydroxyapatite; HAP/TCP ceramic composites for orthopaedic and maxillo-facial surgery; ecological multifunctional polymeric materials with polyphenolic antioxidant from plants; innovative nanostructured materials and coatings with antimicrobial activity;
- **integration of materials in products and technologies:** fixing magnetic elements for maxillofacial substitution; devices for transport of ceramic microspheres-based biological fluids; ceramic prosthesis for bone head;
- **other:** composite ceramic crucibles in dental application;

materials with special and/or environmental applications:

- **structural materials:** polymeric composite materials reinforced with carbon nanotubes;

polymeric composite materials reinforced with carbon fiber; carbon composite materials reinforced with carbon fiber; carbon materials with high thermo-mechanical shock resistance for aerospace industry; amorphous alloys and amorphous matrix composites to protect the space shuttles impact with meteorites and other orbital remains; amorphous alloys materials as strips;

- **functional materials:** contrast powder for non-destructive control of ferromagnetic materials; nickel powder with high specific surface; DLC synthesis and deposition on metal substrate and silicon oxide; conductive coatings with noble metal of magnetic nanostructures; composite materials based on soft magnetic ferrites used for electromagnetic shielding of military objectives undetectable by radar; composite materials with insulating ceramic microspheres to reduce energy loss in buildings;
- **multifunctional materials:** innovative materials and processes for selective removal of heavy metals from wastewaters;
- **integration of materials in products and technologies:** radiating elements based on carbon composite for heat management of satellites;

- **interdisciplinary researches in the field of surface functionalizing and the study of interface properties:**
  - functionalization of interfaces made of dissimilar material couplings to induce the specific properties at the interface (adherence, functional properties);
  - functionalization of surfaces to induce the functional properties (wear resistance, corrosion resistance, UV resistance, etc.);
  - functionalization of implant - living matter interface to increase the degree of assimilation by living organisms implants;
- **study of interface properties and structural changes in bulk materials and thin layers subjected to stress:**
  - obtaining of 1D and 2D nanoscale structures;
- **characterization of metallic, ceramic, magnetic, carbon and polymer materials:**
  - investigation the thickness and optical constants of thin films (elipsometry);
  - determining the tribological properties of thin films (wear and friction);
  - determining the mechanical properties of thin films (hardness, Young modulus, scratch resistance);
  - determining the gas adsorption/desorption properties (hydrogen, nitrogen, argon, carbon dioxide, methane) by Sievert method;
  - investigation the thermal properties of materials (heat forming, transformation temperatures, Curie temperature, thermal diffusivity, linear coefficient of thermal expansion);
  - investigation of materials surface properties (specific surface, distribution and size pores);
  - characterization of nanocrystalline materials in suspension form (particle size, granulometric distribution, zeta potential, molecular weight);
  - investigation the optical characteristics of nanocrystalline materials in powder form by spectrophotometry (reflectance);
  - investigation the mechanical properties of materials (tensile, compression, bending) at RT and T = 20....500°C;
  - investigation the luminescence phenomena (chemiluminescence, thermo-chemiluminescence, lio-luminescence, fluorescence, radio-thermo-luminescence);
  - investigation the radio-induced processes;
  - investigation and development of knowledge in the field of degradation and stabilization of polymeric materials under the action of different factors;
  - assessment of life cycle and remaining life cycle of electrical insulating materials in different conditions;
  - characterization of stabilizers for polymeric materials;
  - investigation of materials behaviour (of biomaterials) in the presence of fungi and molds;
  - electrical characterization of electrical insulating materials (complex impedance, complex admit, complex relative permittivity, loss factor, complex electrical conductivity).

DEPARTMENT for EFFICIENCY in ENERGY CONVERSION and CONSUMPTION

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RESEARCH AREA AND FIELDS OF ACTIVITY

- **renewable energy sources and energy efficiency:**
  - development of innovative equipment for increasing energy efficiency and use of renewable energy in industry and transport;
  - development of electrical machines (high speed motors, motors for special applications, generators for applications in electrical power conversion from renewable energy sources);
  - hydrodynamics and mass transfer of water aeration systems;
  - new technologies with applications in "harvesting energy";
  - new types of magnetostrictive, electromagnetic and piezoelectric actuators use in aerospace;
- **electromechanical design – mechanical and microprocessing:**
  - CAD/CAM/CAE design in electrical and mechanical engineering;
  - precision processing on CNC machines;
  - 3D analysis by mechanical and optical scanning;
  - fast prototyping;
  - mechanical vibration monitoring systems, dynamic balancing machines and in-situ;
- **applications of superconductivity and cryogenics in electrical engineering:**
  - applications of superconductivity in electrical engineering (superconducting coils and superconducting electromagnets for particle accelerators);
  - superconducting electrical machines (electrical motors and generators);
- **physico-chemical and electrochemical systems and devices with applications in energy:**
  - hybrid applications and systems to produce energy from new and renewable energy sources;
  - sensitive structures based on thin films and nanocomposites;
  - structures/devices/systems to storage and production of energy;
- **other applications in electrical engineering.**

DEPARTMENT for MICRO-NANO-ELECTROTECHNOLOGIES

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RESEARCH AREA AND FIELDS OF ACTIVITY

- **micro and nanoelectromechanical**: piezoceramic, electrostrictive, magnetostrictive, electromagnetic, electrodynamic and electrothermal microactuators; electromagnetic and electrostatic micromotors and microgenerators; electromechanical or piezoelectric microharvesting systems; linear, angular and electromagnetic microsensors with applications for monitoring in landslides and position; electrochemical gas microsensors; microsensors for the study of motility and medical re-education; micro and nanobionics / the study of magnetic bacteria with applications in MEMS and NEMS; sensors and microelectromechanical systems for procedures of medical rehabilitation or sports application;
- **application in aeronautics:** piezoelectric and electrostrictive microactuators for the control of carrying capacity; small gyro motors and flywheels;
- **micro and nanostructures of thin films and oxide nanoparticles:** nanoparticles and thin layers of oxide semiconductors with dilution magnetic properties; piezoelectric flexible nanocomposites; magnetic nanofluids; fluorescent functionalizing oxide magnetic nanoparticles;
- **microsystems for magnetic multilayers** with GMR (giant magnetoresistence) and TMR (tunnel magnetoresistance) effect for spintronics; dilute magnetic semiconductors; Core-Shell magnetic nanosystems for diagnosis with magnetic resonance method (MRI); self-assembled magnetic nanoparticles for "chip" diagnostic micro-devices; nanostructures of transparent oxidic semiconductors with controllable properties by doping for applications in optoelectronics, spintronics; oxidic semiconductor nano-devices (nano-wires, nano-ribbons) for applications in nano-electronics and nano-medicine;
- **technology transfer of electromechanical systems**: checking systems of railway equipment; monitoring micro-systems for movement and motility; software for monitoring systems of movement; identification of motion parameters with micro and macro-photogrammetry; 2D and 3D active control and micro-drive systems;
- **micromotors and generators of very high speed;**
- **Training Centre in Scientific Research for Young Olympians – ECYO:** specific methodology to initiate in scientific research on main interdisciplinary areas: microbiotechnologies, bionic and electromechanics; harvesting with application in microenergy recovery from buildings and aircraft route; microrobotics; magnetic bacterium with applications; sensors and matrix system from sensors for medical rehabilitation procedures; microsensors toolkits for measurements in the field of meteorology and climate.

TECHNOLOGICAL TRANSFER CENTRE ICPE-CA (CTT ICPE-CA) INTELLECTUAL PROPERTY

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FIELDS OF ACTIVITY

- technological transfer of products (models and prototypes) and technologies developed by INCDIE ICPE-CA; consultancy in the implementation of technology transfer;
- promoting the use of INCDIE ICPE-CA patents and other results of R&D activities by licensing, know-how transfer and spin-off establishment;

- consultancy/assistance to the negotiation of licensing agreements or know-how transfer contracts;
- consultancy in preparing the documentation for intellectual property protection and exploitation of these rights;
- information and consultancy in finding the financial support for implementing the research results in SMEs;
- facilitating the SME's access to technological services and research infrastructure of INCDIE ICPE-CA.

LABORATORY for TESTING and CHARACTERIZATION of ELECTROTECHNICAL MATERIALS and PRODUCTS

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FIELDS OF ACTIVITY

- investigation on material composition: atomic absorption spectrometry, mass spectrometry with laser ablation; X-ray fluorescence spectrometry with wavelength dispersive;
- structural investigation: X-ray diffractometry, optical microscopy, SEM scanning electron microscopy; high resolution TEM;
- physical and mechanical tests: density, Vickers and Knoop microhardness, Vickers and Brinell hardness;
- study of surface properties: STM tunnelling electron microscopy, AFM atomic force microscopy;
- determining the magnetic properties: remanence, coercitive field, maximum energy product, total power loss, polarization, relative permeability.

LABORATORY for ELECTROMAGNETIC COMPATIBILITY

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RESEARCH AREA AND FIELDS OF ACTIVITY

- determining the level of attenuation of electromagnetic screens used to protect electronic equipment, buildings and/or humans exposed to electromagnetic radiations;
- determining the level of electromagnetic field;

- determining the electromagnetic field of electrical and electronic devices;
- measurements of the dielectric permittivity (in complex), the loss tangent in the frequency range 40 Hz – 30 MHz;
- measurements of the magnetic permeability (in complex) in the frequency range 40 Hz – 110 MHz;
- measurements of the surface and volume resistivity;
- spectral analysis of infrared images for electrical circuits, printed circuit boards, fire prevention, electrical connections, buildings etc.;
- THz reflectance and transmission spectroscopy;
- high voltage equipment testing.

LABORATORY for EVALUATION of THERMAL BEHAVIOR of PRODUCTS and MATERIALS

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FIELDS OF ACTIVITY

- thermogravimetry (TG);
- derivative thermogravimetry (DTG);
- diffeential thermal analysis (DTA);
- differential scanning calorimetry (DSC);
- dilatometry (DIL);
- dynamic mechanical analysis (DMA);
- determining the thermal lifetime of the polymeric materials, including the polymeric electroinsulating materials;
- physico-chemical characteization of materials from heritage objects.

LABORATORY for MICRO and NANOELECTROMECHANICAL TESTING

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FIELDS OF ACTIVITY

- Measurements of micro and nanodisplacements;
- Measurements of surfaces nano roughness (profile diagrams).

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FIELDS OF ACTIVITY

- maintenance, rational use and record of buildings, facilities related to other fixed means and inventory items that are in the institute administration;
- operating, maintenance and repair activities of the ICPE-CA vehicles, ensuring their rational use;
- make proposals to the investment plan and repair the buildings, facilities related to other fixed means that are in the institute administration, follows the carrying out of the work involved and participates to perform the repairs;
- participation in the reception of maintenance, repair and carrying out of works only on the basis of management;
- monthly performing the inventory of fuel stock from the car tanks and filling in the documents regarding the transport activity;
- check daily activities of institute's drivers and manage fuel vouchers;
- announces the institute's leadership regarding the damage, downgrade, loss or theft of goods from inventory;
- prepares reports for the consumption of materials and confirms the payment status regarding on consumption of energy, water, heating, gas, sanitation, repair of the institute.

Our expertise

MULTIFUNCTIONAL MATERIALS WITH APPLICATIONS IN ELECTRICAL ENGINEERING

Composite materials with performant mechanical properties

INTRODUCTION

Thin layers of carbon (DLC) with thicknesses of nanometer/micron size, which are obtained by chemical or physical vapour deposition and combinations of these methods are of particular interest for a variety of applications due to their remarkable mechanical and tribological properties. Among these, we can notice DLC coatings deposited on the surface of cutting tools, dies and devices used in various industries to increase the lifetime of the processing tools, as well as coatings for protection of moving parts in contact by increasing the wear resistance of such parts [1-8]. In this aim, we developed and investigated some hybrid materials of steel/carbon type with carbon-DLC thin layers or Cr/Cr+C/C multilayer deposited on steel substrate by thermionic vacuum arc (TVA) process. This type of hybrid materials are included within the functional coatings with the role to increase the lifetime of some components subjected to mechanical and tribological stresses and it represents a viable solution for sustainable development.

Research staff of the project
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Project Co-Responsibles:
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Eng. Sorina Mitrea, IDTI
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Techn. Dorina Vlad
Techn. Doina Zoicaş
Techn. Adrian Militaru
Techn. Gheorghe Iancu
Techn. Florin Dobrin
Valerica Matei
Nicolae Vicol
Dan Neagu
Constantin Velea
Constantin Voicu

EXPERIMENTAL

Objective/15.03.2014: Steel/carbon hybrid materials for high temperature applications

- achievement of experimental models (EMs) of carbon/steel hybrid materials by TVA process by electron bombardment of the target surface (C or C+Cr) on 310S stainless steel and C45 carbon steel substrate, using a deposition installation of INCDFPLR technical base, voltage acceleration (U_a) of C/Cr during deposition of 1.2-2.5 kV, vacuum pressure in the reaction chamber < 3.4×10^{-5} torr, mean temperature of C45 and 310S steel substrate (T_s) of 300ŢC and 400ŢC respectively, arc current (I_a) during deposition <1.6 mA, heating current of the filament (I_f) < 82 A, deposition rate < 0.17 nm/s;
- structural characterization (Raman analysis) and tribological of the coatings using a Raman spectrometer of Jobin Yvon/Spec/Dilor type and a ball-on-disc tribometer (CSM Instruments, Switzerland) (normal load F_n = 5 N, linear speed V_l = 3.5 cm/s, sliding distance L = 140 m, static partner: 100Cr6 steel ball of 6 mm diameter).

b) Objective/15.06.2014: Steel/DLC hybrid materials with improved mechanical and tribological properties

- achievement of optimized experimental models (EMs) of carbon/steel hybrid materials by TVA process, by deposition of DLC, respectively Cr/Cr+C/C (DLC) on C45 carbon steel substrate, using a voltage acceleration (U_a) of C during depositions of 1.2 kV, 2.2 kV and 3 kV, vacuum pressure in the reaction chamber < 1.7×10^{-5} torr, mean temperature of the steel substrate (T_s) of 300ŢC and 450ŢC respectively, arc current (I_a) during deposition < 2.6 mA, heating current of the filament (I_f) < 84 A, deposition rate < 0.27 nm/s;
- microstructural characterization (SEM), tribological (friction coefficient, wear rate) and mechanical (scratch and nanoindentation tests) of the optimized EMs using a focused ion beam scanning electron microscope (Auriga, Zeiss, Germany), ball-on-disc tribometer (CSM Instruments, Switzerland) (normal load F_n = 0.25-2 N, linear speed V_l = 3.5 cm/s, sliding distance L = 100-500 m, static partner: 100Cr6 steel ball of 6 mm diameter) and a Micro Combi Tester equipment with nanoindentation module (NHT) and Berkovich diamond indenter and microscratch module (MST) and Rockwell diamond indenter (CSM Instruments, Switzerland) (progressive normal load from 0.03 N to 30 N, scratch length of 5 mm).

RESULTS AND DISCUSSIONS

a) four experimental models of steel/DLC hybrid materials were obtained by TVA method with coatings of C (DLC) or Cr + C on cylindrical semi-finished parts of steel with dxh of 40 mm x 3.2 mm: EM1 - C deposition (200 nm) on C45 steel, EM2 - C deposition (200 nm) on 310S stainless steel, EM3 - C + Cr deposition (1200 nm) on Ni-electroplated 310S stainless steel, EM4 - C + Cr deposition (1200 nm) on Cr-plated C45 steel by thermal evaporation.

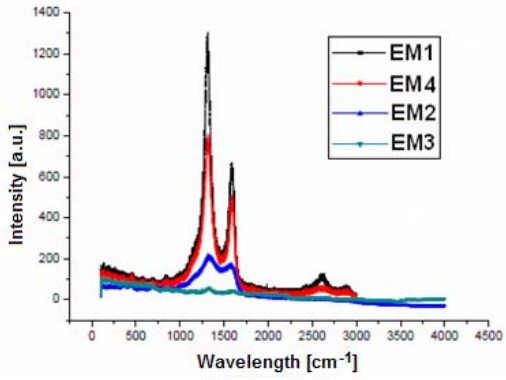

Fig. 1. Raman spectra for EM1-EM4 of carbon/steel hybrid materials

Raman spectra (Fig. 1) prove the formation of amorphous carbon film with DLC characteristics. C45 steel substrate was more favorable for C depositions than 310S stainless steel because the degree of disorder in a network with sp^2 hybridized carbon atoms increased in the order: EM1, EM4, EM2 and EM3.

The mean friction coefficient of DLC films tribologically tested (F_n = 5 N, V_l = 3.5 cm/s, L = 140 m) increased in the series: EM1 (μ = 0.167), EM4 (μ = 0.374), EM2 (μ = 0.547) and EM3 (μ = 0.705). The wear rate of DLC films increased in the series: EM1 (7.8×10^{-6} mm^3/Nm), EM4 (2.1×10^{-5} mm^3/Nm), EM3 (38.3×10^{-5} mm^3/Nm) and EM2 (102×10^{-5} mm^3/Nm). The obtained results show that the EM1 sample - DLC coating (200 nm) on C45 steel has excellent tribological properties (Fig. 2), which are due to microstructure of carbon areas which have a predominant sp^2 state with incipient layered structure (according to Raman spectra).

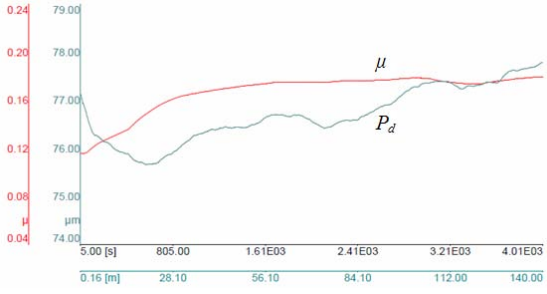

Fig. 2. Variation of friction coefficient (μ) and penetration depth (P_d) against sliding distance for sample EM1 - DLC coating (200 nm) on C45 steel substrate

b) five optimized experimental models of steel/DLC hybrid materials were obtained by TVA method with coatings of C (DLC) or Cr/Cr + C/C on cylindrical semi-finished parts of C45 steel with dxh of 40 mm x 3.2 mm: EM1 and EM2 - C deposition (200 nm and 260 nm) at T_s of 300ŢC, and 450ŢC respectively, and U_a of 2.2 kV, EM3-EM5 - Cr (200 nm)/Cr + C (400 nm)/C (900 nm) multilayer deposition at T_s of 450ŢC and U_a of 2.2 kV (ME3), 3 kV (ME4) and 1.2 kV (ME3) (Fig. 3).

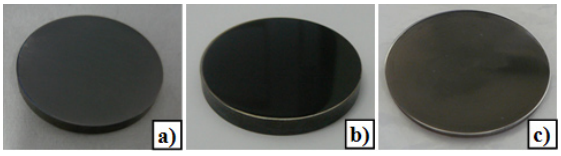

Fig. 3. Macroscopic aspect of EMs of DLC/steel hybrid material: a) EM1, b) EM2, c) EM3-EM5

Amorphous carbon (DLC) films had various brightnesses and colors, from matte dark gray (EM1), glossy black (EM2) to matte black (EM3-EM5) due to interference effects of the thin layer of different thickness with steel substrate [7].

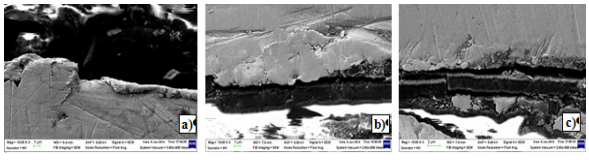

Fig. 4. SEM images of EMs of Cr/Cr + C/C (DLC) on steel hybrid material: a) ME3, b) ME4, c) ME5, cross section, 10000X magnification

From the samples EM3-EM5 of Cr/Cr + C/C (DLC) multilayer coatings on C45 steel substrate, sample EM5 obtained at the lowest arc voltage of the TVA plasma of 1.2 kV presents the best tribological and mechanical properties (Fig. 5, Table 1), followed by samples EM3 and EM4. It is noticed that Vickers hardness shows typical values for DLC films of a-C type. Scratch tests (Table 2) revealed that the DLC film from the multilayer samples of Cr (200 nm)/C + Cr (400 nm)/C (900 nm) deposited on steel proved strong adhesion, in the series: EM5, EM3 and EM4.

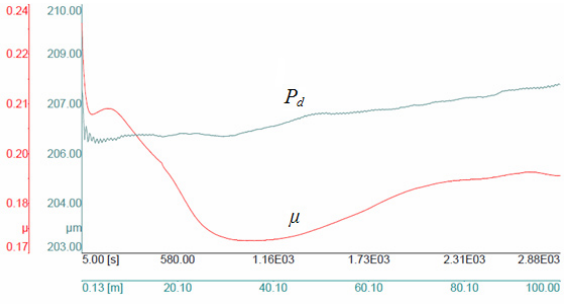

Fig. 5. Variation of friction coefficient (μ) and penetration depth (P_d) against sliding distance for sample EM5 - Cr/Cr + C/C (DLC) multilayer coating on C45 steel substrate

Table 1. Results obtained from tribological and mechanical tests for samples EM1-EM5 and C45 steel substrate.

Sample	Mean friction coefficient	Mean wear rate x10^5 [mm^3/Nm]	Mean Vickers hardness	Mean Young's modulus [GPa]
EM1	0.14-0.19	0.76-6.1	4450 ± 851	566 ± 158
EM2	0.16-0.26	1.78-9.7	763 ± 239	90 ± 13
EM3	0.12-0.28	1.75-68.8	554 ± 134	28 ± 8
EM4	0.28-0.34	1.65-67.4	419 ± 68	25 ± 6
EM5	0.12-0.27	1.62-29.1	1193 ± 481	96 ± 40
C45	0.42-0.47	16.5-98.9	261 ± 12	173 ± 3

Table 2. Critical loads determined from scratch tests of DLC coatings.

Sample	Critical load [N]		
	Lc1	Lc2	Lc3
EM1	2.34	8.50	17.28
EM2	1.57	5.08	16.87
EM3	2.77	9.85	17.64
EM4	2.32	9.04	17.38
EM5	2.91	6.64	15.11

Lc1 critical force (cohesive force) where microscopic defects occurred due to Hertzian stresses increased with decrease of arc voltage of the TVA plasma, yielding highest values for sample EM5 (U_a of 1.2 kV). The samples had similar behavior at scratch, Lc2 (adhesive strength) confirming the beginning of delamination with interfacial spallations along all edges of the scratch track with continuous ductile perforation of the coatings and Lc3 indicating total delamination. For the multilayer samples, the Cr film deposited on steel contributed to the relaxation of residual stresses by improving resistance to interfacial breaking of the surfaces with induced defects [8].

Resulted patents from the research thematic: Patent Application no. A/00581 of 30.07.2014, OSIM file, authors: M. Lungu, I. Ion, M. Lucaci, D. Tălpeanu, V. Marinescu, V. Tsakiris, C.D. Cîrstea, A. Brătulescu, „Functionally graded planar junctions and process for preparing the same"

CONCLUSIONS

All activities and objectives/2014 were accomplished, yielding the following results:

- four experimental models of steel/DLC hybrid materials with C (DLC) (200 nm) or Cr + C (1200 nm) coatings on 310S stainless steel and C45 carbon steel substrate, from which EM1 of amorphous carbon (DLC) (200 nm) coating on C45 steel substrate presents excellent tribological properties, which recommend its use in anti-friction and anti-wear applications at working temperatures up to 400°C in an oxidizing atmosphere and up to 1000°C in a protective atmosphere;

- five optimized experimental models of steel/DLC hybrid materials with C (DLC) (200 nm and 260 nm) or Cr (200 nm)/Cr + C (400 nm)/C (DLC) (900 nm) coatings on C45 carbon steel substrate, from which EM5 of multilayer coating presents excellent tribological and mechanical properties, which recommend its use in anti-friction and anti-wear applications such as processing and cutting tools, dies and devices used in metallurgy and mechanical industry, etc.

REFERENCES

[1]. X.T. Zeng, S. Zhang, X.Z. Ding, D.G. Teer, *Comparison of three types of carbon composite coatings with exceptional load-bearing capacity and high wear resistance*, Thin Solid Films, vol. 420-421 (2002), pp. 366-370.

[2]. A. Grill, *Diamond-like Carbon: State of the art, diamond and related materials*, vol. 8 (1999), pp. 428-434

[3]. J. Marciniak, Z. Paszenda, W. Walke, M. Basiaga, J. Smolik, *DLC coatings on martensitic steel used for surgical instruments*, Materials Science and Engineering, vol. 28, issue 5 (2007), pp. 285-288.

[4]. Z. Khalaj, M. Ghoranneviss, E. Vaghri, A. Saghaleini, M.V. Diudea, *Deposition of DLC film on stainless steel substrates coated by nickel using PECVD method*, Acta Chim. Slov., vol. 59 (2012), pp. 338-343.

[5]. F. Ma, Q. Chen, X. Cai, G. Li, H. Ma, *DLC film fabricated by a composite technique of unbalanced Magnetron Sputtering and PIII*, Materials Transactions, vol. 43, no. 6 (2002), pp. 1398-1402.

[6]. J. Robertson, Diamond - like amorphous carbon, Materials Science and Technology, vol. 37 (2002), pp. 129-281.

[7]. Q.Y. Li, F.M. Wang, L. Zhang, *Study of colors of diamond-like carbon films*, Science China Physics, Mechanics and Astronomy, March 2013, Vol. 56, Issue 3, pp. 545-550.

[8]. N. Sharma, N. Kumar, S. Dash, C.R. Das, R.V. Subba Rao,, A.K. Tyagi, B. Raj, *Scratch resistance and tribological properties of DLC coatings under dry and lubrication conditions*, Tribology Int., vol. 56, 2012, pp. 129-140.

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Magnets made by nanocomposites materials used in high speed electric motors manufacturing

INTRODUCTION

The solution for a cleaner transportation, as well as a necessity of increase in connectivity, have led to a tendency for electrification, therefore, in terms of aviation, to the development of MEA (More Electric Aircraft) architecture – an advanced concept for building the aircraft of the future [1], where electrical generators are much more powerful than today [2]. So their corresponding mass increase can be a drawback for future aircraft MEA architectures. The need for novel soft magnetic alloys, with improved magnetisation, temperature capabilities and mechanical strength, constitute the major requirement in numerous electrical machines and actuator applications, aerospace and other related application fields. The new soft magnetic materials with increased strength, at the same magnetic performance, can lead to a reduction in power system size and weight, and finally, to the improvement in electrical efficiency. J. Long et al. reported a new high-saturation induction, high-temperature nanocomposite, based on Fe-Co alloy, for high-power inductors [3]. The nMAT project approach and will solve the above technical and scientific problems using an inexpensive new method to build chemically the novel desired materials. In this way, it will be created microstructures with entirely new properties, which are up to now unaffordable with the current classical engineering techniques. The processing technique will be more facile than the metallurgical processing of the manufacturing process of metallic laminated soft magnetic cores and so, the fabrication costs will be diminished. The goal of nMAT project is to propose and develop new magnetic materials, with improved magnetisation, temperature capabilities and mechanical strength, for the high speed rotating machines and actuator applications, aerospace and other related application fields. The project aims to demonstrate the feasibility of exploiting of the soft magnetic to improve the magnetic and mechanical performances of the key components used in electrical engineering applications and also to develop a technology for preparation of this novel soft magnetic materials, adequate for a future technological transfer to the industrial partner. The new soft magnetic materials, based on consolidated bodies from core-shell nanoparticles, with increased strength, at the same magnetic performance, will lead to a reduction in power system size and weight, and finally, to improvement in electrical efficiency. The novel created technology, which appeals to the newest nonconventional processing techniques can have a great scientific and technical impact in the electrical engineering and electronics field. Beside the use of these novel materials al key materials for realisation of rotors in rotating electrical machines, new opportunities occur for commercial applications: power converters, microwave antennas or rectennas, high frequencies electronic parts made by ferrites, such as inductors, chokes, sensors, core-shape transformers, ultrahigh radio frequency telecommunications, planar transformers, hybrid circuits, computers.

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EXPERIMENTAL

Starting from the corresponding precursors have benn synthesised, through chemistry methods, soft magnetic nanopowders, type core-shell - $FeCo/Al_2O_3$ - with two molar ratios: 1:3 and 1:1 and various Al_2O_3 amounts. During the different steps of preparation, the crystalline structure was analysed by XRD, SEM-EDAX and TEM investigations, and were performed measurements of magnetic (by magnetometry) and electric properties.

RESULTS AND DISSCUSION

In the investigated sample can be distinguished the presence of FeCo compound, known as wairauite, characterised by a crystalline structure bcc type, space group: Pm3m (see Figure 1). The value determined for the cell parameter: $a = 2.851$Å was very close to the value of the cell parameter of FeCo compound from 00-049-1567 fiche ($a_{fiche} = 2.855$Å).

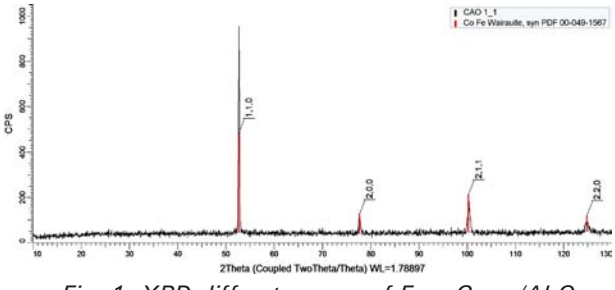

Fig. 1. XRD diffractograms of $Fe_{0,50}Co_{0,50}/Al_2O_3$ core-shell nanoparticles

The observed peaks are very sharp, well defined and intense, indicating that the resulted FeCo compound is very pure and characterised pronounced crystallinity. In the X-ray recorded diffractogram was not observed the presence of any impurities in the form of another phase. The average crystallite size was calculated using the most intense peak, corresponding to the (100) crystallographic plane and located at $2\theta = 52.5^{o}$: D(110) = 41.18 nm.

In the case of the Al_2O_3 compound, his presence could not be evidenced by X-ray diffraction, but only by the further HR-TEM investigations (Figure 2). They proved not only his formation, but have also allowed the determination of nanometric thickness of Al_2O_3, for various $FeCo/Al_2O_3$ ratios.

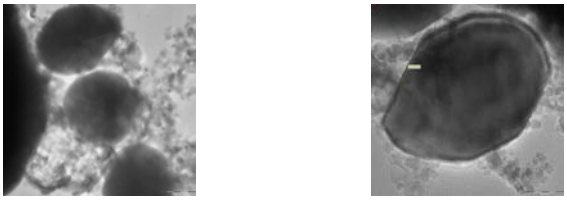

Fig. 2. TEM images of $Fe_{0.50}Co_{0.50}/Al_2O_3$ nanopowders, with 4% Al precursor salt

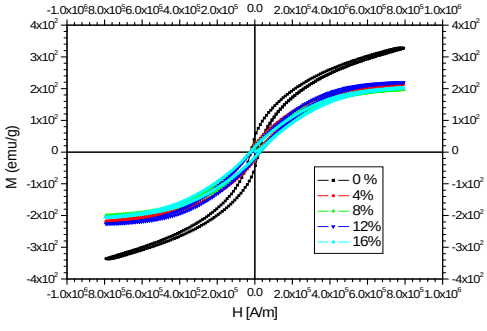

Fig. 3 Comparative hysteresis loops of $Fe_{0,50}Co_{0,50}/Al_2O_3$ nanopowders with 4, 8, 12 and 16% Al precursor salt

Figure 3 shows the comparative hysteresis loops of $Fe_{0,50}Co_{0,50}/Al_2O_3$ nanopowders with 4, 8, 12 and 16% Al precursor salt.

The values of the main magnetic characteristics are relatively close for $FeCo/Al_2O_3$ nanopowders with different amounts: 4, 8, 12% of Al precursor salt.

The specific magnetic moments, remanent σ_r and saturation σ_S, decrease from 50 emu/g, respectively 328.7 emu/g for the FeCo compound without alumina up to 16.7 emu/g, respectively 202.2 emu/g for $FeCo/Al_2O_3$ core-shell nanopowders, with 16% Al precursor salt. The samples coercivities remain relatively constant: $H_c \sim 320$ Oe.

CONCLUSIONS

Have been prepared by chemistry methods $FeCo/Al_2O_3$ core-shell nanoparticules, which have been structural and magnetic characterised. The XRD diffractograms confirmed the FeCo (wairauite) compound formation, as crystaline graines, having average size situated in the range 40 – 50 nm and characterised by bcc crystalline structure, high purity and pronounced crystallinity. The TEM investigation highlighed the presence of a nanometric layer of Al_2O_3, surrounding the grains of FeCo compound.

REFERENCES

[1] *** *GE Aviation Systems – Advanced Battery Systems for More Electric Aircrafts* (MEA), July 2010.

[2] A. A. AbdElhafez, A. J. Forsyth, *A Review of More Electric Aircraft*, 13th International Conference on Aerospace Sciences & Aviation Technology, May 2009, Cairo, Egypt.

[3] J. Long, M. McHenry, D. Urciuoly, V. Keylin, J. Huth, T. E. Salem, *Nanocrystalline material development for high-power inductors*, Journal of Applied Physics 103, (2008) 07E705-1-07E705-3.

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Medium voltage cables polyamide materials processed by irradiation

ABSTRACT

In this phase have achieved the objectives of the project implementation plan. Thus, for the 10 formulations of polyamide made compounds were made:

- *preliminary tests of thermal stability;*
- *dielectric tests (determination of volume resistivity, real and complex relative permittivity, dielectric loss angle tangent, electrical capacitance and impedance);*
- *mechanical tests;*
- *tests for rapid estimation of life coupled with thermal analysis techniques (TG-DTA-DSC) DSC: an estimate of the thermal endurance tests;*
- *TG-DSC a test;*
- *compatibility testing;*
- *SEM micrographs.*

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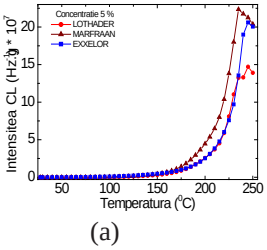
EXPERIMENTAL, RESULTS AND DISCUSSIONS

1. PRELIMINARY DETERMINATION BY CL NON-ISOTHERMAL THERMAL STABILITY

Made compounds studied in this phase are: PA6; PA6/5Marfran; PA6/10Marfran; PA6/ 20Marfran; PA6/5 Exxelor; PA6/10Exxelor; PA6/20 Exxelor; PA6/5Lotader; PA6/10Lotader; PA6/20Lotader. In Figure 1 are shown the chemiluminescence non-isothermal curves recorded on the concentration of the polyamide mixture and the type of elastomer used in the mixture.



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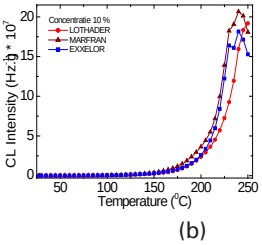

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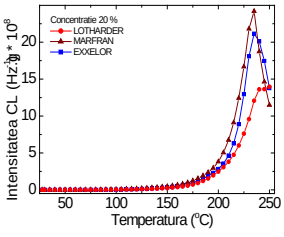


(c)

Fig. 1. The non-isothermal curves chemiluminescence recorded on the three different types of elastomer concentrations: (a) 5%, (b) 10% and (c) 20%

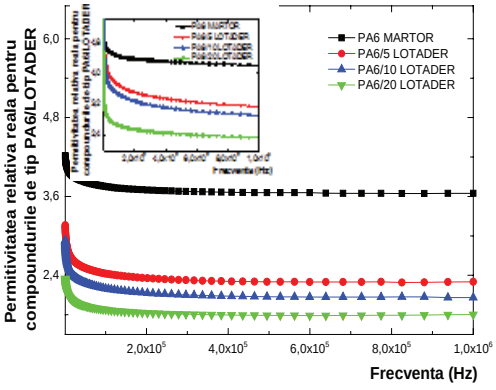
By analyzing the curves of Fig. 1 it can be seen that the oxidation of the mixtures of polyamide starts at temperatures higher than 150°C. The three elastomers used, different in structure, make different contributions to the stability of the whole polymer system change, depending on the concentration and nature.

For non-isothermal chemiluminescence assays is observed that the polyamide mixture with Lotader of greatest stability termooxidare, followed by Exxelor and Marfran.

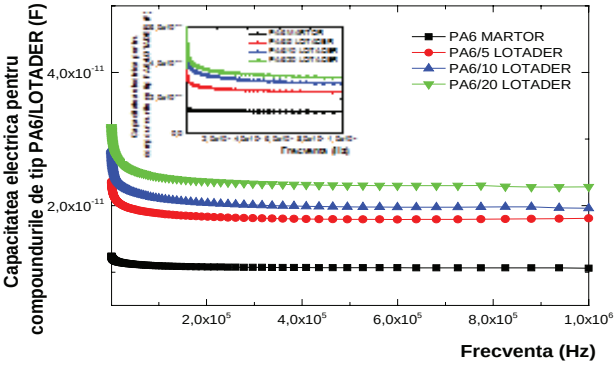
This behavior can be explained by the presence of maleic anhydride to result in a reduced reactivity as compared to oxygen. It can be assumed that oxygen atoms components of this structure form hydrogen bonds with the polyamide chain, forming a compact structure that prevents the diffusion of oxygen into the material, thereby altering the stability and termooxidare.

2. DETERMINATION OF THE DIELECTRIC CHARACTERISTICS

The presence of maleic anhydride in the structure of elastomers, polymer blends components of polyamide 6 only affect the current values in the first 2-3 minutes after applying the electric field. Lotarderul proved to be a suitable elastomer to produce the cable insulation with respect to Exxelorul. For example I presented with Lotader tests made compounds.



(a)



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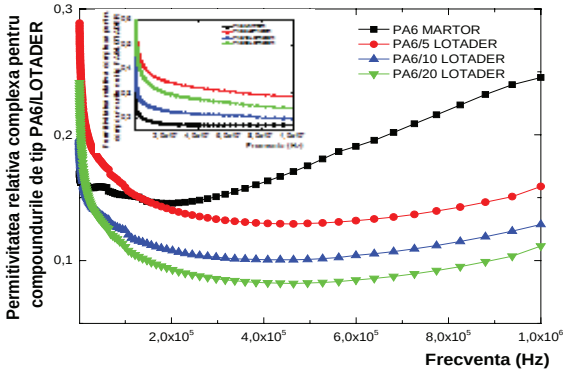

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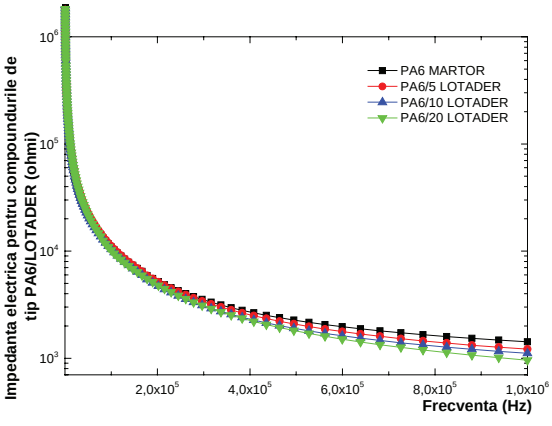

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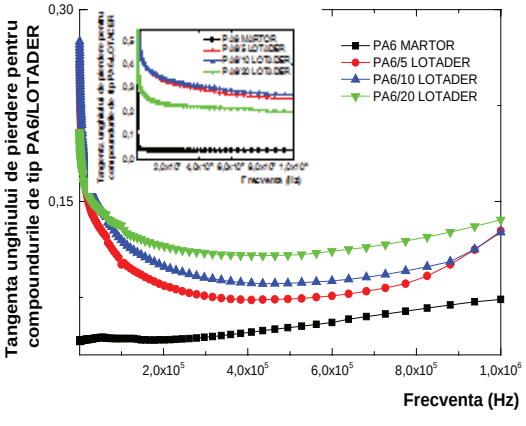


(c)

Fig. 2. (a) real relative permittivity; (b) the complex relative permittivity; (c) dielectric loss tangent angle; (c) capacitance; (d) electrical impedance type made compounds PA6 / Lotader

Fig. 2 (a) shows that the real relative permittivity made compounds of type PA6 / Lotader decreases with the addition of elastomer. Hence it can be said that by adding increasing concentrations of compound insulating elastomer Lotader character decreases. Best insulation is PA6 and PA6/ 20 Lotader. However, in Fig. 2 (b) shows that the complex relative permittivity made compounds of type PA6/Lotader decreases with the addition of elastomer. Hence it can be said that by adding increasing concentrations of compound insulating elastomer Lotader character decreases. Best insulation is PA6 and PA6/20 Lotader. For insulating material loss angle tangent (Fig.2 (c)) must be kept small. From the results obtained for the loss tangent of the angle made compounds of type PA6 / Lotader is confirmed that by adding increasing concentrations of elastomeric insulating character decreases.So the best insulation in terms of the loss tangent is PA6 and PA6 worst is / 20 Lotader.

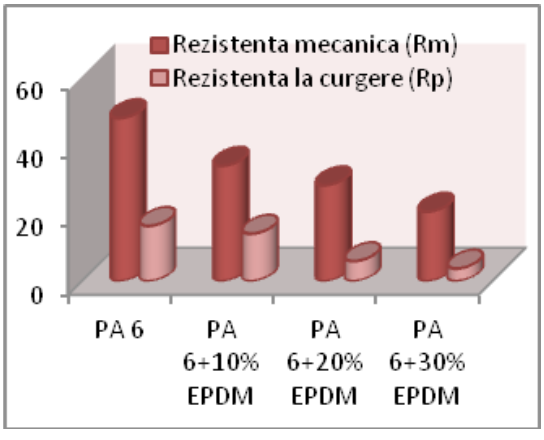
And if capacitance (Fig.2 (d)) there is an increase

it with the addition of elastomer Lotader, implying a decrease in insulating character. Thus, it can be said that by adding increasing concentrations of compound insulating elastomer Lotader character decreases. Best insulation is PA6 and PA6/ 20Lotader.

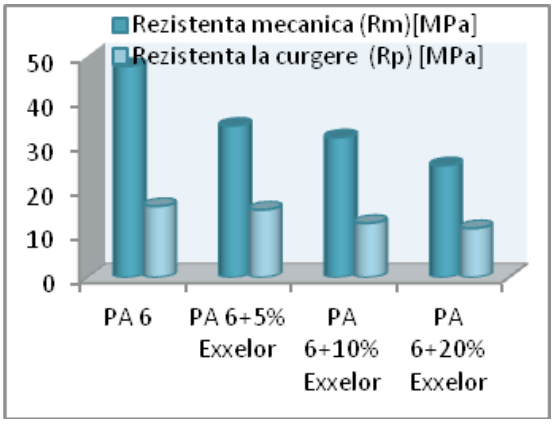
If electrical impedance (Fig.2 (e)) is found to decline with the addition of elastomer Lotader, implying a decrease in insulating character. Thus, it can be said that by adding increasing concentrations of compound insulating elastomer Lotader character decreases. Best insulation is PA6 and PA6/ 20Lotader. Exxelor concentration of 20% is not recommended for achieving electrical insulation, since the amount of oxygen was large and the resulting resistance is smaller. The values are lower than the saturation currents for mixtures PA6/Exxelor, compared with PA6 / Lotader.

3. TESTS AND MECHANICAL ANALYSIS OF MIXTURES PA / EPDM / OTHER ELASTOMERS

3.1. Tensile strength



(a)



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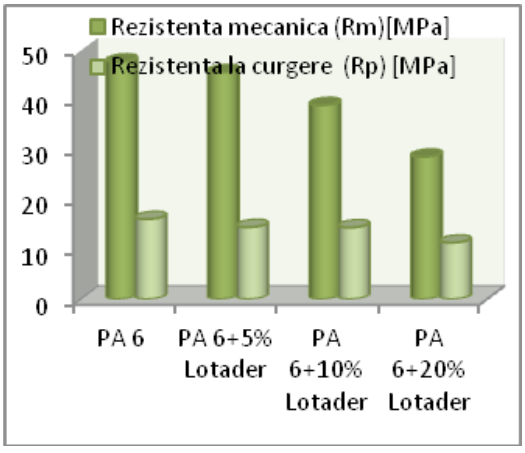

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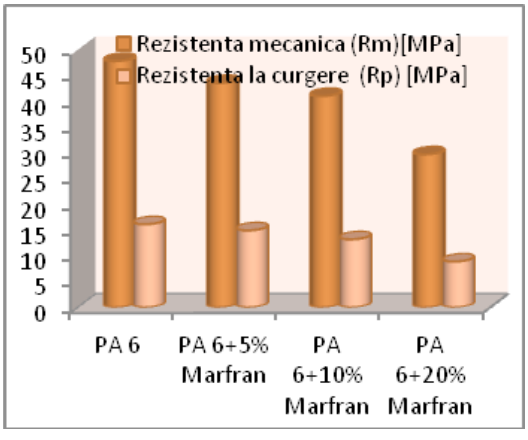
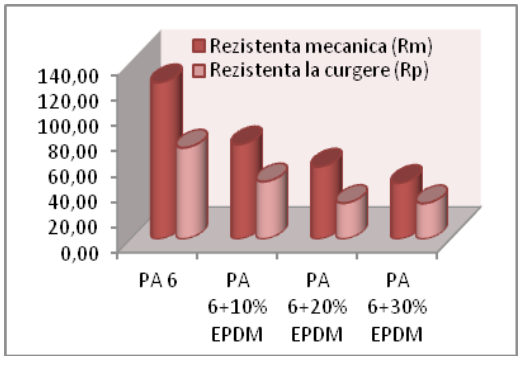


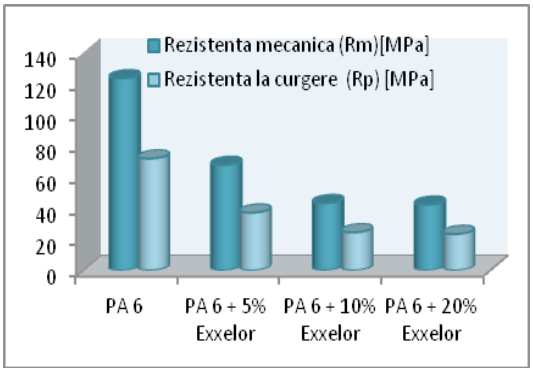
(d)

Fig. 3. The tensile strength of the elastomer made compounds: (a) EPDM, (b) Exxelor, (c) Lotader (d) Marfran

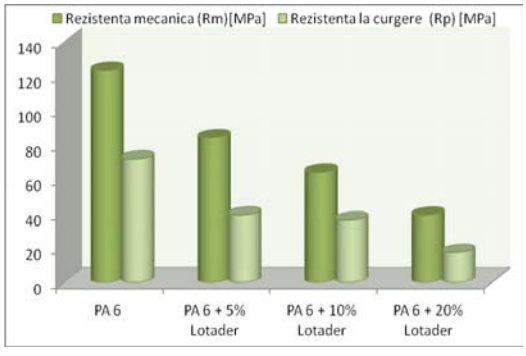
3.2. Tests for flexural strength in three-point



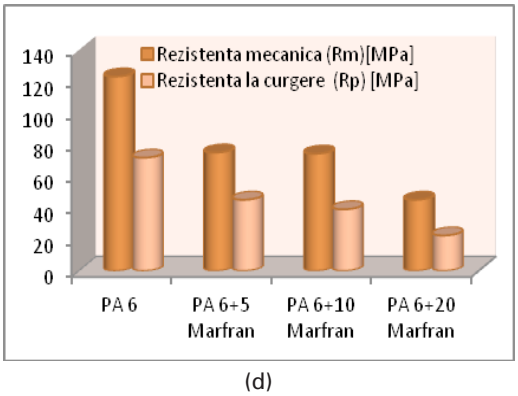
(a)



(b)



(c)



(d)

Fig. 4. Comparative presentation of media flexural strength of the elastomer made compounds: (a) EPDM, (b) Exxelor, (c) Lotader (d) Marfran

The aim of this project was to get a cable insulating material with improved mechanical properties and high resistance to ionizing radiation [3,4], based on PA6 modified with different elastomers, and the compatibility of these polymers immiscible with radiochemical processing . Since polyamide is a very rigid material which is very difficult to machine the insulation of cables, the composition thereof was added in increasing percentages of different elastomers, we observed an improvement in the mechanical properties, in particular increased elongation at break and the yield strength of the material. An order of decreasing mechanical strength can be expressed as: RmPA6/5Lotader > RmPA6/10EPDM > Rm PA 6/5Marfran > RmPA6/5Exxelor. From this point of view we can say that the best option is PA6/5Lotader.

3.3. Microhardness Vikers determined by nanoindentation

From the results it appears that the highest hardness has witnessed PA6 and PA6 lowest presents / 30EPDM, that is compounded with the highest content of elastomer.

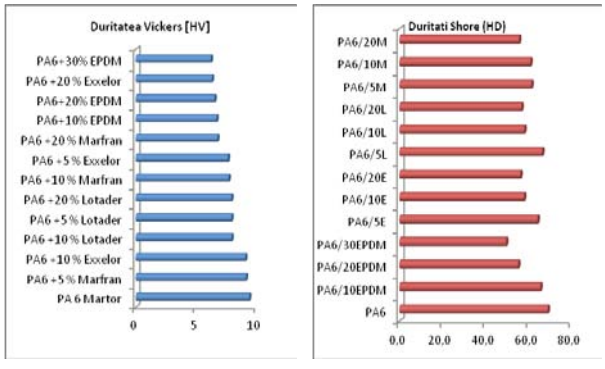
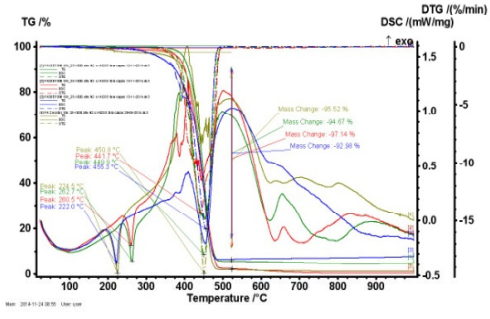


Fig. 4. (a) Determined by nanoindentation hardness Vickers, (b) Shore A Hardness

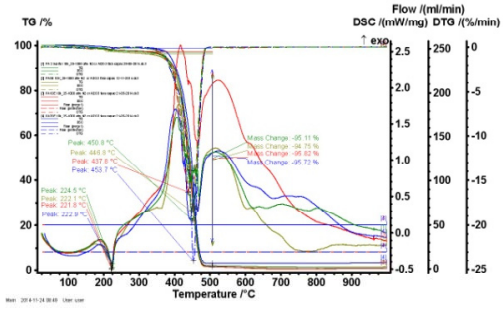
3.4. Shore hardness

The experimental results are shown in FIG. 4 (b). The hardness value was chosen as an average of 3 measurements. Shore hardness values obtained are determined according to the D45 1291 / _D (Rubber and plastics - Hardness Shore A or D). It is noted that the Shore hardness values are in the range from 55.7 to 69.1 HD.

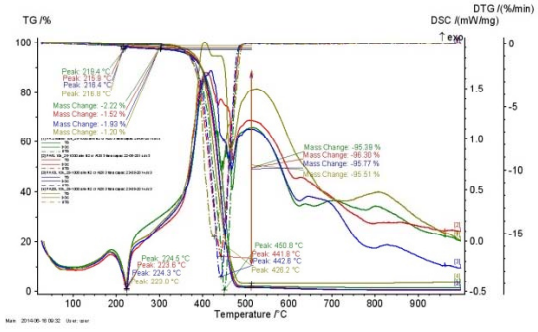
4. LIFETIME RAPID ASSESSMENT BY THERMAL ANALYSIS TECHNIQUES COUPLED (TG-DTA-DSC)



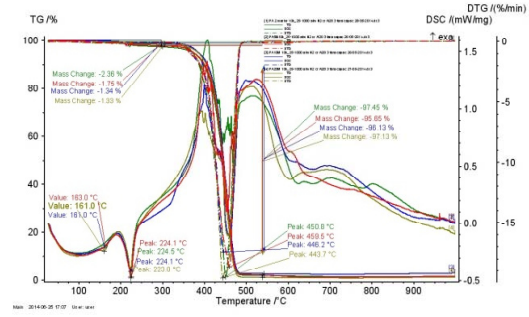
(a)



(b)



(c)



(d)

Fig. 5. Thermograms control evidence PA6 2: (a) 10, 20 and 30% EPDM; (b) 5, 10 and 20% Exxelor; (c) 5, 10, 20% Lotader and (d) 5, 10, 20% overlapping Marfran

For all samples tested, regardless of the type of elastomer used, the majority observed behavior of polyamide blank processes outlined in the thermogram 1 a melting followed by a complex decomposition, as evidenced by loss of mass TG, DTG and by its derivative (both processes with negative enthalpy - endothermic). This process is complex, varying according to the elastomer used and the heterogeneity of the samples analyzed. For all samples is observed at a melting process overlapped namely a loss of mass ~ 1.2% by mass which probably is the removal of volatile fractions and is characteristic of polyamide 6 blank.

There is one feature for the samples containing Marfran which is observed a softening point / glass transition in the temperature range of 160°C present in all samples.

4.2. Characterisation of blends of polyamide by differential scanning calorimetry (DSC)

Non-isothermal DSC measurements in oxidizing atmosphere highlighted termooxidare high stability and thus a long life of these mixtures with different types of polyamide elastomer induced by high stability of PA6 matrix. The stability to oxidation of the polyamide mixtures is lower than pure PA6. In the case of the samples functionalized with maleic anhydride (Exxelor), stability to oxidation increases with the concentration of the elastomer. Effect of maleic anhydride can be diminished by the existence of a component elastomer structure ethyl acrylate (Lotader). Changing elastomer concentration leads to lower degree of crystallinity of the blends compared to pure PA6.

4.3. Estimation of thermal endurance made compounds with different concentrations of elastomer mass loss criterion

Choosing levels of thermal stress and life of materials is based on the following requirements and remarks:

- The minimum temperature was chosen as polyamide exposure to 180°C temperature and 220°C the maximum;
- the first stage temperature should not exceed 20 degrees respectively materalului use temperature.

Program for evidence of exposure to temperature polyamide material is presented in Table 1. The criterion chosen for these materials degradation was weight loss. It is considered as the end of life of polyamide material to a weight loss of 30%.

Table 1. Program of exposure to temperature

Temperature, °C	Exposure time (hours)
180	120
200	72
220	24

After heat aging tests were obtained the results shown in Fig. 6. As a result of these tests, it appears that temperature indices are very close to made compounds studied. This can be justified by the fact that the polyamide is the major component compound and so it is one that prints a majority of thermal endurance materials compounded and thus it is one that prints a thermal endurance of materials.

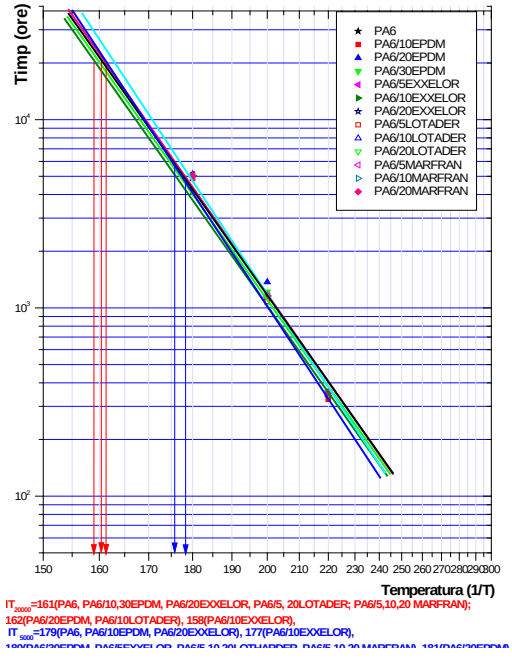


Fig. 6. Regression straight lines all made compounds studied

Thus, in these tests can be said that these polyamide made compounds with use as electrical insulation:

- a stand for a period of 5000 hours at a suitable temperature (IT 5000) and
- a stand for a period of 20000 hours at an appropriate temperature (IT 20000).

Of all made compounds notes that the temperature is the highest it has compounded PA6/20 EPDM and lowest presents the receipt PA6 /10 Exxelor.

5. MICROSTRUCTURAL ANALYSIS FOR ALL COMPOSITIONS MIXTURES PA / EPDM / OTHER ELASTOMERS

5.1. Structural Analysis

5.1.1. Structural Analysis - qualitative analysis phase by X-ray diffraction technique

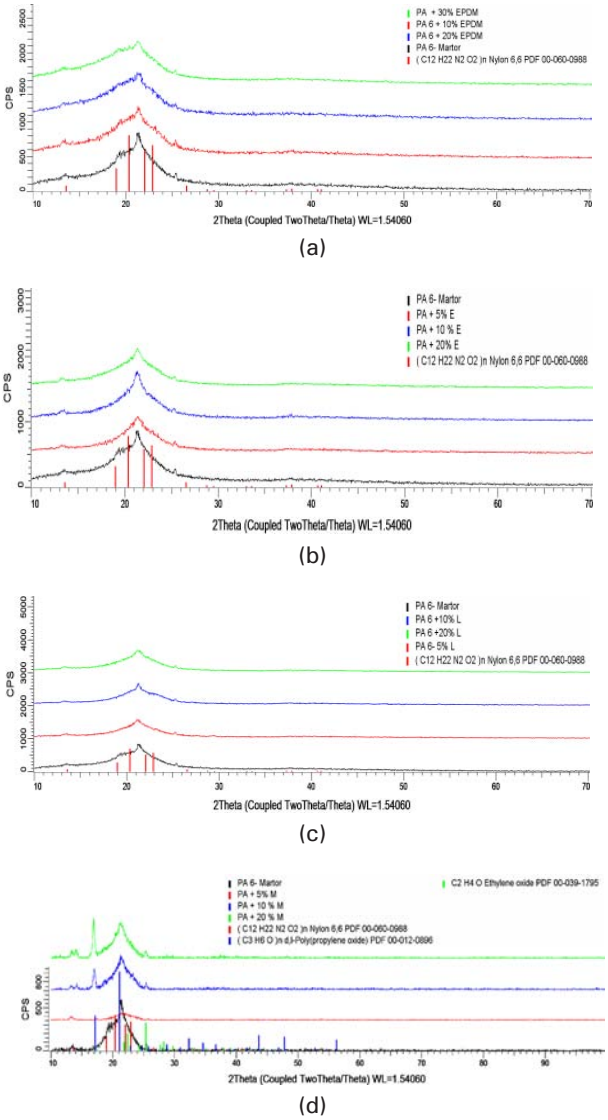


Fig. 7. Spectra resulting from X-ray diffraction analysis performed on the elastomer made compounds: (a) EPDM, (b) Exxelor, (c) Lotader (d) Marfran

5.1.1.2. Comparisons between the formulations of the same concentrations

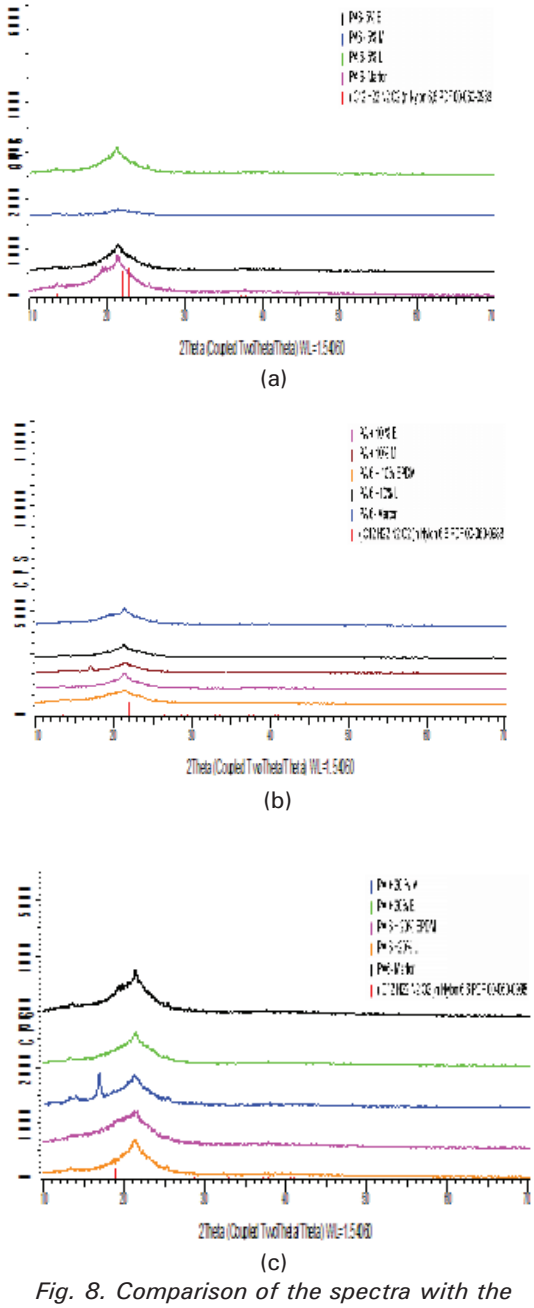
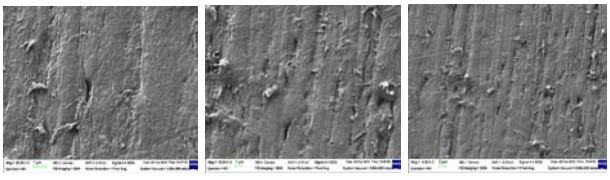


Fig. 8. Comparison of the spectra with the concentration of (a) 5% of all the formulations studied, (b) 10%, (c) 20% to the PA6 control

Following the structural analysis by X-ray diffraction samples PA / EPDM / other elastomers are found to occur predominantly spectrum and adding polyamide elastomer increasing percent increase amorphous character. Elastomer only exception to this rule is Marfranul. In this case, an occurrence of a bit (imposed by the elastomer mixture components) which leads to the conclusion that this elastomer elastomer adding increasing amounts of increase of crystallinity of the polyamide compound.

5.2. Electron microscopy analysis

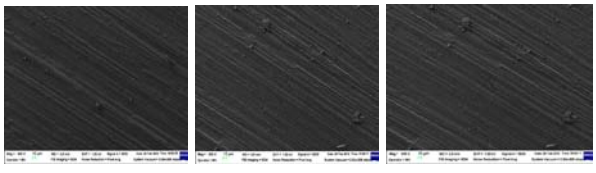
5.2.1.1. PA6 control section



a b c

Fig. 9. The series of SEM images for the PA6 control section

5.2.1.2. PA6 control surface

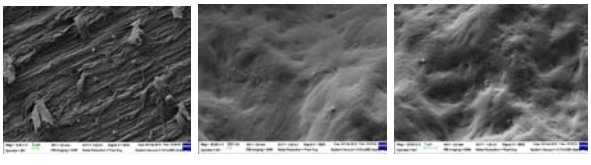


a b c

Fig. 10. Series Surface SEM images for PA6 control

5.2.2. PA 6/30 EPDM

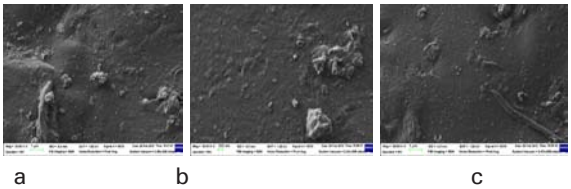
5.2.2.1. PA 6 /30EPDM section



a b c

Fig. 11. The series of cross-sectional SEM images for PA6 / 30EPDM

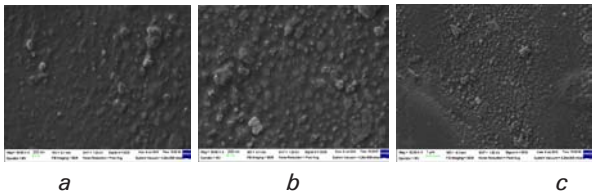
5.2.2.2. PA6/30EPDM area



a b c

Fig. 12. Series Surface SEM images for PA / 30EPDM

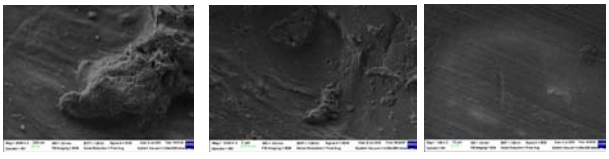
5.2.3. PA6 /5 Marfran



a b c

Fig. 13. Series Surface SEM images for PA / 5Marfran

5.2.4. PA6/5 Exxelor



a b c

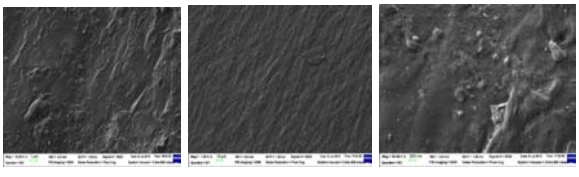
Fig. 14. Seria de imagini SEM la suprafață pentru PA/5 Exxelor

5.2.5. PA6/10 Exxelor

a b c

Fig. 15. Seria de imagini SEM la suprafață pentru PA6/10 Exxelor

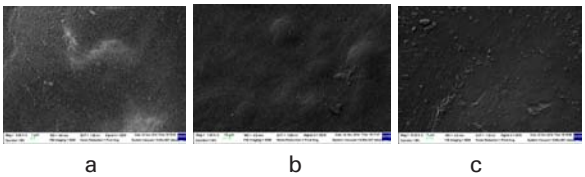
5.2.6. PA6/20 Exxelor



a b c

Fig. 16. Seria de imagini SEM la suprafață pentru PA/20 Exxelor

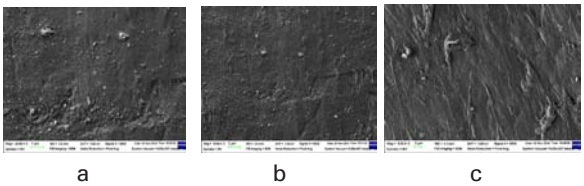
5.2.7. PA6/5 Lotader



a b c

Fig. 17. Series SEM images for PA / 5 Lotader

5.2.8. PA6/20 Lotader



a b c

Fig. 18. Series SEM images for PA / 20 Lotader

Scans were performed in the sample section. Thus, it appears that the images:

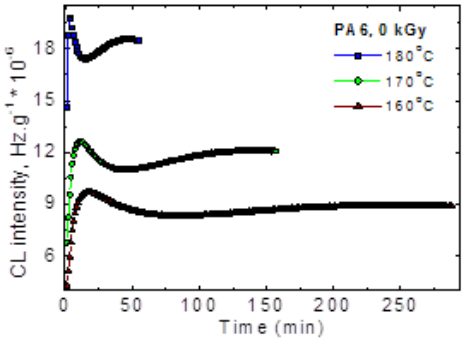
- March 6, polyamide (PA6) shows a homogeneous lamellar structure;
- for PA6 / 30EPDM inclusions is observed, as well as structural inhomogeneities elastomer / polymer

matrix core. You cannot say that is a very good mixing of the elastomer in the polymer. The elements present at the surface, as shown morphology appear to be specific SiO2 powder contamination resulting from technological process or various manipulations.

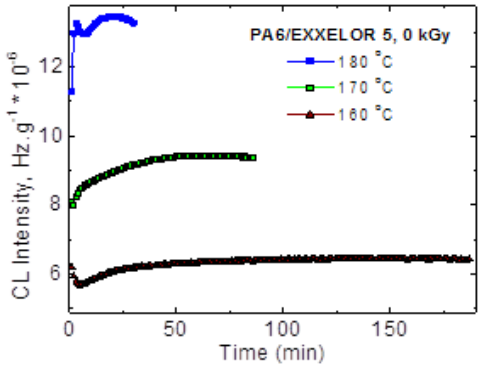
- for PA6 / 5 Marfran it is noted that the elastomer is dispersed in the matrix of the base polymer without the occurrence of discontinuity or alternating structure amorfo-crystalline phase compared with the receipt of PA6 / EPDM. It can be said that by replacing EPDM elastomer polyamide 6 with Marfran obtain a better homogeneity of the polymer compound thus obtained.
- for PA6 / 5 Exxelor it is noted that the surface of the sample dispersion in the elastomeric matrix of the core is relatively homogenous polymer with the occurrence of agglomeration areas of the elastomer and other inclusions, SiO_2 may process-specific and sample handling. From the images acquired can be assumed homogeneity is better than EPDM, but weaker than Marfran.
- for PA6 / 10 Exxelor is noted that the elastomer is well dispersed in the polymer matrix compared with the receipt PA6 / EPDM, but less than PA6 / Marfran. In scanning microscopy images larger needle is found clumps of elastomer than the addition of 5%. Then there is a small presence of surface contamination of SiO_2.
- for PA6 / 20 Exxelor there is no large agglomerations of elastomeric than the percentage of 5% to 10% Exxelor. From SEM analyzes presented in image b is found that the surface homogeneity of the compound without topographic differences or inclusions structural morphology resembles that of compound 5% Marfran. Also present on the surface of contaminants agglomerations specific morphological standpoint SiO_2 particles.
- Lotader for a 20% larger agglomerations not found elastomer ratios than 5% and 10% Exxelor. From SEM analysis presented shows that the compound is homogeneous surface without topographic differences or inclusions.

5.3. Compatibility tests

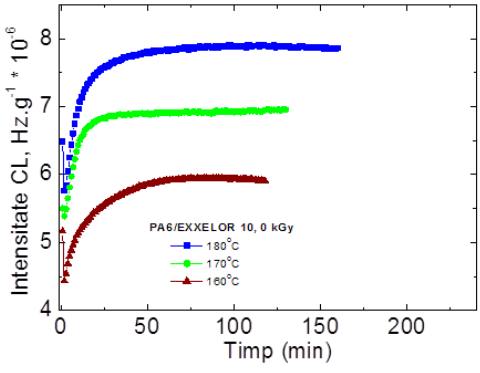
For performing these tests have been carried out by the process of investigation of thermal stability isothermal chemiluminescence. Working temperatures were 180°C, 170°C and 160°C.



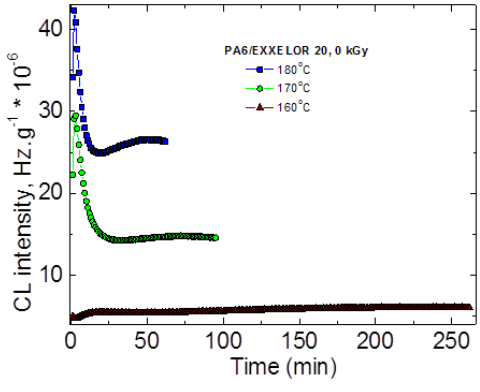
a



b



c



d

Fig. 19. The insulated chemiluminescence spectra recorded on the concentrations of elastomer samples: (a) the PA6 control (b) 5%, (c) 10%, (d) 20%

Investigations of thermal stability by isothermal chemiluminescence method revealed availability studied mixtures to oxidize relatively moderate temperatures, between 160 and 180°C. Form isothermal spectra differ from one concentration to another elastomers, which requires the consideration that the two components are high interaction, which binds various molecular chains bridged Van der Vaals. The concentrations of 20% in a mixture thereof with polyamide elastomer 6 are characterized by a more pronounced stability. At

concentrations of 5%, the form of the oxidation curves similar to that of the unmodified polyamide.

CONCLUSIONS

In this phase corresponding objectives were achieved our institute the project implementation plan. Thus, the following:

- Preliminary tests of thermal stability (non-isothermal CL) shows that oxidation of polyamide 6 made compounds with various elastomers is significant at 150°C. Three elastomers differ in their structural formulas were differentiated consideration, depending on the concentration or their nature non-isothermal chemiluminescence has been estimated that the elastomeric component of their contribution to the reduction of oxidation is Marfran < Exxelor < Lothader. This means that the presence of maleic anhydride leads to a decreased reactivity with respect to oxygen. It can be assumed that oxygen atoms components of this structure form hydrogen bonds and, thus, modify the thermal stability of the system and the rate of diffusion of the oxygen that powers;
- comparison of results from dielectric tests can be done following classification:

The presence of maleic anhydride in the structure of elastomers, polymer blends components of polyamide 6 only affect the current values in the first 2-3 minutes after applying the electric field. Lotarderul proved to be a suitable elastomer to produce the cable insulation with respect to Exxelorul.

Exxelor concentration of 20% is not recommended for achieving electrical insulation, since the amount of oxygen was large and the resulting resistance is smaller.

The values are lower than the saturation currents for mixtures PA6 / Exxelor, compared with PA6 / Lotarder.

o *Mechanical tests:*

One for tensile strength were chosen optimal choice for each of the following elastomer made compounds: PA6 / 10EPDM; PA6 / 5Exxelor; PA6 / 5Lotader; PA6 / 5Marfran. Among them may be the following classification: RmPA6 > RmPA6 / 5Lotader > PA6 / 5Marfran > Rm PA6 / 5Exxelor > PA6 / 10EPDM. Thus, one can choose the best option in terms of tensile strength version PA6 / 5Lotader.

For a 3-point bending strength decreasing order of mechanical strength can be expressed as: Rm PA6 / 5 Lotader > Rm PA6 / EPDM 10 > Rm PA6 / 5 Marfran > Rm PA6 / 5 Exxelor. From this point of view we can say that the best option is PA6 / 5 Lotader.

- Fast estimation of life coupled with thermal analysis techniques (TG-DTA-DSC)

An estimate of the thermal endurance tests showed the made compounds studied as temperature indices are very close so it can be concluded that:

one for a lifetime of 5000 hours electrical insulation temperature indices are in the range: 177-181 and

one for a lifetime of 20,000 hours electrical insulation index temperature are in the range: 158 - 162. Of all made compounds notes that the temperature is the highest it has PA6 20 EPDM and lowest presents PA6 + 10 Exxelor.

TG-DSC a test indicates that all samples analyzed regardless of the type of elastomer used mainly observed behavior of polyamide blank processes outlined in the thermograms, melting followed by a complex decomposition, as evidenced both by TG mass loss as and its derived DTG (both processes with negative enthalpy - endothermic). This process is complex, varying according to the elastomer used and the heterogeneity of the samples analyzed. For all samples is observed at a melting process overlapped namely a loss of mass ~ 1.2% by mass, which probably is the removal of volatile fractions and typically blank polyamide.

- a non-isothermal DSC measurements in oxidizing atmosphere highlighted termooxidare high stability and thus a long life of these mixtures with different types of polyamide elastomer induced by high stability of PA6 matrix.

An oxidation stability of mixtures of polyamide is lower than pure PA6. In the case of the samples functionalized with maleic anhydride (Exxelor) oxidation stability increases with the concentration of the elastomer. Effect of maleic anhydride can be diminished by the existence of a component elastomer structure ethyl acrylate (Lotader).

Changing an elastomer concentration leads to lower degree of crystallinity of the blends compared to pure PA6.

- compatibility tests were carried out by investigation of thermal stability by isothermal chemiluminescence method revealed that studied mixtures availability to oxidize relatively moderate temperatures, between 160 and 180°C. Form isothermal spectra differ from one concentration to another elastomers, which requires the consideration that the two components are high interaction, which binds various molecular chains bridged van der Vaals. The concentrations of 20% in a mixture thereof with polyamide elastomer 6 are characterized by a more pronounced stability. At concentrations of 5%, the form of the oxidation curves similar to that of the unmodified polyamide.
- Images (SEM micrographs) made at various sizes were relatively homogeneous surfaces surprised tive material phases. No inclusions or porosity reveal intrinsic material analyzed. Samples with PA6 / EPDM but special morphology due to alternating crystalline-amorphous areas between the copolymer used basic polymer structure. There are currently several inclusions (especially on the surface of particles) on their morphological SiO_2 possible, but not other contaminants

Within this phase was performed and dissemination of results embodied in the publication of the following works:

1. A.R. Caramitu, T. Zaharescu, V. Tsakiris, L. Avadanei, S. Mitrea, "*Influence of Concentration on Thermal and Mechanical Properties of Elastomeric Polyamide Blends for Industrial Applications*", presented at: THERMAM 2014 –Izmir, Turkey, 3rd Rostocker Symposium on Thermophysical Properties

for Technical Thermodynamics

Date of Conference: 12-15 June 2014

Proceeding : ISBN: 978-605-84726-1-7 **Page(s):** 279-283.

2. A. R. Caramitu, T. Zaharescu, S. Mitrea, V. Tsakiris, G. Sbarcea, D. Patroi, L. Avadanei, "*Study regarding mechanical, thermal and structural properties of some elastomeric polyamide blends destined to cable insulating*"**,** presented at: International Symposium on Fundamentals of Electrical Engineering 2014

Date of conference: 28-29 noiembrie, 2014, Bucharest

Procediing; Page(s): **IEEE Xplore (ISBN: 978-1-4799-6821-3)**

3. T. Zaharescu, M. E. Lungulescu, A.R.Caramitu, V. Marinescu, "*Radiation effects în PA6/EPDM blends*"**,** presented at 4th INCC – 4th International Nuclear Chemistry Congress, Maresias, Brazil

Data of Congress: 14-19 september 2014

Proceeding: Page(s): 80

REFERENCES

[1] *Materiale electrotehnice, Fise de laborator*

[2] *Materiale dielectrice. Condensatoare*, Catedra Telecomenzi şi Electronică în Transporturi, UPB

[3] Zdenek H., Danek M., Miroslav M., Jakub C. and Martina M., "*The Influence of Ionizing Radiation on Chemical Resistance of Polymers*", International Journal of Mechanics, 2011, 5(3):210-217.

[4] IAEA-TECDOC-1062 (INTERNAȚIONAL ATOMIC ENERGY AGENCY), *„Stability and stabilization of polymers under irradiation"*, Final report of a co-ordinated research project 1994-1997

[5] Udipi K., Dave R.S., Kruse R.L. and Stebbins L.R., Polymer, 1997, 38(4): 927

[6] Czech Z., Kowalczyk A., Kabatch J., Swiderska J., Polym. Bull., 2013, 70:1911-1918

[7] Motori A., Montanari G.C., Saccani A., Giannoni S., Journal of Materials Research, 2000, 15(1): 243-247

[8] Liu Y., Wei X., Xiong Y., Zhang F., and Xu W., Chinese Journal of Polymer Science, 2009, 27(3): 343-35.

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Fibrous nanostructures for fluid filtration obtained by electrospinning

ABSTRACT

The following specific objectives were pursued in the project phases: the obtaining of CNT/PAN composite polymer fibers by electrospinning and morpho-structural characterization of them; the study of the process parameters influence (viscosity and flow rate of the solution, applied electric field); making a documentary study concerning to the filters configuration based on fibrous nanostructures (substrate, nanofibrous layer, types of polymers, functional groups); development of the CNT/PAN composite polymer layers by electrospinning on different porous substrates: cellulose, carbon or metal. It also aimed to obtain experimental models of polymeric structures deposited by electrospinning on the textile substrate and the characterization of them in terms of morphologically, porosity and mechanical properties.

INTRODUCTION

Electrospinning represents a simple and relatively inexpensive method to obtain fibers with nanometer or under-microns diameters using polymer solutions or melts [1-4]. Based on the advantages of simplicity and relatively low cost method, combined with its versatility, a number of applications based on such nanocomposite fibers were analyzed [5]. PAN is the most widely precursor used in the manufacture of high-performance fibers [6], nanofibers obtained by the electrospinning being uniform, with diameters of about 300 nm [7].

The introduction of some particles in the polymer, such as carbon nanotubes (CNT), can lead to mechanical properties improvement, of thermal stability, electrical conductivity and other functional properties of these type of fibers [8].

The membranes based on electrospinned nanofibers may be used for water microfiltration due to the fact that they have a pore size distribution of under-microns to micrometers.

Yoon et al. [9] have proposed a concept of filtration membranes manufacturing, involving the use of electrospinned nanofibers membrane. The proposed system consists of a composite structure with three levels: (i) a hydrophilic non-porous top layer based on a chitosan coating, (ii) a membrane of electrospinned PAN nanofibers as intermediate layer and (iii) a conventional non-woven polyester microfibre as substrate support. This structure has been used to make ultrafiltration membranes with high flow and low-fouling.

Based on literature data, preliminary experiments were carried out to obtain polymer micro/nanofibrous layers by electrospinning on various substrates, in order to obtain membranes for fluids filtering.

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EXPERIMENTAL

In order to obtain a membrane for filtering fluids, polymer solutions of polyacrylonitrile in dimethylformamide (PAN/DMF) of 3%, 5%, 7% and 10% PAN concentration were prepared. Thereafter, the PAN suspensions of 0.5 and 1% CNT concentration were obtained. In order to obtain the best possible dispersion of the CNT in the PAN polymer solution, polyvinylpyrrolidone (PVP) was use as a dispersant. PAN solutions and PAN/CNT suspensions have been structurally characterized by IR spectroscopy (FTIR), by the electrically point of view, by measuring the electrical conductivity and the rheological point of view, by determining the viscosity.

Polymer fibers were made by electrospinning with NaBond equipment, using PAN/DMF solutions or CNT/PAN suspensions. During the electrospinning process, the flow rate of liquid injection and the distance between the electrodes have been kept constant and the operating voltage was varied.

Based on the literature data presented, preliminary attempts have been made to obtain the micro/nanofibers polymer layers by electrospinning on various substrates, in order to obtain filtering membranes. PAN/CNT nanocomposite polymer solutions were used having the following composition:

Table I. PAN/CNT electrospinned solutions composition

Sample	PAN concentration, % wt	CNT concentration, % wt
P10C0.5	10	0,5
P10C1	10	1
P10C5	10	5
P10C10	10	10

In order to obtain the micro/nanofibrous layers, a NaBond electrospinning unit was used, having glass syringe and a flat tip needle with inner diameter of 0.8 mm. To collect the membranes, a copper plan collector was used.

The experiments were carried out under the following conditions: applied voltage - 18 kV; the distance between the needle and the collector - 20 cm; solution flow rate - 1.2 ml/h; needle inner diameter - 0.8 mm; deposition time - 180 minutes; stationary collector. The micro/nanofibrous polymeric layers were deposited on different substrates by electrospinning: aluminium, cellulose, carbon paper, Ni mesh/foam, mounted on aluminium foil.

In order to obtaining experimental models of micro/nanofibrous polymeric layers deposited on the textile substrate, PAN/CNT nanocomposite polymeric solutions of various concentration were used, which were deposited on the textile substrate of gauze. PAN/CNT solutions were obtained using PAN fibers (manufactured by Bluestar), multi-walled CNT and dimethylformamide (DMF), density 0.94 g/cm^3 (purchased from Alfa Aesar).

To obtain polymeric layers a copper plan collector was used, covered with aluminium foil on which was mounted the gauze textile substrate, the deposition being performed under the conditions described above.

Four samples of material were obtained as follows:

Table II. Samples of micro/nanostructured polymeric layers deposited on the textile substrate

Sample	PAN/CNT concentration, % wt	Textile substrate
P10C0.5	10/0.5	gauze
P10C5	10/5	gauze
P10C1	10/1	gauze
P10C10	10/10	gauze

They were characterized morpho-structural and mechanical point of view.

RESULTS AND DISCUSSIONS

The obtained results in the determination of the electrical conductivity of PAN solutions (P3, P5, P7 and P10) are shown in Table III.

Table III. The electrical conductivity of PAN solutions

Sample	Electrical conductivity [S/m]	Electrical rezistivity [*m]
P3	$2.15*10^{-3}$	$4.65*10^{2}$
P5	$1.96*10^{-3}$	$5.10*10^{2}$
P7	$1.86*10^{-3}$	$5.38*10^{2}$
P10	$0.98*10^{-3}$	$1.20*10^{3}$

It is noted that the electrical resistivity of PAN solutions are in the typical range for semiconductors.

In the figures shown below are presented PAN/CNT polymeric membranes obtained on different substrates.

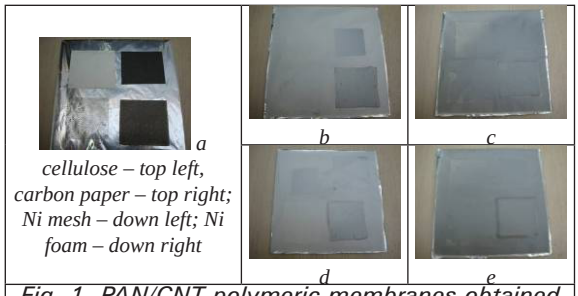

Fig. 1. PAN/CNT polymeric membranes obtained on different substrates: a) uncoated substrates: b) P10C0.5; c) P10C5; d) P10C1; e) P10C10

Figure 2 presents SEM micrographs of membranes obtained by the electrospinning on the aluminium substrate, and Figure 3 shows the membranes obtained by electrospinning of the P10C10 solution on the substrate of cellulose, carbon, nickel mesh or nickel foam.

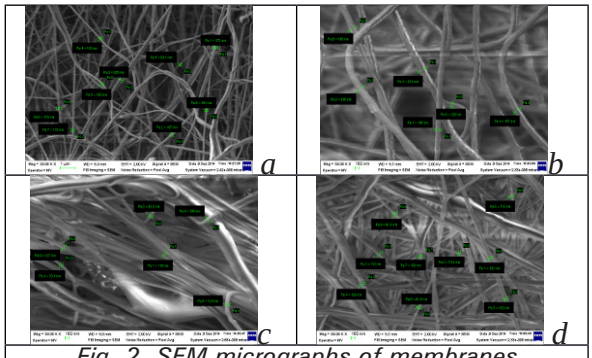

Fig. 2. SEM micrographs of membranes deposited on aluminium substrate: a) P10C0.5; b) P10C1; c) P10C5; d) P10C10

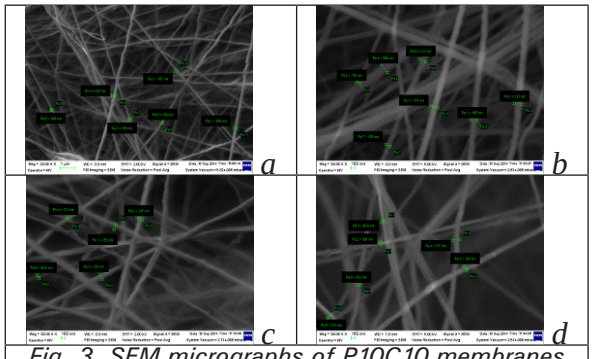

Fig. 3. SEM micrographs of P10C10 membranes deposited on the substrate of: a) cellulose; b) carbon paper; c) Ni mesh; d) Ni foam

Figure 4 shows SEM micrographs of the membranes obtained by electrospinning on gauze.

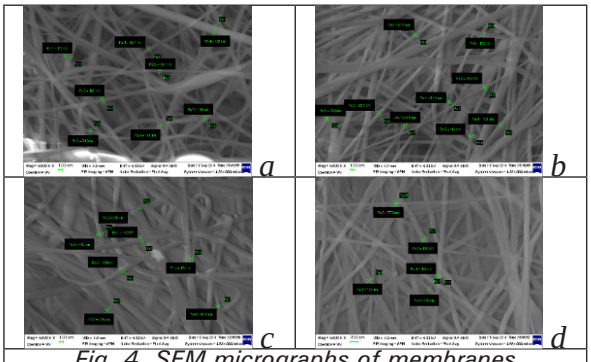

Fig. 4. SEM micrographs of membranes deposited on gauze: a) P10C0.5; b) P10C5; c) P10C1; d) P10C10

For the calculation of the membrane porosity was used the following equation: $P(\%) = [(m_0 - m_1)/A \cdot \tau] \times 100$, where: P - the membrane porosity (%), m_0 – the membrane mass wetted with distilled water (g), m_1 - the mass of dry membrane (g), A - membrane area (cm^2) and τ - membrane thickness (cm).

Table IV. The dimensions and porosity of polymeric layers

Sample	Calculated porosity (%)	Thickness layer (μm)	Diameter (nm)		
			ave-rage	min	max
P10C0.5	61.52	20.7	93.4	76.6	112
P10C1	57.01	29.7	98.5	79	113
P10C5	44.96	42.56	145.9	119	170
P10C10	27.38	41.2	148.8	100	237

The results obtained at the mechanical properties testing of the polymeric layers are shown in the following table and figures.

Table V. The values of mechanical strength and elongation of the 4 samples

Sample	Average mechanical strenght, R_m (MPa)	Average elongation, A (%)
P10C0.5	2.03	10.78
P10C1	1.98	14.74
P10C5	1.42	5.95
P10C10	2.37	18.09

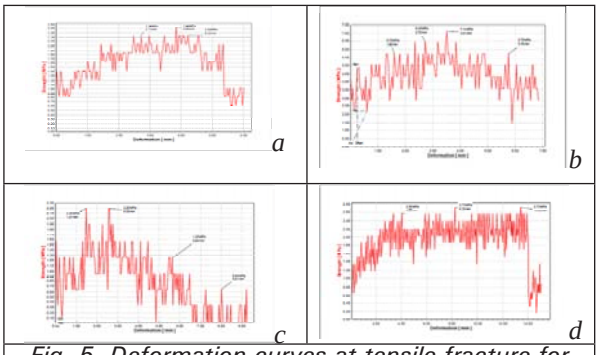

Fig. 5. Deformation curves at tensile fracture for samples: a) P10C0.5; b) P10C1; c) P10C5; d) P10C10

CONCLUSIONS

It is noted that the thickness obtained in the same conditions of electrospinning process increases with CNT concentration increasing from 0.5 to 5% weight, and then decreases slightly at 10% concentration, for a electrospinning process duration of 180 minutes.

The porosity of the polymeric layer decreases with the increase of the CNT concentration in the solution due to the increase in its viscosity, which results in increased fiber diameters and thickness of the polymer layer. Thus, the highest porosity (61.52%) was obtained for the electrospinned membrane from the solution with the lowest percentage of CNT (0.5%), and for the membrane obtained from the solution with 10% CNT, the determined value of porosity was of 27.38%.

In all studied cases, the obtained values of tensile strength are larger than 1 MPa and elongation values are greater than 6%. Thus, for P10C0.5 samples, the average tensile strength is 2.03 MPa and the elongation has an average value of 10.78%. In the case of P10C1 samples, the average tensile strength is 1.98 MPa and the elongation has an average value of 14.74%. P10C5 samples show an average tensile strength value of 1.42 MPa and elongation has an average value of 15.95%. P10C10 samples show an average tensile strength value of 2.37 MPa and elongation has an average value of 18.09%. Deformation curve shape, similar in all cases, have 3 maximum points.

REFERENCES

[1] Bo Qiao, Xuejia Ding, Xiaoxiao Hou, and Sizhu Wu, "*Study on the Electrospun CNTs/Polyacrylonitrile-Based Nanofiber Composites*", Journal of Nanomaterials, vol. 2011, Article ID 839462, 7 pages, 2011. doi:10.1155/2011/839462.

[2] R. Andrews, D. Jacques, A. M. Rao et al., "*Nanotube composite carbon bers*", Applied Physics Letters, vol. 75, no. 9, pp. 1329–1331, 1999.

[3] R. H. Baughman, A. A. Zakhidov, and W. A. De Heer, "*Carbon nanotubes-the route toward applications*", Science, vol. 297, no. 5582, pp. 787–792, 2002.

[4] Y. V. Basova, D. D. Edie, Y. S. Lee, L. K. Reid, and S. K. Ryu, "*Effect of precursor composition on the activation of pitchbased carbon bers*", Carbon, vol. 42, no. 3, pp. 485–495, 2004.

[5] W.J. Chou, C.C. Wang, C.Y. Chen, "*Characterization of polyimide-based nanocomposites containing plasma modified multi-walled carbon nanotubes*", Composites Science and Technology, vol. 68, nr. 11, pp. 2208-2213, 2008.

[6] I. Chun, D. H. Reneker, H. Fong et al., "*Carbon nano bers from polyacrylonitril and mesophase pitch*", Journal of Advanced Materials, vol. 31, nr. 1, pp. 36–41, 1999.

[7] Y. Dzenis, "*Spinning continuous bers for nanotechnology*", Science, vol. 304, no. 5679, pp. 1917–1919, 2004.

[8] J. Johnson, L. N. Phillips, and W. Watt, "*The production of carbon bers*", British Patent, no. 1,110,790, 1965.

[9] K. Yoon, K. Kim, X. Wang, D. Fang, B. S. Hsiao, B. Chu, *High flux ultrafiltration membranes based on electrospun nanofibrous PAN scaffolds and chitosan coating*, Polymer, 47 (2006) 2434-2441.

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Nanostructured steels in the form of plates / strips made from amorphous precursors

ABSTRACT

The making of the nanostructured steels presents a particular interest in industrial applications aimed at achieving complex structural components used in the automotive industry such as: parts and components of the carriage, longerons, sidebar, but also for other applications such as: liquefied natural gas canisters, gas storage cylinders, drill bit. The novelty aspect of these materials is that, by nanostructuring, the materials show high values of tensile strength > 900 MPa and elongation > 20% in those applications and can help reduce weight, decreased the energy and material consumption, while maintaining safety in operation. In the frame of the project two types of steels suitable for amorphization were carried out using two production technologies - casting in the form of Cu and rapid solidification on the Cu rotating drum.

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INTRODUCTION

The strong competition generated in the last decade between steel industry and low density metal industries led to researches in steel industry focused in finding solutions for subassemblies and components mass reduction. In this aim, the researches were directed in finding a new class of stronger and more ductile, with improved formability iron based alloys, leading to the reduction of the mass of components by reducing their thickness [1-3]. The key to obtain such alloys is the nanostructuring. There are several methods to produce nanocrystalline materials such as: inert gas condensation, sputtering and plasma processing, vapor deposition, electrodeposition, rapid solidification, mechanical alloying, severe plastic deformation and spark erosion [4]. The rapid solidification technique is a method which allows obtaining of various types of alloys with nanocrystalline structure, derived from the crystallization of metallic glasses. The glass – crystalline transformation involves decomposition of single-phase supersaturated solid solutions into multiphase nanoscale microstructure. To obtain a nanoscale structure, the crystallization process should take place with a high nucleation rate while the crystal growth rate has to be suppressed as much as possible. In the iron-based systems the crystallization temperature generally varies from 500 to 650°C and the enthalpy of the glass to crystalline transformation varies from -75 J/g to -200 J/g [5-7]. The facility by which the amorphous phase is forming by preventing the crystallization during solidification is known as glass forming ability (GFA) of the alloy [8].

In this project are presented the properties of some amorphous alloys zirconium modified from Fe-Cr-Ni-Si-B system processed by two rapid quenching methods.

EXPERIMENTAL

The multi-component $Fe_{63.4}Cr_{15.68}Ni_{8.75}B_{6.09}Si_{6.08}$ (C1) and $Fe_{63.85}Cr_{11}Ni_{6.15}B_{10}Si_3Zr_6$ (C1M) master alloys (in at%) were prepared by vacuum induction melting of a mixture of pure Fe, Cr, Ni and Si metals and pre-alloyed Fe-B 80-20 and Zr-Si-Fe 97.85-1.41-0.74 under an ultra pure argon atmosphere and than poured into a copper mould. A master alloy $Fe_{74}Cr_4Ni_9B_{10}Si_3$ (C2) similar with that obtained by reference [8] was also made, for comparison. The obtained master alloys were divided into four equal parts. The first three parts were re-melted and then casted using the copper mould casting method, in order to obtain sheets of 69.7 mm x 64 mm x (3/1.5) mm. From the fourth part strips were obtained using an Edmund Bühler melt spinning installation. The used melt spun parameters were the followings: copper reel diameter of 250 mm, quartz tube with diameter of 15 mm with a calibrated orifice of 1 mm, the distance between the inlet quartz tube and the surface of the rotating copper reel of 0.5 mm and the argon pressure of 1.5 bar. The linear speed of the reel was of 30 m/s, 33 m/s and 36 m/s respectively.

The amorphicity of the samples was examined by X-ray diffractometry with Cu K_α radiation using a Bruker D8 Advance Diffractometer. The thermal properties of the alloys obtained were investigated by scanning calorimetry using the simultaneous thermal analysis equipment TG-DSC/DTA Netzch STA 449 F3 thermal analyzer. The tests were performed in argon atmosphere, from room temperature to 1350°C using a heating rate of 10 K/min. The tensile strength tests were performed using an Instron testing machine with the maximum applied force of 30 kN on the C1, C1M and C2 strips with sizes of 1.5 mm in width and 30 μm in thickness.

RESULTS AND DISCUSSIONS

The appearance of the samples of the alloy obtained by the two methods are shown in Fig. 1.

C1,C1M,C2,3 mm *C1,C1M,C2, 1.5 mm*

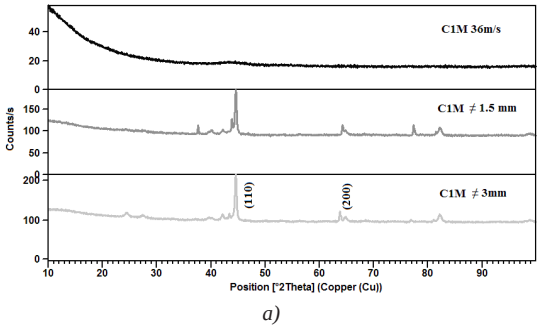
a) Sheets obtained by copper mold casting method

C1,36 m/s *C1M,36 m/s* *C2,36 m/s*

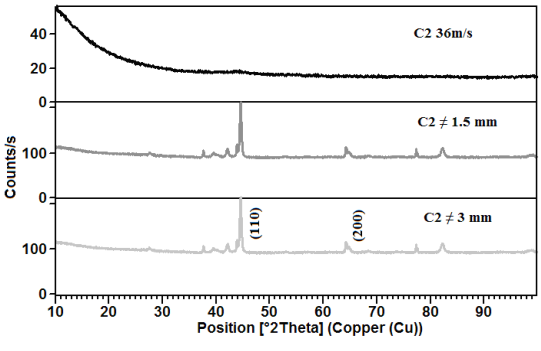
b) Melt spun strips

Fig. 1. Images of BMGs sheets and strips

The formation of the fully amorphous phase for Zr modified compositions (C1M and C2) processed by melt spinning method is shown in Fig. 2.



a)



b)

Fig. 2. X-ray diffraction patterns of the a) C1M and b) C2 processed by copper mold casting and melt spinning methods

In the case of copper mold casting process, the C1M material solidifies in a form of multi-phase type consisting of a majoritary phase of α Fe(Ni) solide solution with a bcc crystal lattice and at least three minoritary phases of intermetallic compounds type, namely: Fe_2Si with hexagonal crystal lattice, $Cr_{13}Ni_5Si_2$ with tetragonal crystal lattice, $Ni_{10}Zr_7$ with orthorhombic crystal lattice, and $CrFe_4$ with cubic crystal lattice.

The C2 material shows similarities with the C1M material in terms of the behaviour during the the cooling process.

Thermal properties of the obtained amorphous materials were extracted from the DSC curves showed in Fig. 3. The values of the thermal properties of the amorphous materials (C1M and C2) are sumarized in table I. For comparison, the table shows the thermal properties values obtained from reference [8]. From the recorded DSC curve it can be concluded that the crystallization behavior of the C1M material is of one-stage crystallization mode, while the C2 shows a multi-stage crystallization process.

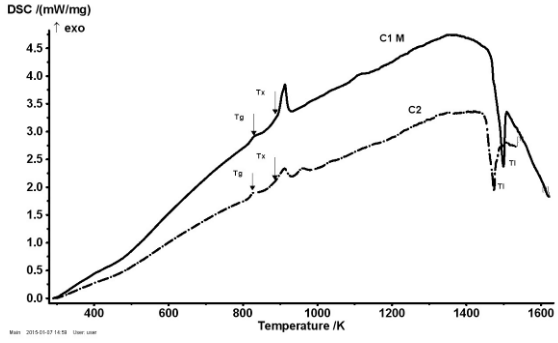


Fig. 3. DSC curve of the C1M and C2 glassy alloy strips

Table I. Thermal properties of the obtained amorphous materials

Sample code	T_x [K]	T_g [K]	T_l [K]	$\Delta T_x = T_x - T_g$ [K]	$T_{rg} = T_g/T_l$	$\gamma = T_x/(T_g + T_l)$	$\delta = T_x/(T_l - T_g)$
C1M	896	825	>1499	71	0.55	0.38	1.33
C1	-	-	-	-	-	-	-
C2	887	830	1474	57	0.56	0.38	1.34

Fig. 4 shows the microstructure image of solidified material in the form of strips of composition C1.

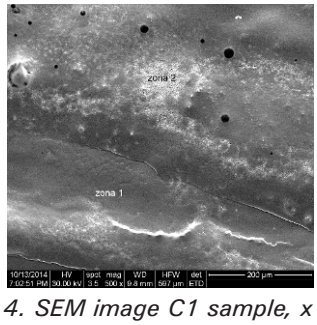


Fig. 4. SEM image C1 sample, x 500

The melt spun C1 strips present a gradient in the thickness of the strip, the edge areas being thinner than the middle areas.

The quantitative chemical micro-analyses, EDX done on the zone 1 and zone 2, is presented in table II.

It is distinguished a slice variation of chemical composition of about 1 wt %.

Table II. The C1 material EDX analysis

	Zone 1		Zone 2	
	at %	wt %	at %	wt %
Fe	66.89	69.81	65.98	69.28
Cr	17.12	16.63	16.54	16.17
Ni	9.04	9.91	9.25	10.21
Si	6.95	3.65	8.23	4.35

The EDX spectra are shown in Fig. 5 a) and b) for zone 1 and zone 2.

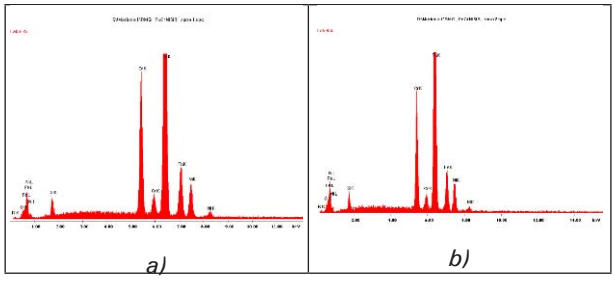
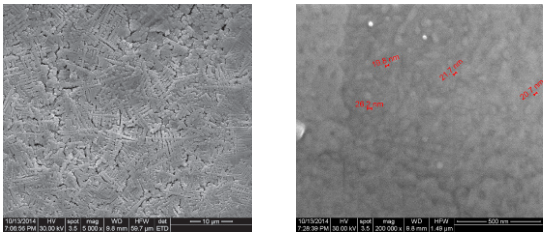


Fig. 5. EDX spectra of the C1 material

In Fig 6 are shown microstructural details in materials obtained in the form of strips of C1 composition.



X 5000 *X 200000*

Fig. 6. Microstructural details in the strips obtained from the C1 material

From the point of view of mechanical properties, the C1 and C2 strips exhibit elastic deformation up to certain values of the applied stresses (599 MPa and 467 MPa respectively), followed by final fracture. Regarding to the values of the elastic deformation that these materials can support, the C1 crystalline strip shows a better deformation than the C2 amorphous strip.

Fig. 7 illustrates the tensile strength - strain registered for the C1M amorphous material in the form of strips.

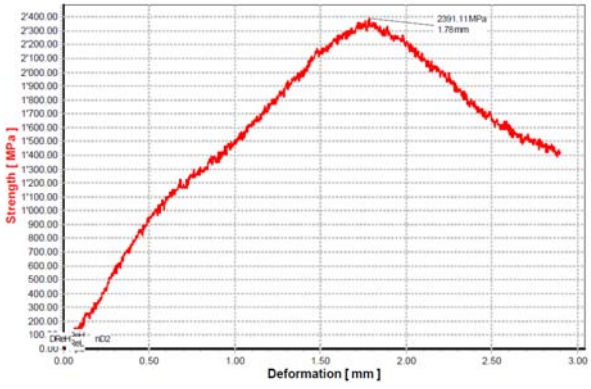


Fig. 7. Tensile strength – strain curve of C1M amorphous strip

The C1M amorphous strip shows the highest value of the mechanical strength of about 2.4 GPa. Furthermore, the C1M amorphous strip exhibits the highest elastic deformation of 1.78 mm, followed by plastic deformation before final rupture.

CONCLUSIONS

The results obtained for the materials studied lead to the following conclusions:

- The rapid solidification method on rotating copper drum allows the obtaining of the C1M and C2 composition alloys in amorphous form;
- The addition of Zr contributed to obtaining of the amorphous bands with a wide range of ΔT_x giving a good measure of the stability of the amorphous phase;
- The method of molding in the form of Cu has not resulted in the amorphous alloys made in the form of strip with thickness ≥ 1.5 mm;
- Thermal analyzes have shown that the C1M material obtained by the rapid solidification on the rotating drum crystallized by a one stage crystallization process, while the C2 material has a crystallization process in two stages;
- All materials presented elastic deformations to certain values of the applied tensile stregth;
- C1M material presents a final plastic deformation before the final rupture.

REFERENCES

[1] R. Kuziak, R. Kawalla, S. Waengler, *Advanced high strength steels for automotive industry*, Archieves of Civil and Mechanical Engineering, vol VIII, no.2, 2008, 103-117

[2] D.K. Matlock, J. G. Speer, E. De Moor, P. L. Gibbs, *Recent developments in advanced high strength sheet steels for automotive applications: An overview*, Jestech, 15(1), (2012), 1-12.

[3] D.K. Matlock, J.G. Speer, *Processing opportunities for new advanced high-strength sheet steels*, Materials and Manufacturing Processes, 25 (2013), 7-13

[4] T. Kulik, *Nanocrystallization of metallic glasses,* Journal of Non-Crystalline Solids, 287 (2001), 145-161

[5] A. Inoue, *Stabilization of metallic supercooled liquid and bulk amorphous alloys*, Acta Materialia, 48 (2000), 279-306

[6] A. Inoue, A. Takeuchi, B. Shen, *Formation and functional properties of Fe-based bulk glassy alloys*, Materials Transactions, Vol. 42, No. 6 (2001), 970-978

[7] A. Takeuchi, A. Inoue, *Calculation of crystallization temperature of multicomponent metallic glasses*, Materials Transactions, Vol. 43, No. 9 (2002), 2275-2285

[8] A Masood, *Functional metallic glasses*, Doctoral thesis, 2012, 5-16

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Development of new materials and devices for controlled drug delivery with applications in biomedical engineering

ABSTRACT

The new paradigm for medical industry will be surgical operations in which implants are fully adapted to the particular requirements of each patient. This "vision" will be fulfilled when new biomaterials are developed and new technologies for design and rapid manufacturing of such implants are implemented.

In this stage were designed and developed experimental models of synthetic bone and cranial implant, using plaster molding technique of ceramic slips based on hydroxyapatite (HAP). For the development of customized medical devices has been developed an experimental set of HAP granulated ceramic powder for rapid prototyping (RP) technique. At the end, experimental models have demonstrated the biocompatibility quality through the specific tests, in vitro.

INTRODUCTION

Cranial trauma and their sequelae are a major public health problem in the industrialized world. The incidence depends on the socio-economic and cultural factors, the cause of about two thirds of post-traumatic deaths and the most common generator of post-traumatic permanent disability [1]. Recent statistics from the US and Germany has a number of 200-300 instances of traumatic brain injury per 100,000 population, with a peak incidence in the age group of 15-24 years [1-3]. The overall aim of cranial reconstruction consists, on the one hand, in making a "closure" appropriate and secondly getting a cosmetic/aesthetic good result. To solve these complex problems currently for reconstruction, different techniques and diverse materials are available [4, 5]. The cranial-implant market is dominated by a number of medical-device manufacturers which has been providing custom-fit cranial implants since 2004. The cranial implants themselves have traditionally been made from metals - such as titanium - and customized using patients' computed tomography data and computer-aided design/computer-aided manufacturing. From the literature study showed that the synthetic ceramic material used for the development of implants and/or repairs of the cranial bones is based on hydroxyapatite (HAP), used as powders/granules, ceramic paste (cement) or shaped as dense or porous articles.

The aim of the project is to study, development and testing of *medical devices*- ceramic biomaterials based on calcium phosphates (carriers of therapeutic substances), as shaped or granular products, for medical applications, particularly in general surgery of bone addition (cranioplasty).

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EXPERIMENTAL

Phase 1: **"Optimization experimental model of synthetic bone for repairs in neurosurgery"** The main objective: activities for optimizing experimental models of synthetic bone through:

- optimization of the rheological characteristics of HAP ceramic slips: preparing ceramic slips containing min. 60% solid phase, and optimal content of additives (dispersing agent and binder);
- optimization technique of casting in plaster molds of ceramic slips: ultrasonification and degassing/ deaeration processes producing molded articles with min. 50% density of the ρ_{th};

Phase 2: ***"Develop and characterization experimental model of cranial implant"***

The main objective: development and characterization of experimental models of cranial implant prosthesis in terms of compositional (XRD; FT-IR measurements), structural (SEM measurements) and the physical and mechanical properties (thickness and mechanical resistance).

Phase 3: ***"Develop and characterization HAP ceramic powder for manufacturing of cranial implants by rapid prototyping (RP)"***

The main objective: development and characterization of HAP ceramic powder, and preparing a experimental lot of HAP ceramic powder for preliminary experiments in rapid prototyping (RP).

The specific objectives consisted in:

- develop sorts of hydroxyapatite-based ceramic powder (min. 95% HAP);
- characterization of HAP ceramic powders: XRD; FT-IR and SEM measurements;
- develop and characterization experimental lot of HAP ceramic powder (45-63μm granules);

Phase 4: ***"Testing in vitro for experimental models of cranial implant"***

The main objective: to assess the biocompatibility of experimental models of cranial implant, by in vitro tests. Specific tests of microbial loaded (sanitation/ sterility tests), citotoxicity tests by agar diffusion tests performed on L929 cells, and that, MTS viability tests performed on two types of cells (L929 and Mg- 63), were carried out.

RESULTS AND DISCUSSIONS

Phase 1: **"Optimization experimental model of synthetic bone for repairs in neurosurgery"**

1. optimization of % dispersant

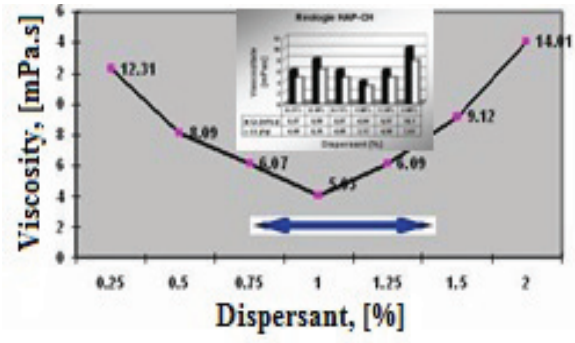


Fig.1. Optimal proportion of the dispersant of the HAP ceramic powder, calcined at 1100˚C-4h

➢ *Optimal proportion of the dispersant: 0,7-1,5%, for apparent viscosity, min.5-6mPa.s*

2. reology optimization of HAP slurry

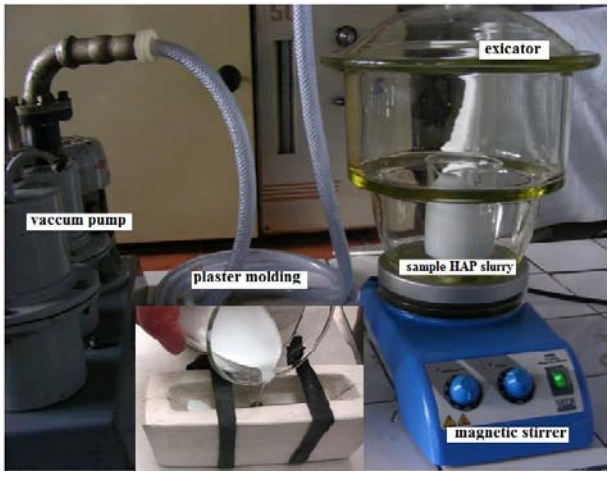
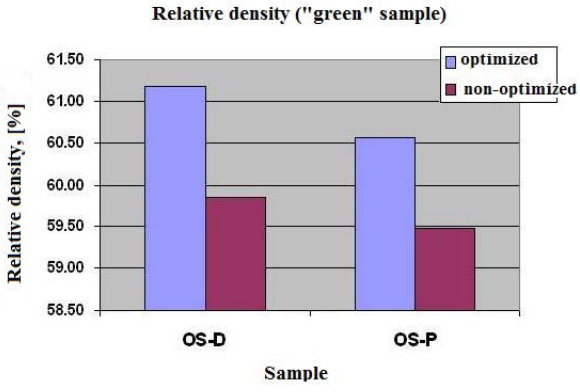


Fig. 2. Synthesis procedure of EM and deaeration installation of ceramic slips with vacuum system

3. optimization of slip casting technique



➢ *molded products with green density min. 50% of the ρ_{th}*

4. optimization of EM

- experimental models prepared: dense (OS-D) and porous (OS-P)

Sample	Tsint [°C]	P_T [%]	Strength [MPa]
OS- DO	1300°C-2h	18,12	57,43
OS- PO	1250°C-2h	28,75	26,14

- slurries concentration: 69%;
- dispersant: 0,7 ÷ 5%; Porogen: 1,5% (NH_4HCO_3)

➢ *develop optimized EM, with 20-40% porosity and mechanical strength, min. 40MPa.*

Phase 2: ***"Development and characterization experimental model of cranial implant"***

- Materials used:

- HAP ceramic powder (min. 95% HAP), calcined at 1100°C - 4h;
- Dispersant (Na-PAA): 1-1.50% HAP
- *Manufacturing technique:* plaster molding of HAP ceramic slips.

Fig. 3. Experimental model of cranial implant prosthesis with the average thickness of ~ 3.5mm

Characterization of EM: XRD; IR; SEM

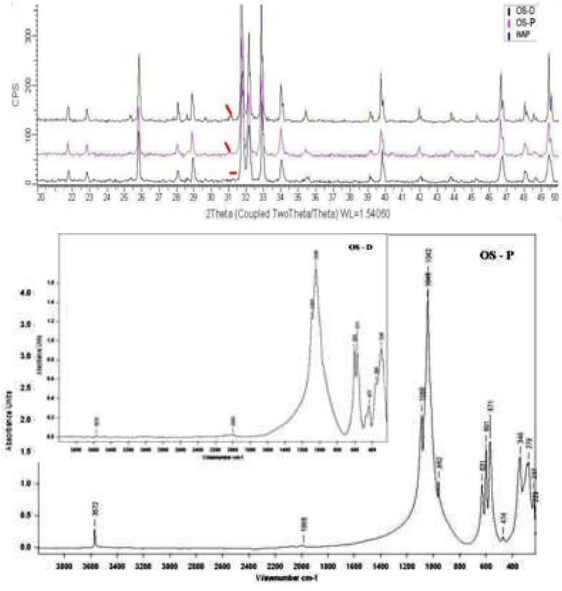


Fig. 4. DRX and FT-IR spectra for EM of cranial implant

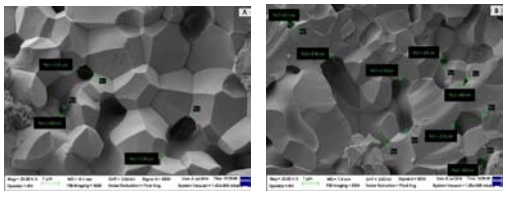


Fig 5. SEM imagage of EMs (A: OS-D; B: OS-P), x 20.000

Tabel 1. Average values of mechanical strength for sintered EMs

Bending strength, [MPa]		Compression strength, [MPa]	
Semple		Semple	
OS - D	~55	**OS - D**	~ 46
OS - P	~32,50	**OS - P**	~ 33

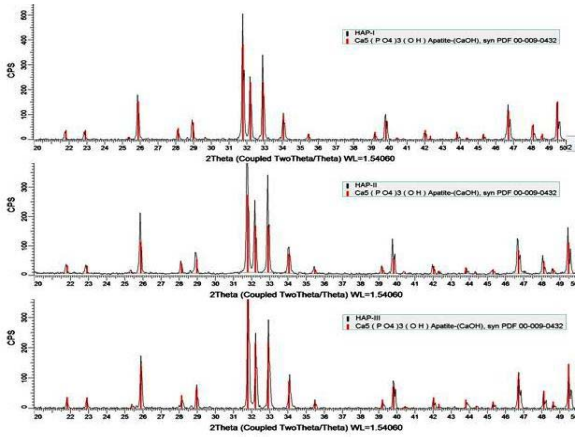
In conclusion, experimental models show average values of mechanical resistance according to the value expected for the proposed application, and in accordance with the value disclosed in the literature.

Phase 3: ***"Develop and characterization HAP ceramic powder for manufacturing of cranial implants, by rapid prototyping technique (RP)"***

Table 2. HAP ceramic powders prepared

HAP ceramic powder	Preparation
HAP - I	- calcined: 950°C - 1h / grinding/sieving (45- 63μm)
HAP – II	-calcined: 1125°C - 4h grinding/ sieving
HAP - III	- calcined: 1125°C - 4h / grinding/sieving

Ceramic powder HAP, characterization: XRD, FT-IR



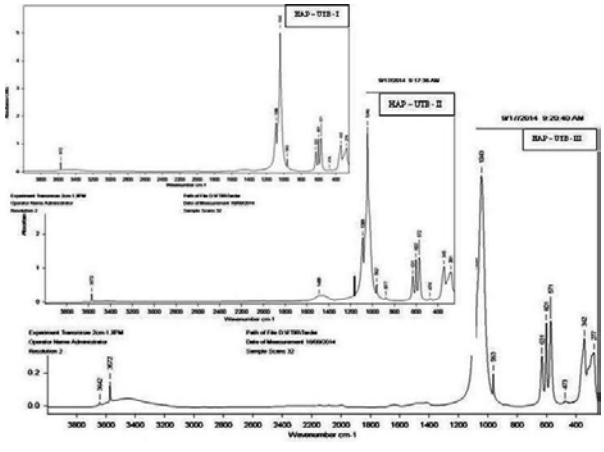
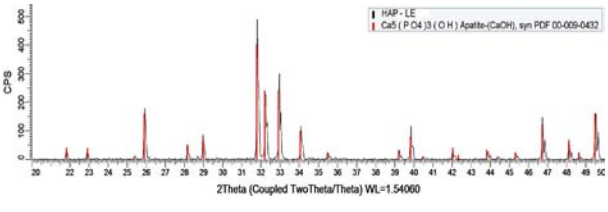


Fig. 6. DRX and IR spectra of experimental HAP ceramic powders (HAP I-III), calcined at 1125°C

Experimental Lot making (HAP – LE)

Features of Experimental Lot (HAP-LE)



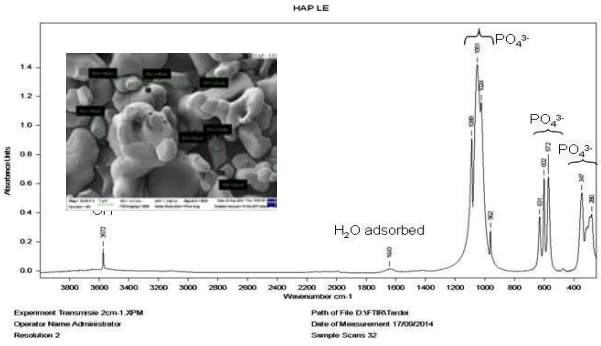


Fig. 7. DRX, IR and SEM spectra of HAP – LE

➢ was developed HAP-LE, 45-63μm beads with flow density $\rho = 0.3636 g/cm^3$

Phase 4: ***"Testing in vitro for experimental models of cranial implant"***

Experimental Models assesed (ME):

- experimental model with high density (P_T ~ 10%), called *OS-D;*
- Experimental model with low density (porous) (P_T = max. 26%), called OS-P.

1. Tests of sanitation/sterility

According to the results (reports presented attached) test samples show an obvious biocompatibility feature, environments being microbiologically sterile and showing an absence of pathogenic biological agents, classified according to HG 1092/2006.

2. Cytotoxicity assays

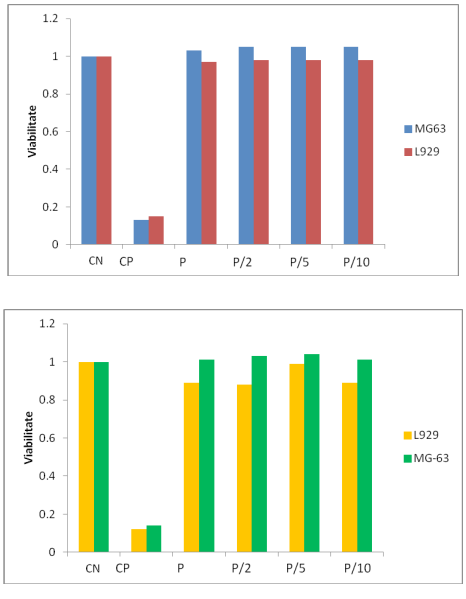


Fig. 8. The viability of L929 and MG-63 cells, treated and untreated with the extract of the materials OS-D/ OS-P (CN - negative control; CP - positive control; P - undiluted sample extract; P/2 - sample extract diluted twice; P/5 - sample extract diluted five times; P/10 - the sample extract 10-fold diluted)

In conclusion, the results obtained show that the tested products (OS-D/OS-P) did not show cytotoxic effects, in contact with both L929 and MG-63 cells does not induce changes in the their viability compared to negative control.

CONCLUSIONS

Experimental models of "synthetic bone" and respectively cranial implant through slip casting technique of HAP ceramic slurries, were made and characterized. Experimental models have been tested for physico-mechanical and biological characteristics (biocompatibility), and presents:

- HAP as major phase, without byproducts of decomposition (unwanted);
- Values of total porosity (P_T = 15-30%) by controlling the molding process, and changing in heat treatment process;
- Mechanical characteristics: OS-D, maximum values of 70,45MPa and respectively, 63,50MPa comparable with data from the literature for similar process

REFERENCES

[1] R. Stefini, G. Esposito, et.al., *Use of "custom made" porous hydroxyapatite implants for cranioplasty: postoperative analysis of complications in 1549 patients*, Surg Neurol Int 2013, 4:12

[2] E. Neovius*, Th. Engstrand, *Craniofacial reconstruction with bone and biomaterials: Review over the last 11 years*, Journal of Plastic, Reconstructive & Aesthetic Surgery (2010) 63, 1615-1623.

[3] Derrick C. Wan, M. D. Kwan, A. Kumar, J.P. Bradley, M.T. Longaker, *Craniofacial surgery, from past pioneers to future promise*, J Maxillofac Oral Surg 2009 8(4):348–356

[4] I. Z. Rodríguez, G.S. Aniceto, J.J. Montalvo Moreno, *Cranial reconstruction with biomaterials. Historical revision and current state,* Rev Esp Cir Oral y Maxilofac 2007;29,2:79-89;

[5] G. Staffa , A. Barbanera, et. al., *Custom made bioceramic implants in complex and large cranial reconstruction: A two-year follow-up*, Journal of Cranio-Maxillo-Facial Surgery 40 (2012) pp. 65

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Innovative nanostructured materials and coatings with antimicrobial activity for medical applications INMATCO

ABSTRACT

The main objective of the project is to research, develop and implement in production of some innovative nanostructured materials and coatings with antimicrobial activity for biocidal functionalization of some critical surgical instruments to reduce surgical site infections and to improve quality of life. In Stage I/2014 a documentary study on technical and scientific assessment of known methods for achieving antimicrobial nanostructured materials and coatings was developed, functional models of graphite moulds for obtaining sputtering targets by spark plasma sintering were designed and realized, experimental models of sputtering targets were achieved and the project website was created.

INTRODUCTION

Microbial adhesion to a specific substrate, followed by its colonization and biofilm formation may have a negative impact in many fields, from the industrial to the medical one [1]. The biofilm is defined as a community of microbial cells irreversibly attached to a substrate, to an interface or to each other, embedded in a polymer or exopolysaccharide matrix produced by these cells [2, 3]. Microbial biofilms are involved in the generation of chronic, persistent, difficult to treat infections, consecutively to biofilm formation on tissues or medical devices [1], [4-8]. At present it is intended to develop new medical devices with modified surface to reduce microbial adhesion and the ability to produce biofilms, as well as local incorporation of some antimicrobial agents to prevent colonization. Inorganic

metal oxides antimicrobial coatings (MeONPs = ZnO, TiO_2, MgO, CaO, etc.) are very promising for biomedical applications, since these oxides contain essential mineral elements for humans [9]. Nanocomposite films composed of metal nanoparticles (MeNPs = Ag, Cu, etc.) embedded in MeONPs matrices or MeNPs films deposited on MeONPs films are of great interest due to their special functional properties combined with antimicrobial and antibiofilm properties [10]. The aim of Stage I/2014 was to carry out industrial research activities, which correlated with subsequent experimental development activities will lead to the development of critical surgical medical instruments of stainless steel functionalized with antimicrobial nanostructured coatings of MeNPs/MeONPs to prevent or reduce adhesion and microbial biofilm development, thereby reducing the risk of surgical site infections and to improve quality of life.

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EXPERIMENTAL

In Stage I/2014 of the project were achieved the followings:

- documentary study on technical and scientific assessment of known methods for achieving antimicrobial nanostructured materials and coatings of MeNPs/MeONPs (Me = Ag, Cu; MeO = ZnO, TiO_2, CaO, MgO) type;
- design and realization of functional models of graphite moulds for obtaining some sputtering targets of 50.8 mm diameter by spark plasma sintering (SPS);
- realization by SPS process of experimental models (EMs) of sputtering targets of diameter 50.8 mm and height 2-3 mm from Ag, Cu, ZnO and TiO_2 nano/microcrystalline powders using a SPS installation of HP D25 type (FCT Systeme GmbH, Germany);
- mechanical characterization of sputtering targets (nanoindentation tests to determine Vickers hardness, Young's modulus and elastic contact stiffness of the investigated samples, using Oliver&Pharr calculation method and Micro Combi Tester equipment with nanoindentation module (NHT) and Berkovich diamond indenter (CSM Instruments, Switzerland);
- selection of stainless steel substrate for medical applications;
- mechanical characterization of the selected stainless steel substrate (nanoindentation tests with Micro Combi Tester equipment with nanoindentation module (NHT) and Berkovich diamond indenter (CSM Instruments, Switzerland) and tests for determining the flexural strength by three-point bending method with LFM 30 kN equipment (Walter & Bai AG, Switzerland));
- creating and updating the project website.

RESULTS AND DISCUSSIONS

Based on the literature data a documentary study on the technical and scientific assessment of known methods for achieving nanostructured materials and coatings of MeNPs/MeONPs (Me = Ag, Cu; MeO = ZnO, TiO_2, CaO, MgO) type with antimicrobial activity was carried out. The study consisted of over 70 references and highlighted technical and economic aspects for various physical (PVD) and chemical vapour (CVD) or solutions deposition methods. The following methods were described briefly: thermal evaporation, electron beam physical vapour deposition (EBPVD), cathodic arc deposition (Arc-PVD), during current (DC) and radio frequency (RF) magnetron sputtering deposition, chemical vapour deposition assisted by plasma, organic-metal sol-gel method with metal alkoxides in organic solvents and inorganic sol-gel method with metal salts in aqueous solutions (chlorides, oxychlorides, nitrates, etc.). The study showed features of each method, along with their advantages and limitations, being identified working parameters and requirements that have to be accomplished by metallic and ceramic sputtering targets. A graphite mould for obtaining sputtering targets of 50.8 mm diameter by SPS process was designed and the execution drawings

of the SPS mould containing a die, two punches and two centering pieces were elaborated (MSPS-50.8 code). Based on the elaborated execution drawings, three sets of functional models of high density graphite moulds for obtaining sputtering targets of 50.8 mm diameter were achieved by turning (Fig. 1). Demonstration of moulds functionality was realized by performing experimental tests with the SPS installation of HP D25 type at various working programs.

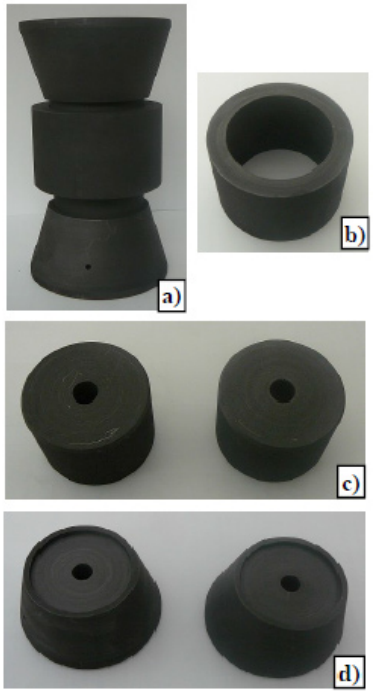

Fig. 1. Functional model of graphite mould: a) SPS mould assembly, b) die, c) punches, d) centering pices

Six experimental models (EMs) of sputtering targets of 50.8 mm diameter and 2-3 mm height of Ag (ME1), Cu (ME2), ZnO (ME3, ME4) and TiO_2 (ME5, ME6) were achieved by SPS process in vacuum.

As a result of the nanoindentation tests for the EMs of targets, Vickers hardness values of 86-313 HV, Young's modulus of 35-143 GPa and elastic contact stiffness of 0.26-0.68 mN/nm were achieved (Table 1), which depended on the material type and processing parameters of the targets. For ZnO targets, the literature states that a Vickers hardness >150 HV provides high mechanical strength, so that targets can be used in sputtering installations without the risk of cracking during the process [11].

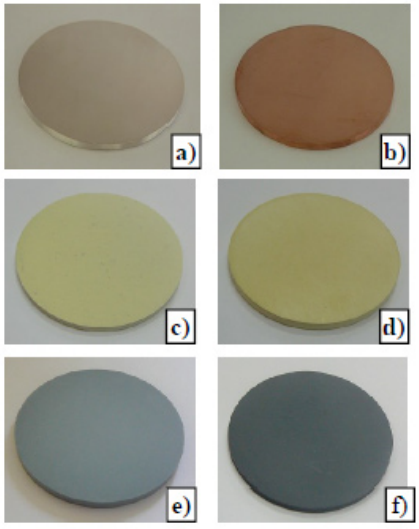

Fig. 2. EMs of sputtering targets obtained by SPS: a) EM1 - Ag target, b) EM2 - Cu target, c) EM3 - ZnO target, d) EM4 - ZnO target, e) EM5 - TiO_2 target, f) EM6 - TiO_2 target

Table 1. Results obtained from the nanoindentation tests for the EMs of sputtering targets samples

Sample (target material)	Mean Vickers Hardness HV_{mean}	Mean Young's modulus E_{ITmean} [GPa]	Mean elastic contact stiffness S_{mean} [mN/nm]
EM1 (Ag)	163 ± 28	59 ± 24	0.39 ± 0.13
EM2 (Cu)	190 ± 34	109 ± 13	0.64 ± 0.04
EM3 (ZnO)	167 ± 21	55 ± 4	0.37 ± 0.02
EM4 (ZnO)	240 ± 20	92 ± 10	0.49 ± 0.04
EM5 (TiO_2)	136 ± 50	88 ± 24	0.59 ± 0.06
EM6 (TiO_2)	220 ± 93	120 ± 23	0.64 ± 0.04

Based on the literature study and the indications specified in ASTM A240: 2009 standard for stainless steels used in dental and surgical instruments manufacturing, an austenitic stainless steel of 316L grade/1.4404 and a martensitic stainless steel of 420 grade/1.4021 was selected as a substrate.

The selected stainless steel samples that were mechanically tested showed values of flexural strength of 1274 MPa and 1712 MPa, respectively, and Vickers hardness of 495 ± 69 HV, and 513 ± 66 HV respectively, values which indicates a hardened state of the steels.

In order to disseminate the project results on a large scale and to increase the project international visibility, the project website was created and updated, which can be accessed at:

http://www.icpe-ca.ro/lib/files/inmatco.pdf

CONCLUSIONS

All activities and objectives of Stage I/2014 were accomplished, yielding the following results:

1) documentary study on methods for obtaining antimicrobial nanostructured materials and coatings of MeNPs/MeONPs (Me = Ag, Cu; MeO = ZnO, TiO_2, CaO, MgO) type;

2) execution drawings for graphite moulds for obtaining sputtering targets of 50.8 mm diameter by SPS;

3) three sets of functional models of high-density graphite dies;

4) six experimental models of Ag, Cu, ZnO and TiO_2 sputtering targets of 50.8 mm diameter and 2-3 mm height with the most Vickers hardness values higher than the ones for the commercial sputtering targets;

5) project website:

6) stage report.

Researches on obtaining antimicrobial coatings on stainless steel substrate for critical surgical instruments are still in incipient phase in the worldwide, in literature being few references in this respect, the most depositions being performed on small flat substrates of glass, plastics, Si, Ti, etc.

REFERENCES

[1]. P. Kaali, E. Strömberg, S. Karlsson, *Prevention of biofilm associated infections and degradation of polymeric materials used in biomedical applications*, Pub. In Tech., 2011, pp. 513-540.

[2]. V. Lazăr, *Aderenţă microbiană*, Ed. Academiei Romane, 2003, pp. 17-24, 24-50, 88, 91, 92, 165.

[3]. V. Lazăr, M.C. Chifiriuc, *Medical significances and new therapeutical strategies for biofilm associated infections*, Romanian Archives of Microbiology and Immunology, vol. 69, issue 3 (2010), pp. 125-138.

[4]. R.M. Donlan, J.W. Costerton, *Biofilms: survival mechanisms of clinically relevant microorganisms*, Clin. Microbiol Rev, vol. 15 (2002), pp. 167-193.

[5]. R.M. Donlan, *Biofilms and device-associated infections*, Emerg. Infect. Dis., vol. 7 (2001), pp. 277-281.

[6]. R.M. Donlan, *Biofilms: microbial life on surfaces*, Emerg. Infect. Dis., vol. 8 (2002), pp. 881-890.

[7]. R.M. Donlan, *Role of biofilms in antimicrobial resistance*, ASAIO J., vol. 46 (2000), pp. 47-52.

[8]. M.C. Chifiriuc, G. Mihăescu, V. Lazăr, *Microbiologie şi virologie medicală*, Ed. Universităţii din Bucureşti, 2011.

[9]. J. Panigrahi, D. Behera, et.al., *Radio frequency plasma enhanced chemical vapor based ZnO thin film deposition on glass substrate: A novel approach towards antibacterial agent*, Applied Surface Science, vol. 258 (2011), pp. 304-311.

[10]. D.H. Song, S.H. Uhm, S.B. Lee, J.G. Han, K.N. Kim, *Antimicrobial silver-containing titanium oxide nanocomposite coatings by a reactive magnetron sputtering*, Thin Solid Films, vol. 519 (2011), pp. 7079-7085.

[11]. M. Mesuda et. al., *Zinc oxide sintered compact, sputtering target, and zinc oxide thin film*, Patent Appl. US 20130214215 A1, Aug. 2013.

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Rationally designed coordination polymers as precursors for oxide nanomaterials

ABSTRACT

The project aims to develop rational synthetic strategies leading to novel metallosupramolecular architectures with pre-established structures by linking homonuclear alkoxo-bridged Zn(II) nodes into lattices with various polytopic organic ligands. ZnO particles will be obtained by the calcination of the synthesized Zn(II) coordination polymers.

INTRODUCTION

Coordination polymers consisting of alkoxo-bridged Zn(II) cores and pyridyl derivative spacers have not been reported so far. Therefore, in this project we intend to develop a novel class of Zn(II)-based coordination polymers, that will be further used to generate nanostructured ZnO materials.

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EXPERIMENTAL

Materials. Solvents and reagents were obtained from commercial sources and used as received.

Synthesis. All compounds were prepared by the reaction of different zinc salts (nitrate, acetate, perchlorate, etc.) with aminoalcohols and pyridyl derivatives.

Physical measurements. IR spectra were recorded on KBr pellets in the 4000-400 cm^{-1} range using a Bruker TENSOR 27 FTIR Spectrometer. PXRD diffractions patterns were recorded on a Bruker D8 ADVANCE difractometer. Single crystal XRD data were collected on a STOE IPDS II X-ray diffractometer. Thermal stability studies were performed with a Netzsch STA 409 PC Luxx® simultaneous thermal analyzer.

RESULTS AND DISCUSSIONS

Three new coordination compounds were synthesized: $\{[Zn(H_5BT)]_2(bipy)\}(NO_3)_4$ **1**, $\{[Zn(H_5BT)]_2(bpe)\}(NO_3)_4 \cdot 1.9H_2O$ **2**, $\{[Zn(H_5BT)]_2(azpy)\}(NO_3)_4$ **3** (H_5BT = Bis(2-hydroxyethyl)amino-tris(hydroxyl-methyl) methane, bipy = 4,4 -Bipyridine, bpe = 1,2-Di(4-pyridyl) ethylene, azpy = 4,4 -Azopyridine). All systems consist of binuclear centrosymmetric units $\{[Zn(H_5BT)]_2(L)\}^{4+}$ (L = bipy, bpe, azpy) and 4 nitrate anions (Fig. 1). The Zn···Zn separation in the binuclear unit is 11.05 Ă for **1**, 13.40 Ă for **2** and 13.04 Ă for **3**.

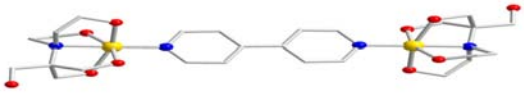

*Fig. 1. The binuclear unit in **1***

The thermal stability of **1**-**3** was investigated by thermogravimetric analysis. The TG, DTG, DTA and Gram-Schmidt curves for **1** are presented in Fig. 2.

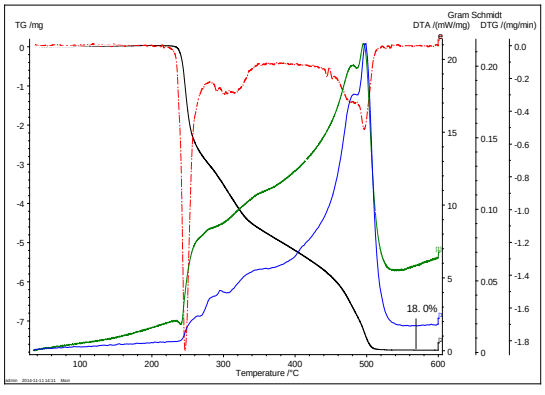

Fig. 2. TG, DTG, DTA and Gram-Schmidt curves for 1

The TG analysis revealed a series of weight losses in the 240-520 °C range, attributed to the elimination of bipyridine and amino-alcohol molecules. The decompositions is characterized by several peaks in DTG and DTA, respectively. The overall weight loss is consistent with the zinc oxide formation (exp.: 18%, caldc.: 17.2%).

CONCLUSIONS

Three new homonuclear Zn(II) coordination compounds have been isolated and characterized by XRD, FTIR, TG/DTG/DTA measurements.

The crystal structures revealed the formation of binuclear units. The TG/DTG/DTA curves present several peaks in DTG and DTA, respectively. The overall weight loss is consistent with the zinc oxide formation for all compounds.

REFERENCES

[1]. (a) R. W. Gable, B. F. Hoskins, R. *J.* Robson, *Chem. Soc., Chem. Commun.* **1990**, 1677; (b) B. F. Hoskins, R. Robson, *J. Am. Chem. Soc.* **1990**, *112*, 1546.

ACKNOWLEDGEMENTS

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Immunobiosensor for rapid detection of some carbamic residues (carbaryl, carbendazim) in horticultural products Project PN-II-PT-PCCA-2013-4-0128 (147/2014)

AbSTRACT

Immunobioesensors are sensors that use antibodies (Ab) or antigens (Ag) as the specific sensing element and provide concentration-dependent signals. They appear to be appropriate for identification of a single pesticide or, in some cases, small groups of similar pesticides in environmental monitoring, as they are rapid, specific, sensitive and cost-effective analytical devices (Mallat and Barcel´ o, 2001a). Furthermore, they can be used and interpret in the field by operators with minimal training and, generally, do not require sophisticated equipment to be accomplished. Therefore, developing such immunoassays has gained immense popularity during the recent years. Among these, immunochromatographic biosensors (ICBs) combine the highly sensitivity, rapidity and low costs of immunoassays with very high performance of chromatography for quantitative analysis. Furthermore ICBs can be easily used as reliable and rapid screening tests, thereby reducing the number of samples requiring confirmation by conventional methods (Liu 2013; Fan and He 2011).

In this context and in agreement with the 5.1.10 priority theme call, through this project, we intend to develop and validate high affinity antibodies against carbaryl and carbendazim/related molecules, synthesize nanoparticles/nanomaterials for biosensing application, and then to combine these compounds (developed antibodies with functionalised nanoparticles) in order to develop an experimental model of an immunobiosenzor for a carbamic pesticide detection (carbaryl / carbendazim) or a related pesticide molecule as a function of the antibodies respons obtained after hiperimmunisationof laboratory animals with imunogen compounds. The experimental immunobiosenzor / immunotest will be designed on the ideea of coupling antibodies-carbon/magnetic nanoparticles.

INTRODUCTION

Pesticides play a major role in improving agricultural production through control of pest populations such as insects, weeds, and plant diseases. The toxicological properties of pesticides that allow them the ability to control pests also provide potential risks to humans, to the environment, and to non-target organisms that might be inadvertently exposed to pesticides. Despite their merits, pesticides are considered to be some of the most dangerous environmental contaminants because of their ability to accumulate and their long-term effects on living organisms.

The concern about the presence of pesticide residues in water, soil, and food has prompted the search for alternative methods able to detect low levels of these compounds in a simple way. Biosensors offer great advantages over conventional analytical techniques, including high specificity for real-time analysis in complex mixtures, high sensitivity, simple operation without the need for extensive sample pre-treatment, and low cost (Liu 2013).

Immunobiosensors which can provide concentration-dependent signals, appear to be appropriate for

identification of a single pesticide or, in some cases, small groups of similar pesticides in environmental monitoring, as they are rapid, specific, sensitive and cost-effective analytical devices (Mallat and Barcel´ o, 2001a

The major challenge for immunobiosensors is the development of appropriate antibodies with desired specificity and high binding ability, as these critical biological reagents are usually requiring bio-medical labs with experience in immunoassays research and development. In most cases, antibody affinity and specificity are the limiting factors of these assays.

In this context, biosensing based on nanomaterials is one of the hottest topics in nanotechnology and nanoscience. Thus, in agreement with the 5.1.10 priority theme call, through this project is intended to **develop and validate high affinity antibodies against carbaryl and carbendazim / related molecules (***carbaryl and carbendazim are among the most frequently detected pesticide residues in food analyses worldwide***), synthesize nanoparticles/nanomaterials for biosensing application**, and then to combine these compounds in order to **set up** at least **one highly sensitive and reliable immunobiosensor** for rapid detection of such compounds in horticultural products (*e.g.* fresh and dried fruits and vegetables, horticultural processed products, wine and other beverages).

This project will exploit the unique properties of nanomaterials (carbon based and magnetic) which could offer excellent platforms as electronic and optical signal transduction to **design a new generation of biosensing devices**. The research result of this project will allow to industrial partner to tackle other markets, inside and outside Romania. The end-product of this project will come under international/national economical and food safety regulation providing compact analytical devices designed for biomolecular recognition. The introduction of sensitive, easy-to-use, and fast immunodetection tools and reagents for potential harmful pesticides detection in horticultural products will **really enrich the available tools for monitoring food pollutants,** improve the efficiency of the early warning systems related to the quality of food and feed, and leading to an evident positive impact on the quality of life and health, on a medium and long term basis

Research staff of the project

Dr. Eng. Hristea Gabriela – Project Coordinator, CS 1

Consortium:

Coordinator: National Institute for R&D in Electrical Engineering ICPE-CA (INCDIE ICPE-CA)

Partner 1: National Institute for Research and Development in Microbiology and Immunology "Cantacuzino" Bucharest (IC)

Partner 2: Research and Development Institute for Horticultural Products Processing and Marketing "HORTING"

Partner 3. BEIA CONSULT INTERNATIONAL, PARTNER SIEMENS

EXPERIMENTAL

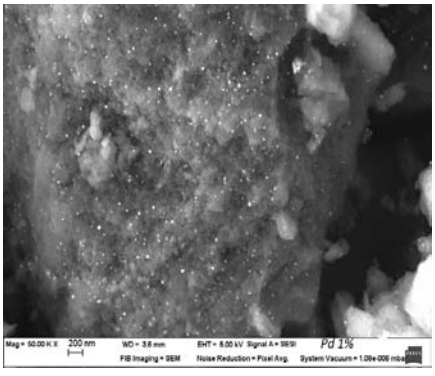
The main activities completed during 2014 had pointed out:

1. Carbon/magnetic nanoparticles synthesis-designed for intended application- experimental variants;
2. Selection and obtaining of complexes pesticide-proteine/ carrier;
3. Conceptual models development for immunogenic hapten-carrier complexes (coupling pesticide molecules with protein carriers – BSA, KLH, CSA);
4. Pesticide molecules for use as immunogens - experimental design.

RESULTS AND DISCUTION

During the first stage of this project have been obtained :

5 experimental variants of carbon xerogels dopped and un-dopped with metalc nanoparticles (Ni/Pd)



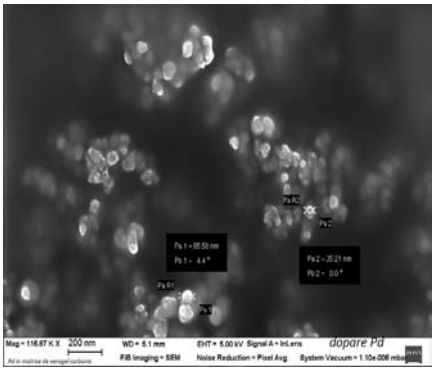


Fig.1. SEM image of an carbon xerogel variant dopped with Pd

2 experimental variants of exfoliated graphite and different coloidal suspensions based graphene oxide

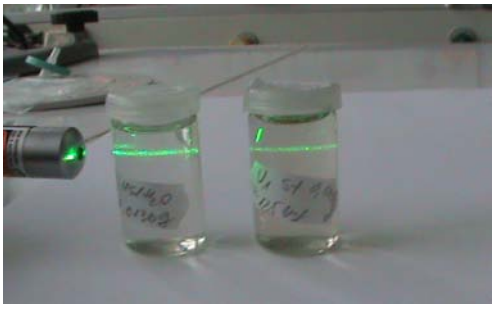


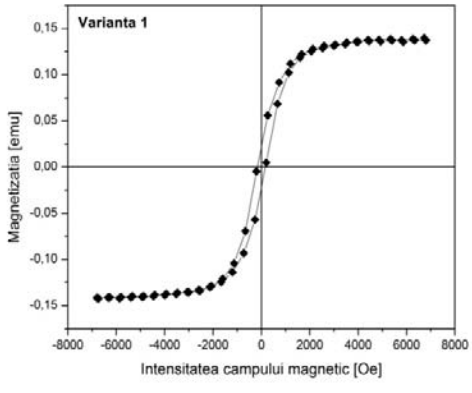
Fig. 2. Tyndal effect for obtained graphene oxides

o Carbon nanoparticles synthesis were conducted by swet chemistry methods (sol-gel mostly);

o Carbon nanoparticles has shown a surface area of 10-150 m^2/g (case of exfoliated graphitea) and around **100-800m^2/g (**case of carbon xerogels- habing as majoritary porous systems nicropores: pores with dimensions below 2 nm);

o Carbon nanoparticles have been analysed by surface area measurements, electronic microscopy, X-ray diffraction and FTIR;

o ***3 experimental variants of magnetic micro/ nanoparticles*** (maghemite/magnetite) obtained by: combined synthesis methods (sol-gel, controled hydrolisis and microemulsionation) of some oxidic nanoparticles based iron oxide; have been evidenced the ferromagnetic behaviour of obtianed nanoparticles: **Ms = 24-27 emu/g** at room temperature. Nanoparticles dimensions: **8-25 nm**; have been performed preliminary experiments to obtain an biocompatible fluorescent magnetic ompound; the magnetic compound consist in a stabilised magnetic core (entraped into a biocompatible polimer and an fluorescent pigment).



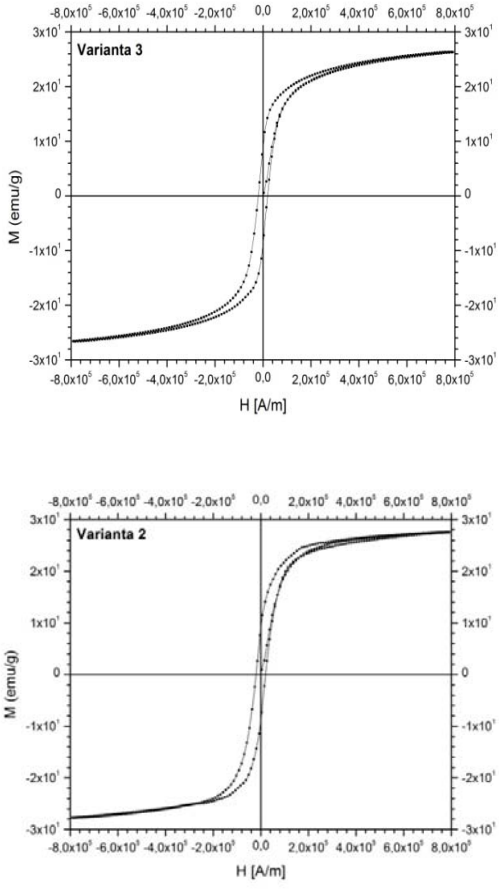


Fig. 3. Magnetic properties analysis for magnetic composites (magnetic nanoparticles –biocompatible polymer- fluorescent pigment)

- for immunogenic complexes type haptene carrier has been elaborated an conceptual model based on a working algorithm for selection of a chemical structure similar to carbendazim pesticide **(Metyil 2-benzimidazol-carbamate);**

- the alghorithm has been developed based ona a bibliographic analysis – using bioinformatic data base and technical data delivered by electronic libraries of recognised chemical/pharmaceutic companies.

Applying the working algorithm have been purchased 3 compounds with benzimidazolic structure and analysed UV-VIS spectra.

- **was obtained an immunogenic complex based on 2-(2-Aminoetyl) benzimidazole and seric bovine albumine;** by UV-VIS has been put in evidence the apparent molar ratio in resulted complexes of 10.

To induce monoclonal antibodies anti-haptenes has been elaborated two imunisation protocols helped by immunoadjuvants in lab animals with repetead inoculation in individual sites.

- has been designed web page of the project: http://www.icpe-ca.ro/lib/files/carbadetect.html and design

of the data base associated to the project: has been established data collecting architecture: software and hardware archtecture.

CONCLUZIONS

During the first stage of this project have been obtained:

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o Carbon nanoparticles have been analysed by surface area measurements, electronic microscopy, X-ray diffraction and FTIR;

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BIBLIOGRAPHY

[1]. Zhu J., Kase D., Shiba K., Kasuya D., Yudasaka M., Iijima S., 2003, "*Binary nanomaterials based on nanocarbons: a case for probing carbon nanohorns biorecognition properties*, Nano Lett. 3 (8), 1033–1036.

[2]. Ju H, Zhang X, Wang J, 2011, *NanoBiosensing: Principles, Development and Application. Biological and Medical Physics*, Biomedical Engineering, Springer Science+Business Media LLC, New York, pp 425-452

Research has been financed by National R&D&I Programme PNCDI II – Partnership in priority area, project no. PN-II-PT-PCCA-2013-4-0128, contract no. 147/2014 (4311/2014).

Innovative Materials and Processes for Selective Removal of Heavy Metals from Wastewater (HAP-CHIT-MAG)

ABSTRACT

The project inscribes in global humanity concern to ensure a good quality water, now, when pollution sources reached maximum level. The project proposes the development of new materials and innovative solutions for the removal of toxic heavy metal ions from wastewaters, and the opportunity to reuse water in the production process. Hydroxyapatite will be used for this purpose, because its crystal structure and chemical composition permit the penetration of heavy ions even at room temperature and shows a high capacity for ion exchange. The preparation technique has a significant effect on the powder morphology, specific surface, stoichiometry, and crystallinity.

INTRODUCTION

The presence of heavy metals in wastewaters and solid waste has become a problem due to its harmful effects on human health and to the fauna and flora of surrounding environment [1]. Conventional technologies for the removal of heavy metal ions from aqueous solutions include: ion exchange, chemical precipitation, reverse osmosis, electrochemical treatment, and adsorption [2]. All these technologies present both advantages and disadvantages. The most widely used method is adsorption due to its efficiency, low cost and simple operation and maintenance conditions. The most commonly used adsorbents are activated carbon, zeolites, clays, biomass and polymeric materials [3]. Some of these adsorbents are characterized by low sorption capacity, but also by the inconvenience regarding their separation. Therefore there is a need to develop new adsorbents with improved characteristics of surface area and performance in terms of selectivity and sorption capacity. A reliable method for the inertization of heavy metals consists of linking them as insoluble salts that can not be washed with water. For this reason, this project proposes to use the hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$ (HAP), obtained by traditional and nonconventional methods. The reason for choosing this ceramic compound is justified by its high ability to immobilize the contaminants, its high stability under oxidizing/reducing conditions, as well as its poor solubility in water [1, 4]. The project's aim is to develop novel materials (at nano- and micro-scale), obtained by solid phase synthesis, precipitation from aqueous solutions, and non conventional techniques such as sol-gel synthesis, with high selectivity, for removal/retaining heavy metals from wastewater.

Research staff of the project
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Petrache Mariana Tehn. pr.
Nicolaescu Elena - Tehn. pr.
Iancu Ionica - Tehn. pr.

EXPERIMENTAL

Stage 1: *„Strategies for obtaining nano/microparticles of hydroxyapatite, with shape, sizes and controlled porosity for heavy metal ions retaining".*

Were developed micro- and nano-structures as based adsorbent material, based on HAP ceramics compounds, by sintering techniques in solid phase (microcrystalline compounds), and unconventional techniques (precipitation from aqueous solutions, respectively, sol-gel) for the development of nano-ceramic powders. We aimed to obtain ultrafine powders with high specific surface, increased chemical reactivity and high sorption of heavy metals (Pb^{2+}) in synthetic aqueous solutions (for this phase of the project) and industrial wastewater. In order to characterize the experimentally obtained HAP ceramic powders, complex characterizations were performed. The purity of the compounds has been controlled by X-ray diffraction (XRD) and FTIR spectroscopy measurements. Thermal stability and kinetics of the formation of the compounds were evaluated by thermal analysis (TG/DTG + DTA). Morphology (shape and size of granules), by electron microscopy SEM. Specific adsorption measurements of heavy metals (Pb^{2+}) on HAP ceramic powders from synthetic solutions of lead salts were also performed.

RESULTS AND DISCUSSIONS

Retention capacity is related to the particular heavy metals (composition, microstructure, morphology, etc.) of the adsorbent material, the electric charge of the surface, the size and the specific surface area, thereof as demonstrated in the following two activities:

I. Experiments on the synthesis of HAP in the form of nano and microparticles

1. Development of nano-HAP

1.a. Development of nano-HAP (ammoniacal method)

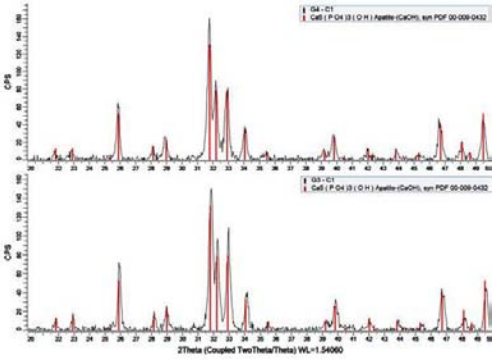

Fig. 1. XRD spectra of G3-G4 HAP powders calcined at 800°C-2h

➢ *The compounds synthesized in the conditions of pH = 10, at a reaction temperature of 60°C and calcined at 800°C are composed mainly of HAP, with a high degree of crystallinity.*

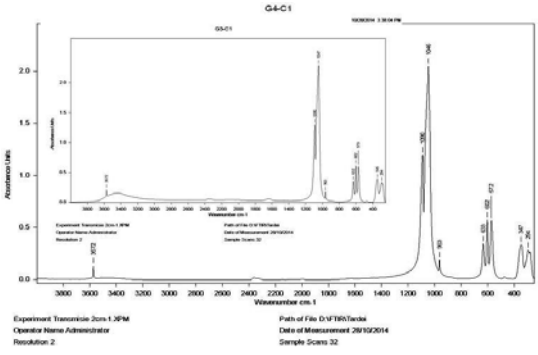

Fig.2. IR spectra of G3- G4 compounds calcined at 800°C-2h

➢ *Typically for all compounds are peaks at 1090; 966; 633cm^{-1}, characteristic for PO_4^{3-} groups; 3571-3574cm^{-1}, characteristic of OH^- group.*

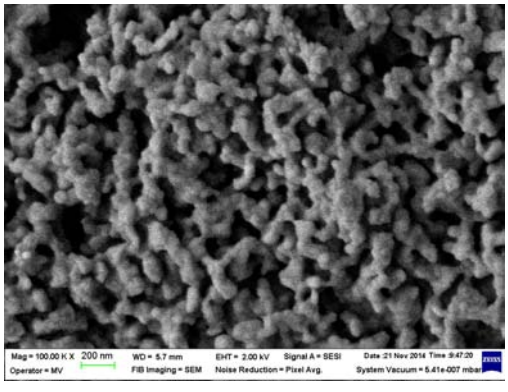

Fig. 3. SEM image of G4 compound, calcined at 800°C-2h, magnification, x100,000

➢ *Nanoscale microstructure: 30-60nm crystallite size, nano-porosity (20-85nm), homogeneous and evenly distributed.*

*1.b. Development of nano-HAP (sol-gel method, powder type **HSG**)*

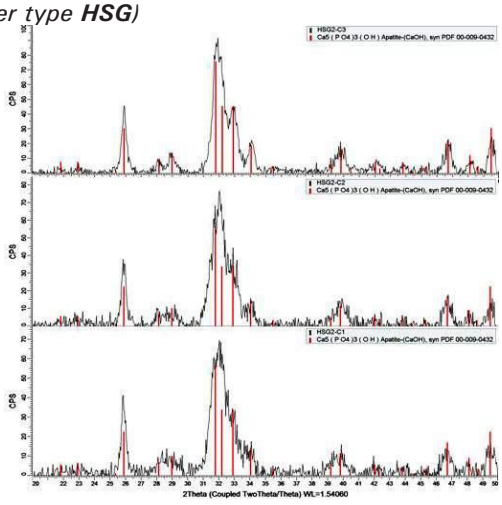

Fig. 4. XRD spectra of HSG-2, calcined at 200-600°C

- Synthesis conditions: pH = 9-10 and 24/48 hours aging time

➢ *The temperature of 600°C is enough for HAP formation, without decomposition or formation of secondary phases.*

Table 1. Physical characteristics of the compounds calcined at 400/600°C

Sample	Average size crystallite - nm, D[002]	Specific surface, [m^2/g]
HSG2-c2	27.60	68.79
HSG2-c3	28.85	65.81
HSG3-c2	23.05	82.37
HSG3-c3	24.27	78.23
HSG4-c2	24.43	77.72
HSG4-c3	23.66	80.25

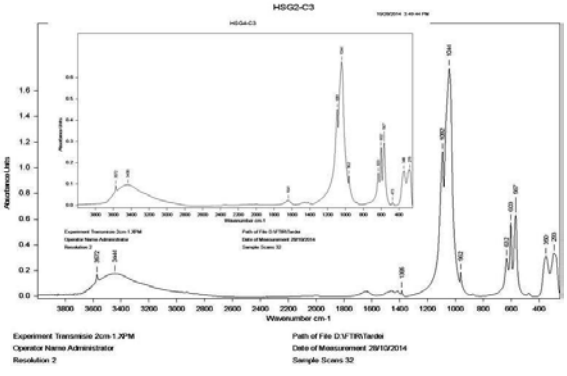

Fig. 5.IR spectra for HSG2 and HSG4 compound, calcined at 600°C-2h

➢ *Fig.5 shows all PO_4^{3-} and OH^- absorption bands characteristic for HAP; for PO_4^{3-} groups (1089-964cm^{-1} and 631cm^{-1}), for OH^- group (3571-3573cm^{-1})*

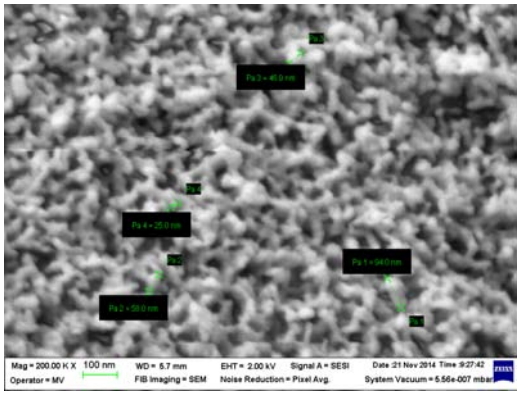

Fig. 6. SEM image of HSG4 compound, calcined at 600°C-2h, magnification, x100,000

➢ *Nanoscale microstructure: 25-94nm crystallite size, nano-porosity (20-45nm), homogeneous and evenly distributed.*

*1.c. Development of nano-HAP (sol-gel method, powder type **HAG**)*

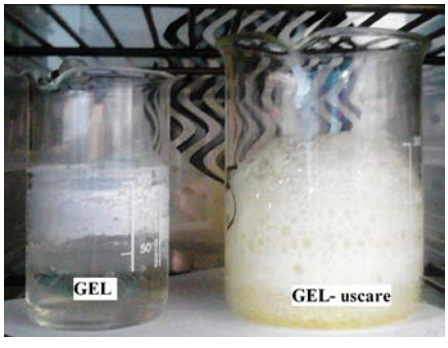

Fig. 7. Gels of HAG-1a, b in drying stage, 80°C-24h

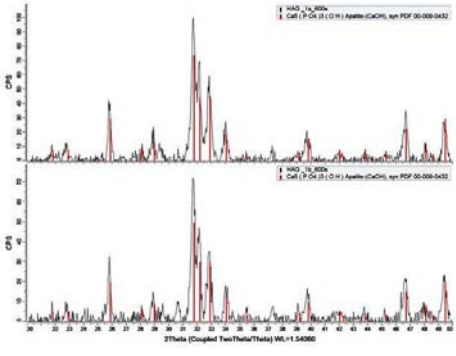

Fig. 8. XRD spectra of HAG-1a and 1b, calcined at 700°C-2h

Table 2. Physical characteristics of the compounds calcined at 600/700°C

Sample	D[211] (nm)	X_c	SSA
HAG_1a_600	58.45	0.65	32.48
HAG_1b_600	39.97	0.67	47.50
HAG_1a_600s	39.38	0.65	48.21
HAG_1a_700s	46.45	0.60	40.87
HAG_1b_700s	46.72	0.81	40.64

➢ *XRD patterns show only the presence of HAP; at 700°C occurs a peak specific β-TCP (beginning the decomposition of HAP)*

➢ *The proportion of crystalline phase (X_c) of HAP is between 0.65 and 0.81; specific surface area (SSA) is 32,48 - 48,21m^2/g.*

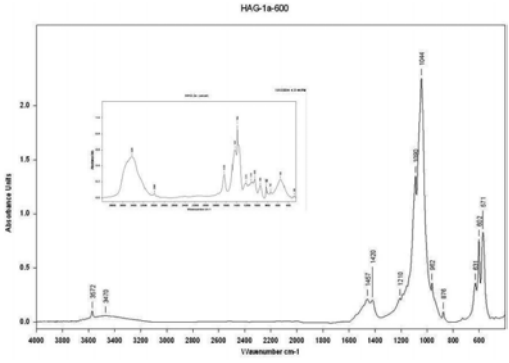

Fig. 9. IR spectra of HAG-1a, after drying and calcined stage at 600°C-2h

➢ *Absorption band from 3572-3573cm^{-1} specific for O-H, and symmetric stretch band of phosphate ion from 1088-1129cm^{-1} and 1037-1049cm^{-1} confirms the formation of HAP, in the samples treated at 600°C.*

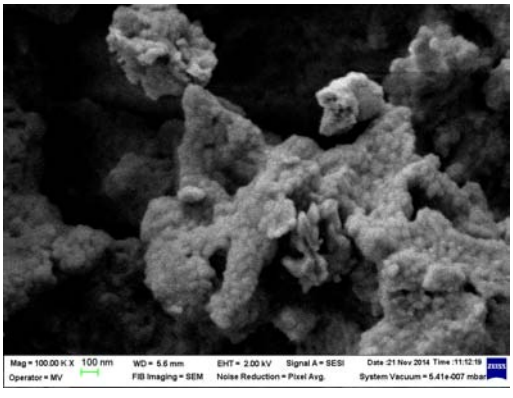

Fig. 10. SEM image of the gel sample (HAG-2a) calcined at 800°C

2. Preparation of microcristaline HAP powder (HAP-CH)

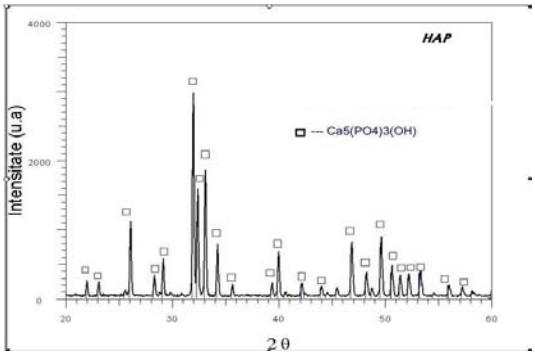

Fig. 11. XRD spectra of HAP-CH compound, sintered at 1150°C

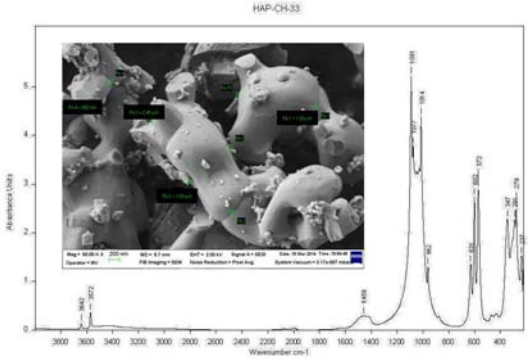

Fig. 12. SEM and IR spectrum of the compound HAP-CH-33

➢ *Characteristic peaks only for HAP with a higher degree of crystallinity; peak at ~ 1460cm^{-1} is characteristic for CO_3^{2-}, derived from working atmosphere.*

II. Experiments developing nano/micro HAP adsorbents, and determining uptake capacity for heavy metals from synthetic solutions. Part I

Experiment 1.

– micronic/ nano-HAP powders, ***S_{sp} = 2-11m^2/g***

- concentration of test solutions: 100mg/L

Experiment 2.

– micronic/ nano-HAP powders, ***S_{sp} = 2-11m^2/g***

- concentration of test solutions: 1000mg/L

Experiment 3.

–nano-HAP powders with ***S_{sp} = ~ (11-16) m^2/g***

- concentration of test solutions: 1000mg/L

Table 3. Retention capacity for Pb^{2+}

Experiment	**Pb^{2+} uptake, [%]**	
	HAP, [μm]	HAP-nano
Experiment 1	~ 2,5%	5-6%
Experiment 2	~ 2,5%	~ 30%
Experiment 3	-	(80/60) %

CONCLUSIONS

Micronic and nanometer size HAP powders were developed (d_{50} = 23 ÷ 47nm; SSA = 42 ÷ 82m^2/g), and tested as adsorbents for heavy metals; Preliminary experiments in testing the retention ability for heavy metals (Pb^{2+}) are highlighted the retention dependence of Pb^{2+} with the physicochemical and morphological characteristics of the HAPs adsorbents.

REFERENCES

[1] Mercedes Vila, Sandra Sánchez-Salcedo, María Vallet-Regí,Inorganica Chimica Acta, Volume 393, 2012, Pages 24–35

[2] Barakat, M.A., New trens in removing heavy metals from industrial wastewater, Arabian Journal of Chemistry 4 (2011), 361.

[3] Wan Ngah, W.S., Teong, L.C., Toh, R.H., Hanafiah, C*hemical Engineering Journal*, 223 (2013), 231-238;

[4] Tang, W-Q., Zeng, R.-Y., Feng, Y.-L., Li, X.-M., Zhen, W., Chemical Engineering Journal 223 (2013) 340-346;

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Direct laser printing of polymer-graphene composites - POLYGRAPH

ABSTRACT

The chemical engraving of the various surfaces with graphene is the hot topic of graphene and related graphene materials with great practical importance in electronics, sensors, field effect transistors, supercapacitors, optical and optoelectronic devices, etc. All these are due to their physical and chemical properties of graphene and graphene-polymer composites. The general objective of the project is to design and obtain a series of polymer-graphene composites by a new technique based on laser curing using a fs-IR laser.

Stage III/2014. *Obtaining polymer nanocomposites with functionalized graphene*

Activity III 4. *Reduction of graphite oxide by chemical method*

Activity III 5. *Synthesis of functionalized graphene*

Activity III 6. *Physico-chemical characterization of functionalized graphene*

INTRODUCTION

Graphene has emerged as a subject of enormous scientifically interest due to its exceptional electron transport, mechanical properties, and high surface area. It has attracted great attention as a reinforcement of polymers due to its ability to modify electrical conductivity, mechanical and gas barrier, properties of host polymers and its potentially lower cost than carbon nanotubes. Graphene films and composites have attractive electronic and optical properties, making them ideal for photonics and optoelectronics [1 – 4].

POLYGRAPH project proposes a new technique to develop graphene based polymers nanocomposite by IR fentosecond laser photo-polymerisation of nanomonomer/graphene system. The general objective of the project is to produce 2D and 3D structures of graphene based polymer nanocomposites by laser writing of monomer-graphene composite using a fs-IR laser.

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EXPERIMENTAL RESEARCH

Within the activities/2014, the P2 partner - ICPE-CA conducted laboratory experiments to obtain functionalized graphene (FGO) and reduced graphene oxide (RGO) obtained by in situ chemical synthesis. The aim was to use these solutions as additives in polymer nanocomposites obtained through a new technique by laser writing of monomer-graphene composite using a fs-IR laser.

RESULTS AND DISCUSSIONS

The aim of the *Activity III 4. Reduction of graphite oxide by chemical method* was to choose the optimal method of reducing the GO to be suitable for nanocomposites synthesis. Two types of chemically reduction methods of GO were experimented (Fig. 1). According to the objectives of this stage of the project six experimental models (EMs) were obtained: two EMs of chemically RGO and four EMs of FGO with Ag (Fig. 4). The obtained EMs were subsequently characterized by XRD and UV-Vis spectroscopy. The results are presented in Fig. 2, Table 1 and Fig. 3.

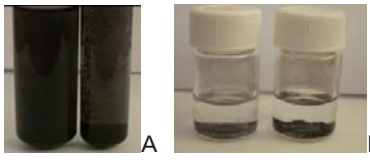

Fig. 1. RGO-$NaBH_4$ - reduced with 1:2 respectively 1:4 (wt. GO/wt. $NaBH_4$), imediately after the reduction (A) and after 48 hours (B)

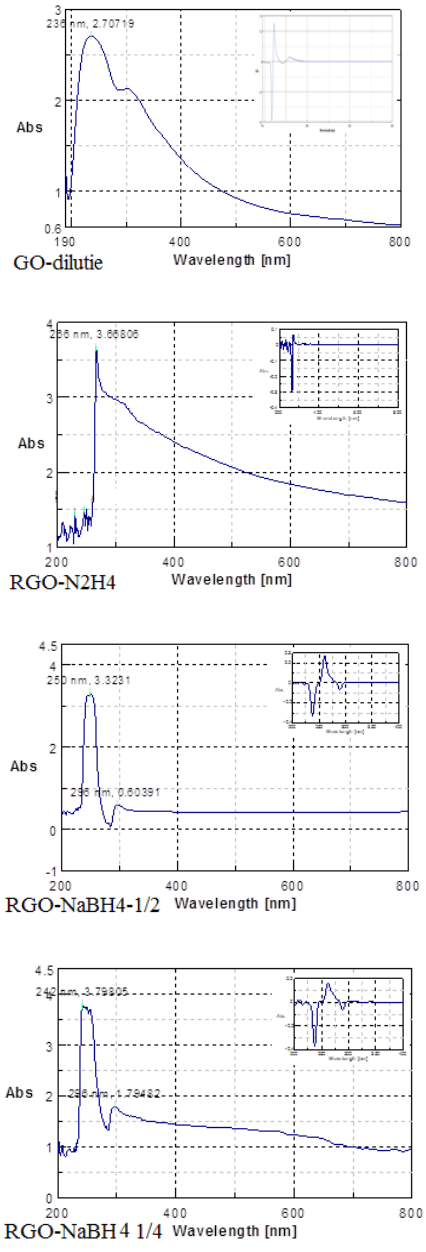

Fig. 2. Optical phonons of aqueous solution of GO and RGO reduced with different amounts of reducing agents and UV-VIS absorption spectra

Table 1. Maximum characteristic absorbtion of GO and RGO samples.

Samples	$A_{max}(\lambda)$ [a.u.]	$A_{max}(\lambda)$ [a.u.]
GO	$A_{(236)} = 2.71$	-
RGO1	$A_{(268)} = 1.36$	-
RGO2	$A_{(250)} = 3.32$	$A_{(296)} = 0.60$
RGO3	$A_{(242)} = 3.80$	$A_{(296)} = 1.70$

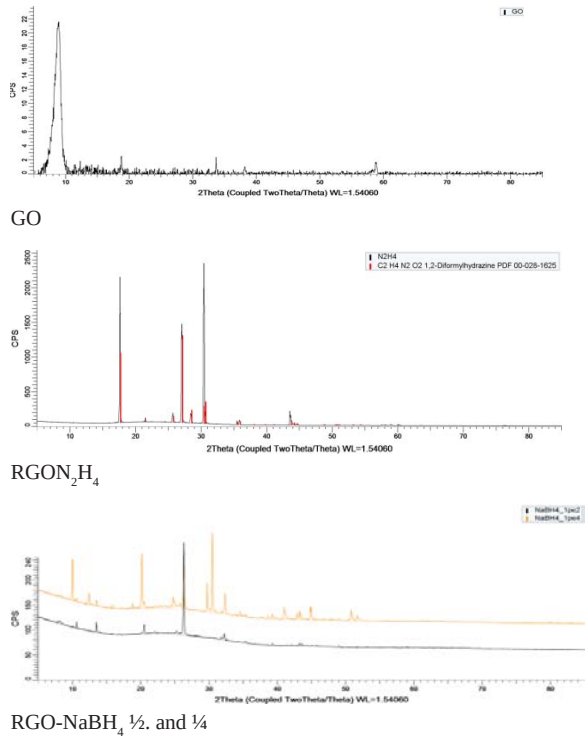

Fig. 3. XRD patterns of GO and RGO reduced with different amounts of reducing agents

The optimum reduction solution of GO to RGO was found to be $NaBH_4$ with mass ratio 1:2. This method was chose because the resulted RGO are suitable for the synthesis of homogenous nanocomposite materials producing a moderate reduction that prevents aggregation of the particles and in the same time is suitable for the synthesis of Ag nanoparticles by reduction of the silver salt.

The aim of the Activity III 5. *Synthesis of functionalized graphene* and Activity III 6. *Physico-chemical characterization of functionalized graphene* consisted in selecting the optimal method for the synthesis of functionalized graphene used in production of polymer nanocomposites by laser writing of monomer-graphene composite using a fs-IR laser.

The synthesis of functionalized graphene was done in situ. Four EMs of functionalized graphene were obtained with mass ratio 1/1 = GO / Ag^0, with two different concentrations of the additive (m1 and m2) and two functionalized graphene concentrations to the final volume (1 mg/mL and 0.28 mg/mL).

Fig. 4. Silver functionalized graphene from left to right coded LGF1-LGF4

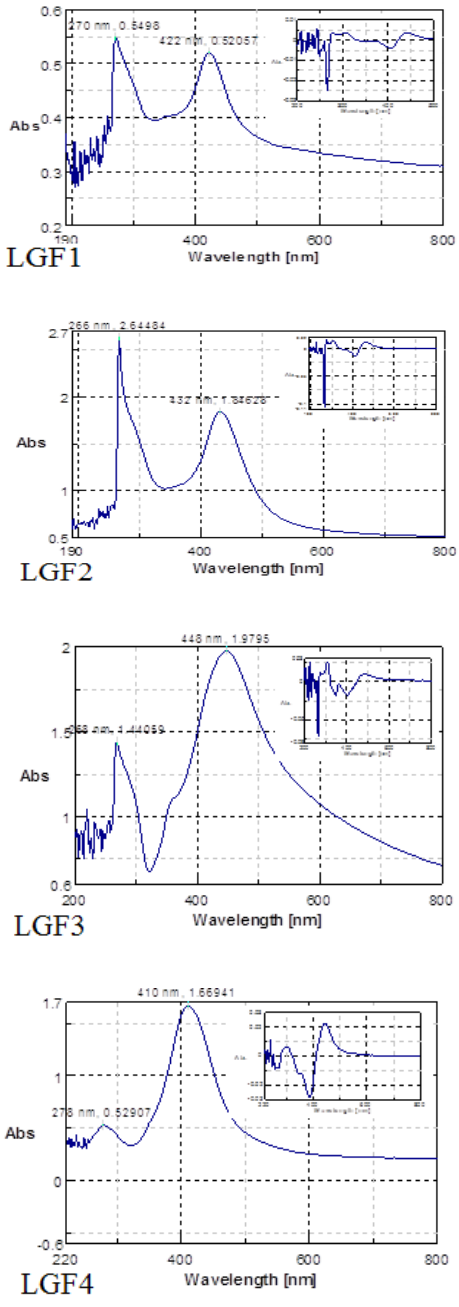

Fig. 5. UV-VIS absorption spectra of LGF1- LGF 4 solutions. In the inset the first derivative is presented

Table 2. – Silver functionalized graphene LGF1- LGF 4 - Maximum characteristic absorbtion.

Sample	$A_{max}(\lambda)$ [au]	$A_{max}(\lambda)$ [au]	$A_{(660)}$ [au]
LGF_1	$A_{(270)}$ = 0,55	A(422) = 0,52	0.32
LGF_2	$A_{(268)}$ = 1.36	A(432) = 1,15	0.54
LGF_3	$A_{(268)}$ = 1.44	A(448) = 1,98	0.93
LGF_4	$A_{(278)}$ = 0.53	A(410) = 1,67	0.25

The UV-Vis spectra of silver functionalized graphene (Fig. 5 and Table 2), present characteristic peak of graphene (~ 270 nm) and characteristic peak of Ag (390-450 nm).

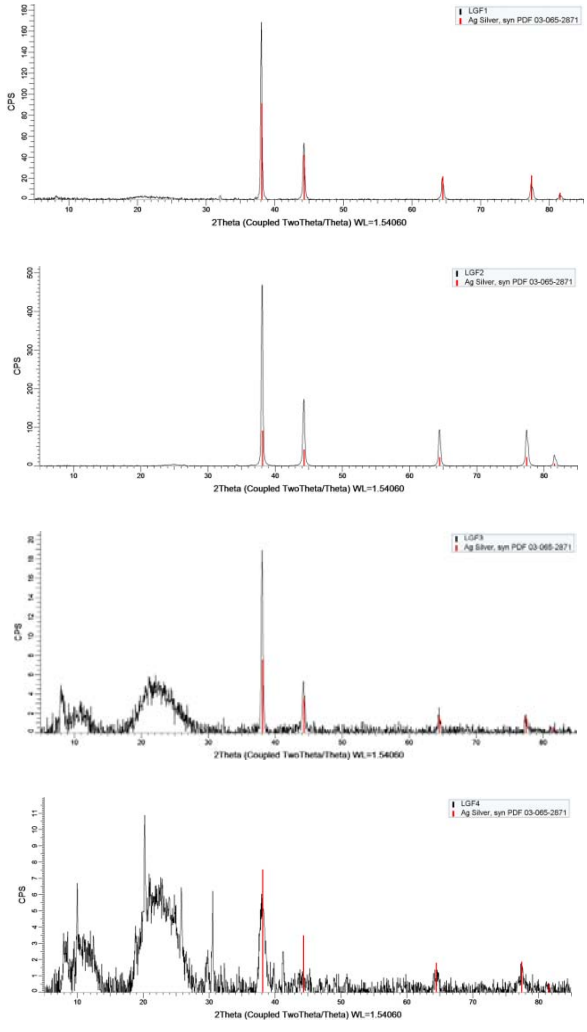

Fig. 6. XRD patterns of silver functionalized graphene LGF1-LGF4

XRD patterns of silver functionalized graphene LGF1-LGF4 shown in Fig. 6 present the characteristic peaks of silver (Ag-polycrystalline - PDF 03-065-2871, a = 4.08610) with crystallite dimension between 35 nm and 39.90 nm for Ag nanoparticles from LGF2 and LGF3, and 10.51 nm for LGF1 and LGF4.

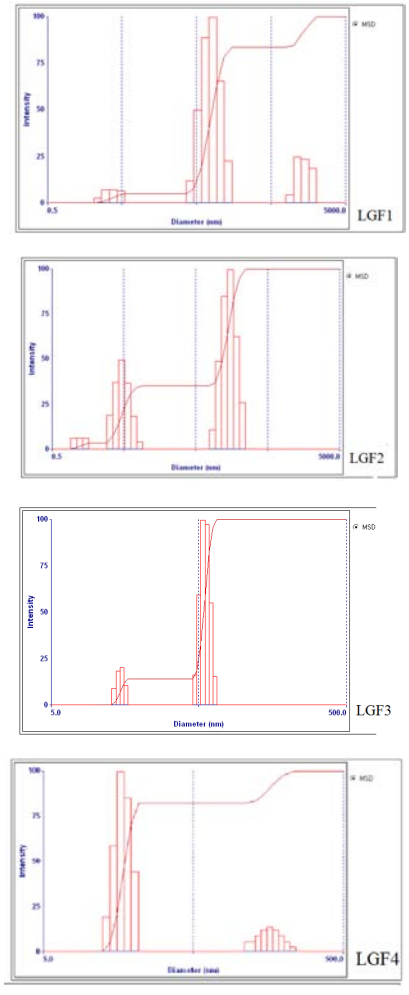

Fig. 7. Grain size distribution of silver functionalized graphene LGF1-LGF4

Table 3. Hydrodynamic diameter obtained by DLS measurements for silver functionalized graphene

Sample	Average hydrodynamic diameter, D_H [nm]	Polidispersity index
LGF_1	79.1 ± 1.3	0.264 ± 0.012
LGF_2	59.2 ± 3.9	0.396 ± 0.030
LGF_3	47.3 ± 2.7	0.296 ± 0.013
LGF_4	22.3 ± 1.9	0.142 ± 0.044

The hydrodynamic diameter obtained by DLS measurements for silver functionalized graphene ranged between 60-80 nm for the 1 mg/mL and 43.4-56.4 nm for 0.28 mg/mL.

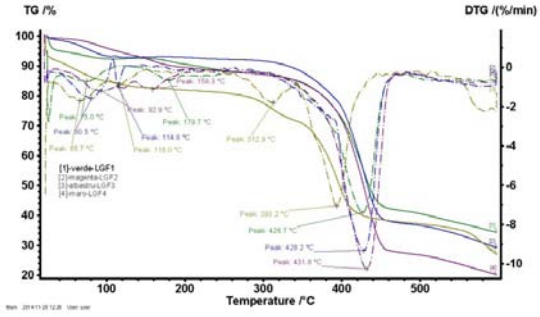

Fig. 8. TGA and DSC curves for silver functionalized graphene

The thermal stability of functionalized graphene was influenced by the composition variables during the synthesis. The highest thermal stability presented the LGF2 sample.

All the synthetised silver functionalized graphene present the mass loss around 100°C, determined by the evaporation of water (physical and chemical bonded), and another two mass loss deterrmined first by the thermal decomposition of oxigenated functional groups and the last thermal decomposition determined by the graphene skeleton aneling.

CONCLUSIONS

1. The optimum reduction solution of GO to RGO was found to be $NaBH_4$ with mass ratio 1:2 being compatible with silver nanoparticles synthesis.

2. At the highest concentration of 1 mg/mL the optimum composition solution was found to be LGF2 because it presents the smallest value of hydrodynamic diameter and crystallite size ($D_H = 59.2 \pm 3.9$ nm/ D = 35 nm).

3. At the smallest concentration of 0.28 mg/mL the optimum composition solution was found to be LGF3 ($D_H = 22.3 \pm 1.9$ nm / D = 10.51 nm) synthesis because it presents the smallest value of hydrodynamic diameter and crystallite size.

REFERENCES

[1] A. Fasolino, J. H. Los & M. I. Katsnelson. Intrinsic ripples in graphene. Nature Materials 6, 858-861 (2007).

[2] K. S. Novoselov, et al. Electric field effect in atomically thin carbon films. Science 306, 666-669 (2004).

[3] K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, M. I. Katsnelson, I. V. Grigorieva, S. V. Dubonos, A. A. Firsov. Two-dimensional gas of massless Dirac fermions in graphene. Nature, 438 197-200 (2005).

[4] Tapas Kuilla , Sambhu Bhadra, Dahu Yao, Nam Hoon KimSaswata, Joong Hee Lee. Recent advances in graphene based polymer composites. Progress in Polymer Science 35 (2010) 1350–1375.

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Permanent magnet with low rare earth [Composite materials with efficient mechanical properties]

ABSTRACT

The project aimed to obtain experimental models of permanent magnet with *hardening exchange interaction, obtained by special sintering and the characterization of these experimental models of composite materials by reducing the content of rare earth permanent magnets through nanostructuring.*

In order to match the fundamental research under ICPE-CA, the electrical engineering of performance materials aims to implement from the point of view of mechanical, electrical, and magnetic properties, for their use in various applications in electrical engineering.

INTRODUCTION

To achieve the project were proposed as objectives, concept and the achievement of the experimental models of permanent magnet with hardening exchange interaction (with the report B_r/B_s ≥0.65 and with Nd containing less 30%); structural and magnetic characterization of experimental models of permanent magnets.

The procedures for conducting took place in three phases as follows:

- stage 1/2014. Realization of experimental model of nanocomposite magnet with hardening exchange interaction obtained by special sintering;
- stage 2/2014. Realization and characterization of structural and magnetic experimental model of permanent magnet structures based on micronic/ nanometric;
- stage 3/2014. Realization of experimental model of permanent magnet based on ferromagnetic microwires - study of filling factor wth microwires on the magnetic properties.

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EXPERIMENTS

Following laboratory experiments carried out the first stage of this project, for achievement of the nanocomposite magnet experimental model with hardening interaction parts were obtained as follows:

- 6 experimental models in the form of samples based on rare earth - $Nd_2Fe_{14}B$ developed in several compositional variants, each of these compositional variations in several batches;
- 6 models of experimental in the form of microwires samples without rare earth developed in several compositional variations;
- 12 experimental models of magnets in the form of microwires embedded in the resin samples, 6 samples of alloys of Co and 6 samples of alloys of the Fe-B-Si.

RESULTS AND DISCUSSION

Results obtained in the case of microwires with low rare earth content.

Structural characterization (v. Fig. 1.1. Was made with a D8 Discover X-ray diffractometer (Bruker): Measurement conditions: optical Primary tube Cu (Cu Kα λ= 1,5406 Å) 40kV, 40mA, mirror Göbel 60 mm; detector: LynxEye PSD, mode 1D; parallel beam scanning, grazing incidence geometry to theta 1° GID, Bragg-Brentano geometry BB, 2Theta angular increment: 0.04.

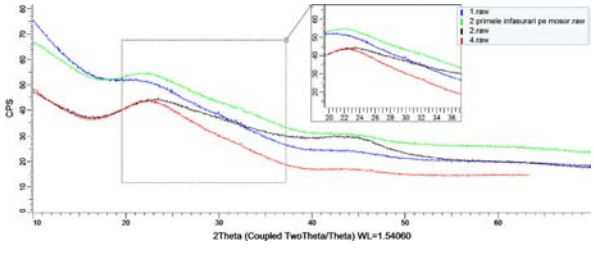

Fig. 1.1. Diffractograms for different technological choices microwires

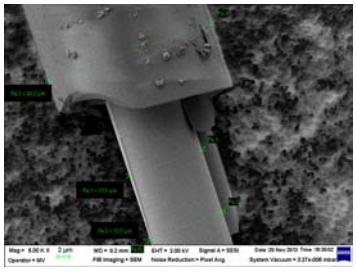

Fig. 1.2. SEM micrograph of microwires with low rare earth isolated glass, made at different magnifications

***Experimental results in case of the models of permanent magnet structures based on* micronic / nanometric**

Determination of active component from magnetic point of view (ferromagnetic core) (see Table 1.1.) It was carried out by optical microscopy by evaluating the filling and homogeneity degree of the active component in micro-images obtained.

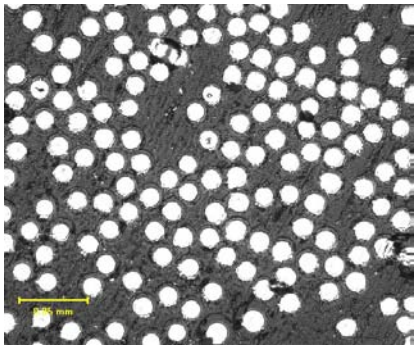

Fig. 1.3. Optical microscopy for sample 1 microwire magnet

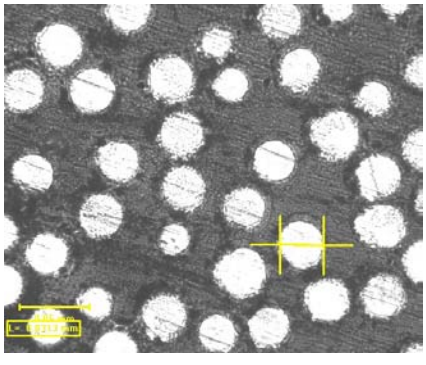

Fig. 1.4. Optical microscopy for sample 3 microwire magnet

Table 1.1. Evaluation report metal component / non-magnetic component

Sample code	% metal	% resin + glass
5kgP	21.22	78.78
10kgP	23.74	76.26
25kgP	25.32	74.68
5kgCC	21.28	78.72
10kgCC	24.27	75.73
25kgCC	29.71	70.29

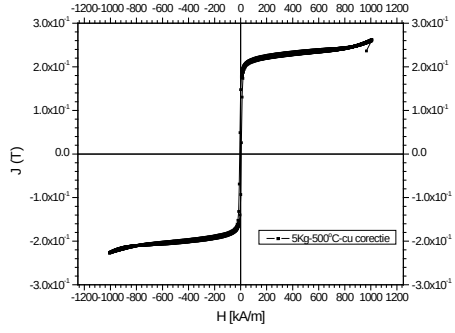

Fig. 1.5. Hysteresis cycle obtained on the sample 5kgP

Experimental models of permanent magnet based on micronic / nanometric structures were analyzed from magnetic point of view (Fig. 1.5 - Fig. 1.6.).

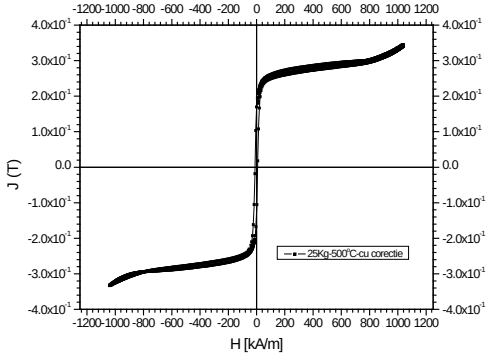

Fig. 1.6. Hysteresis cycle obtained on the sample 25kgP

From magnetic measurements we can see increases of the magnetic parameters (Br, HCJ $(BH)_{max}$ and J_s) with increasing compaction force of the microwires (Table 1.2.).

Table 1.2. Magnetic properties

Sample Cod	B_r [T]	H_{CJ} [kA/m]	$(BH)_{max}$ [kJ/m^3]	J_s [T]
5kgP	0.297	2.6	0.4	0.54
10kgP	0.375	3.94	0.3	0.651
25kgP	0.308	4.84	0.5	0.683
5kgCC	0.263	5.88	0.3	0.403
10kgCC	0.317	5.5	0.2	0.553
25kgCC	0.343	8.55	0.6	0.492

CONCLUSIONS

Experimental models have been made from composite materials with efficient properties, as follows:

- six samples of microwires based on rare earth alloys with eight samples based microwires without rare earth alloys; they have been structurally characterized by X-ray diffraction and Scanning microscope with a beam of electrons and magnetic fields by the vibrating sample magnetometer;

- it have been made and characterized structurally and magnetically four experimental models of permanent magnet based on micronic / nanometric structures.

In Table 1.2 are presented values of the magnetic properties of specimens characterized by hysteresis graph. Thus, it notes that were made to the retention values required for induction Br, coercivity Hc, respectively maximum energy product (BH) max.

- it have been made and characterized structurally and magnetically 12 experimental models of permanent magnet structures based on micronic / nanometric structures.

BIBLIOGRAFIE

[1] G. Hadjipanayis et al., *The Incredible Pull of Nanocomposite Magnets*, IEEE SPECTRUM, Aug. 2011;

[2] S. Kozawa, *Trends and Problems in Research of Permanent Magnets for Motors — Addressing Scarcity Problem of Rare Earth Elements*, Science & Technology Trends, Quaterly Review No. 38, 40 - 54, Jan. 2011;

[3] K.Hono, *Magnetic Property Control by Controlling Nano Tissues: (1) RE magnet materials*, Element Strategy Outlook, National Institute of Materials Science, Dec.31, 2007

[4] T. Schrefl et. al., *Exchange hardening in nanostructured two phases permanent magnets*, J. Magn. Magn. Mater., 127, L273-L277, 1993;

[5] T. Schrefl et al., *Two and three-dimensional calculation of remanence enhancement of RE based composite magnets*, J. Appl. Phys., 76, 10, 7053-58, 1994;

[6] M. Robbins, J. H. Swisher, R. C. Sherwood, Proceed. 16th Ann. Conf. Magnetism and Magnetic Materials, Miami, 1970;

[7] J. H. L. Watson, M. W. Freeman, Proceed. Conf. Magn. Magn. Mat., 1955, AIEE Spec. Publ., T-78, p. 150; 1956, Conference, T-91, p. 163; Kolloid Zeit., 148, 3, 1956.

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Superparamagnetic oxide nanoparticles (Fe3O4 and /γF2O3) for applications in magnetic ferrofluids based on vegetable oils [Device for CO2 detecting and retention]

ABSTRACT

Experimental research of the stage 3, Goal O1, targeted the development of laboratory experiments on the synthesis of superparamagnetic nanoparticles (Fe_3O_4 and /γFe_2O_3) by chemical solution methods (co-precipitation method, in four versions of synthesis). The obtained superparamagnetic Fe_3O_4 and /γFe_2O_3 nanoparticles showed an average particle size < 25 nm, spinel structure, and saturation magnetization (Ms) of 20-80 emu / g. In stage 4, Goal O1, laboratory experiments were carried out on steric stabilization of superparamagnetic Fe_3O_4 nanoparticles with different surfactants and on making stable suspensions in a vegetable oil as carrier liquid.

INTRODUCTION

Magnetic fluids have proven their outstanding properties in a variety of industrial and biomedical applications [1, 2].

Among the industrial applications of ferrofluids are: the linear and rotary seals as magnetic transformers, pressure sensors and transducers, inertial sensors (acceleration, inclination and gravity), active and passive bearings, vibration dampers, linear and rotary actuators, etc.

Preparing a magnetic fluid involves two steps: (1) the development of nano-sized magnetic particles and (2) subsequent dispersion of these particles in various liquids. The synthesis of superparamagnetic nanoparticles with controlled size presented a great scientific and technological interest. Reducing the size of iron oxide nanoparticles leads to new and unusual magnetic properties, of which superparamagnetism is the most important.

In the literature, various synthesis methods have been reported for the preparation of superparamagnetic nanoparticles which include ball milling [3], chemical precipitation [4, 5], thermal decomposition [6], the polyol method [7], microemulsion method [8], and the sonochemical method [9]. The purpose of this research work was to experiment the achievement of magnetic nanofluids based on vegetable oil.

In this regard, the following were aimed:
- stearic stabilization of superparamagnetic Fe_3O_4 nanoparticles with different surfactants;
- structural characterization (FTIR);
- determining the hydrodynamic particle diameter and size distribution by DLS method;
- development of stable suspensions by dispersing the stabilized Fe_3O_4 nanoparticles in vegetable oil as liquid carrier.

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EXPERIMENTAL

The superparamagnetic Fe_3O_4 and /γFe_2O_3 nanoparticles have been synthesized by chemical co-precipitation method, working in four modified versions of chemical co-precipitation method in solution:

- version I: chemical synthesis by coprecipitation of Fe^{2+} and Fe^{3+} ions in the aqueous solution in the presence of a base (NH_4OH) at a temperature of 85^0C;
- version II: synthesis throug partial reduction of Fe^{3+} in the presence of a reducing agent (d-glucose), followed by chemical co-precipitation of the Fe^{2+} and Fe^{3+} ions in aqueous solution in the presence of a base (NH_4OH);
- version III: the chemical coprecipitation of Fe^{2+} and Fe^{3+} ions using a non-stoichiometric ratio of ions (Fe^{2+}: Fe^{3+}) of 0.6: 1.1 in a basic medium and in the presence of a oleic acid - type dispersant;
- version IV: chemical coprecipitation of Fe^{2+} and Fe^{3+} ions in a stoichiometric ratio of 1:2, in the presence of polyvinylpyrolidone (PVP) as a dispersant.

The experiments elaborated within stage 4 targeted the development of magnetic nanofluids based on vegetable oil. It was tested a sunflower refined oil because it has high thermal stability, low siccative character, easy accessibility, low viscosity, compatibility with the optimal stabilization agent.

As magnetic phase, the superparamagnetic Fe_3O_4 nanoparticles obtained in step 3, by the method of chemical co-precipitation of the Fe^{2+} and Fe^{3+} ions in the ratio 0.6 : 1.1, in the presence of NH_4OH at pH = 11, were used.

In order to prevent agglomeration of the particles and to ensure the miscibility with the vegetable oil, Fe_3O_4 nanoparticles were sterically stabilized with surface active agents (surfactants) such as: oleic acid, lauric acid, tetraethoxysilane (TEOS).

RESULTS AND DISCUSSIONS

Oxide nanoparticles (Fe_3O_4 and /γFe_2O_3) obtained by the four synthesis versions were characterized in terms of structural (XRD, FTIR), morphological (SEM) and magnetic (VSM) properties.

In the synthesis version I case, the X-ray diffraction showed the formation of two phases - non-stoichiometric magnetite ($Fe_{2,9}O_4$) and maghemite Fe_2O_3 - due to the oxidative instability of Fe^{2+} ion in the presence of O_2 dissolved in the reaction environment.

In the synthesis versions II and IV, along with the non-stoichiometric magnetite phase ($Fe_{2,9}O_4$) or maghemite - hydrate form ($Fe_2O_3.H_2O$), a phase of impurities in the form of oxy iron hydroxide (FeO(OH)) was obtained.

X-ray diffraction pattern revealed for version III the formation of Fe_3O_4 oxide nanoparticles of spinel structure, crystallized in a face-centered cubic system, as a single phase, without any other impurities phase. The unit cell parameter value, $a_{exp.} = 8,3775Å$, is very close to the theoretical value $a_{teor.} = 8.3778Å$.

FTIR vibration spectra of the four samples of iron oxide nanoparticles obtained by the four synthesis versions of chemical co-precipitation method confirmed the formation of metal-oxygen bonds in all samples.

Absorption peaks observed at 440 cm^{-1} and 586 cm^{-1} confirmed the spinel structure of the magnetite nanoparticles (Figure 1), which is consistent with the results of the X-ray analysis.

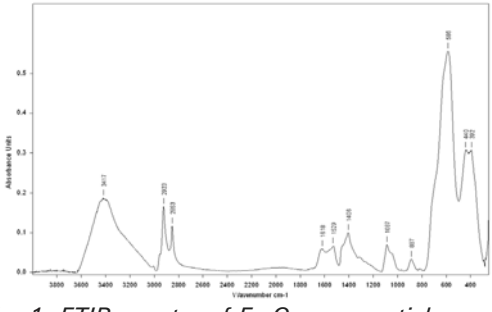

Fig. 1. FTIR spectra of Fe_3O_4 nanoparticles made by chemical co-precipitation method (synthesis version III)

SEM images of the four analyzed samples showed the formation of nanoparticles clusters well defined, spherical, with a narrow nanoparticle size distribution. The size of the thus obtained iron oxide nanoparticles was in the 11-24 nm range.

Magnetic properties measurements on magnetic nanoparticles of iron oxide (Fe_3O_4 and /γFe_2O_3) obtained by synthesis versions I, II, III and IV were performed in a continuous magnetic field ranging between -10 kOe and 10 kOe at room temperature.

From the magnetization curves (M vs H) the superparamagnetic behavior of oxide nanoparticles was deduced (Fig.2), and the (Ms) saturation magnetization value was determined.

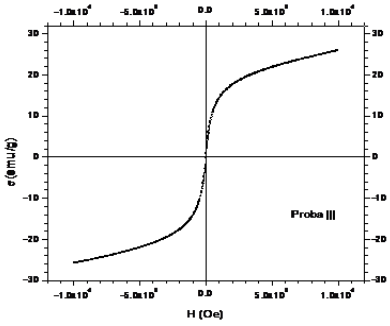

Fig.2. Hysteresis loop of the nanoparticles (Fe_3O_4) sample obtained by chemical co-precipitation method (synthesis version III)

The nanoparticles obtained by the synthesis version III had a saturation magnetization value of 25.96 emu/g, which was higher than in samples obtained in the synthesis version II (19.51 emu/g) and IV (11.35 emu/g).

The stabilized Fe_3O_4 oxide nanoparticles were structurally (FTIR) characterized.

FTIR vibration spectra of the three samples of sterically stabilized nanoparticles with surface-active agents (surfactants) confirmed the formation of Fe-oxygen bonds, characteristic to magnetite phase (in the 400-650 cm^{-1} range), in all samples.

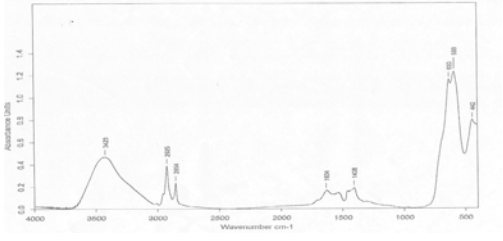

Fig.3. FTIR vibration spectrum of the Fe_3O_4 sample stabilized with oleic acid

The determination of the hydrodynamic diameter of stabilized magnetite nanoparticles and size distribution by the DLS method has shown that, in the case of stabilizing with fatty acid, the values obtained for the hydrodynamic diameter (deff. = 20.5 nm and d_{MSD} = 5.3 nm, when stabilizing with oleic acid; deff. = 14.1 nm and d_{MSD} = 5.5 nm for nanoparticles stabilized with lauric acid) are much lower than for the ones stabilized with TEOS (deff. = 383,5nm and d_{MSD} = 119.7 nm). All samples had a very low polydispersity of 0.005.

The colloidal stability of magnetic nanoparticles suspensions in vegetable oil (sunflower oil) was determined by UV-vis spectrophotometry method.

The recorded absorption curves showed that in the case of magnetite nanoparticles stabilized with oleic acid and respectively TEOS a maximum absorption at the two time intervals (t_1 = 1h, t_2 = 16h) is kept, thus confirming the stability of the suspension.

In the case of magnetite sample stabilized with lauric acid a shift of the maximum absorption has been recorded after 16 h, which shows a clear instability of the suspension over time.

Magnetic characterization was carried out comparatively on Fe_3O_4 samples, as stabilized ferrophase, as well as on the magnetic nano-fluid in vegetable oil samples, with different concentrations of stabilized Fe_3O_4.

The magnetic behavior and the saturation magnetization values of the analyzed samples are given in Table I.

Table I. Results of magnetic characterization of stabilized ferrophase and magnetic nanofluids

Sample	Ms [emu/g]	H_c [A/m]
Oleic acid-stabilized ferrophase	19,37984	19480
TEOS stabilized ferrophase	21,33333	19696
Fe_3O_4 magnetic nano-fluid stabilized with oleic acid of 1M concentration in sunflower oil	6,22	19696
Fe_3O_4 magnetic nano-fluid stabilized with oleic acid of 0.5M concentration in sunflower oil	2,48175	21428
Fe_3O_4 magnetic nano-fluid stabilized with oleic acid of 0.3M concentration in sunflower oil	1,21053	419696
Fe_3O_4 magnetic nano-fluid stabilized with TEOS of 1M concentration in sunflower oil	9,4	22510
Fe_3O_4 magnetic nano-fluid stabilized with TEOS of 0.5 M concentration in sunflower oil.	3,05	27273
Fe_3O_4 magnetic nano-fluid stabilized with TEOS of 0.3 M concentration in sunflower oil	0,77223	20995

CONCLUSIONS

• Experiments were performed regarding the achievement of superparamagnetic oxide nanoparticles (Fe_3O_4 and /γFe_2O_3) for use in magnetic ferrofluids based on vegetable oil.

• For this purpose, the synthesis of oxide nanoparticles (Fe_3O_4 and /γFe_2O_3) was achieved by chemical co-precipitation method in solution under aerobic conditions by four different synthesis versions.

• Experiments were made on following synthesis parameters: - pH, temperature, reaction time; - with or without the addition of dispersing agent; - the nature of the dispersing agent; - the molar ratio of the Fe^{2+} / Fe^{3+} ions

• X-ray diffraction patterns showed the formation, by chemical co-precipitation method (version III), of the Fe_3O_4 nanoparticles with spinel structure, crystallized in a face-centered cubic system, as a single phase.

• Fe_3O_4 nanoparticles obtained by synthesis version III showed the narrowest size distribution range (13-15 nm).

• The magnetic characterization was carried out by recording the magnetization curves at room temperature.

The magnetization curves showed a superparamagnetic behavior of the oxide nanoparticles obtained by synthesis versions II and III.

• In order to achieve a magnetic nanofluid based on vegetable oil (sunflower oil), experiments were carried out in order to stabilize the Fe_3O_4 nanoparticles obtained by chemical coprecipitation (version III).

• In order to determine the optimum stabilizing agent, experiments with oleic acid, lauric acid and tetraethoxysilane (TEOS) were made and favorable results were obtained with oleic acid and TEOS.

• Magnetic measurements on Fe_3O_4 powder sterically stabilized with oleic acid and dispersed in concentrations of 0.3M, 0.5M and 1M refined sunflower oil indicated the following values for the saturation magnetization: Ms = 1.21emu/g for 0.3M Fe_3O_4, Ms = 1.21emu/g for 0.5M Fe_3O_4 and Ms = 6.22 emu /g for 1M Fe_3O_4.

REFERENCES

[1] T. Borbáth , D .Bica, I. Potencz, L. Vékás, I. Borbáth, T. Boros, *Magnetic nanofluids and magnetic composite fluids in rotaring seal systems,* IOP Conference Series: Earth and Environmental Science, vol.12 , no.1, 2010, p.012105.

[2] R. Taylor, S. Coulombe, T. Otanicar, P. Phelan, A. Gunawan, W. Lv, G. Rosengarten, R. Prasher si H. Tyagi, *Small Particles, Big Impacts: A Review of the Diverse Applications of Nanofluids,* Journal of Applied Physics, vol.113, no.1, 2013, p.011301.

[3] G.F. Goya,*Handling the particles size and distribution of Fe_3O_4 nanoparticles through ball milling,* Solid State Cimmunications, vol.130,no.12, 2004, pp.783-787.

[4] A.M. Schmidt,*Introduction heating of novel thermoresponsive ferrofluids,* Journal of Magnetism and Magnetic Materials, vol.289, no. 5, 2005, pp. 5-8.

[5] S. Beyaz, H. Kockar, T. Tanrisever, *Simple synthesis of superparamagnetic magnetite nanoparticles and ion effect on magnetic fluids,*Journal of Optoelectronic and Advanced Materials, vol.1, no.3, 2009, pp.447-450.

[6] K. Woo, J. Hong, S. Choi, H.W. Lee, J.P. Ahn, C.S. Kim, S.W. Lee, *Easy synthesis and magnetic properties of iron oxide nanoparticles*, Chemistry of Materials, vol.16, no.14, 2004, pp.2814-2818.

[7] D. Caruntu, G. Caruntu, C. J. O'Connor, *Magnetic properties of variable-sized Fe_3O_4 nanoparticles synthesized from non-aqueous homogeneous solutions of polyols,* Journal of Physics D: Applied Physics, vol.40,2007, pp.5801-5809.

[8] D.Makavec, A. Kosak, A. Zmidarsic, M. Drofenic, *The synthesis of spinel-ferrite nanoparticles usingprecipitation in microemulsions for ferrofluid applications,* Journal of Magnetism and Magnetic Materials, vol. 289, 2005, pp.32-35.

[9] J. Feng, J. Mao, X. Wen, M. Tu, *Ultrasnic-assisted in situ synthesis and characterization of superparamagnetic Fe_3O_4 nanoparticles,*Journal of Alloys and Compounds, vol.509, 2011, pp. 9093-9097.

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BIOMATERIALS

Intelligent system for the analysis and diagnosis of collagen-based artefacts (COLLAGE)

ABSTRACT

On the basis of the results obtained by thermal analysis methods of some collagen-based materials (pure collagen, new and old parchments, new and old leathers), there were improved the following analytical protocols elaborated in the previous stage of the present project:

- "Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by simultaneous thermal analysis methods (TG + DTA) or TG + DSC";

- "Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by differential scanning calorimetry (DSC) applied for samples immersed in water";

- "Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by differential scanning calorimetry (DSC) applied for samples in nitrogen flow";

- "Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by dynamic mechanical analysis (DMA) applied for samples in air atmosphere".

It was suggested a procedure for extrapolation of DSC data obtained at heating rate of 10 K.min^{-1} to the heating rate of 2 K.min^{-1}. The values of shrinkage temperatures resulted by this extrapolation are in good agreement with those obtained by MHT method.

INTRODUCTION

The following analytical protocols based on the experience accumulated in 15 years of research and publishing some articles in ISI journals [1-8] and some communications at national and international conferences and symposia [9-27] were elaborated in the previous phase of the present project:

- **Protocol TG/DTG + DTA or DSC:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by simultaneous thermal analysis methods (TG + DTA) or TG + DSC;

- **Protocol DSC-water:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by differential scanning calorimetry (DSC) applied for samples immersed in water;

- **Protocol DSC-N_2:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by differential scanning calorimetry (DSC) applied for samples in nitrogen flow;

- **Protocol DMA:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by dynamic mechanical analysis (DMA) applied for samples in air atmosphere.

The objectives of the present phase of the project were:

- Experimentation and improvement of analytical protocols;

- Dissemination of the obtained results by publication of scientific articles and participation at conferences, symposia and workshops.

Research staff of the project

PhD Chem. Petru Budrugeac, CS I, Head of the Laboratory for Evaluation of Thermal Behaviour of Products and Materials – *head of the project*

PhD Chem. Andrei Cucoş

PhD Chem. Carmen Ştefănescu

Eng. Laura Chiose

EXPERIMENTAL

The specific conditions of performing of thermal analysis of collagen-based materials were specified in previous phases of project.

RESULTS OF AND DISCUSSIONS

In the present phase, the data reported in the previous phases, as well as new results obtained for some collagen-based materials by using TG, DTA, DSC and DTA methods were the support for improving the following analytical protocols elaborated in the previous phase of project:

- **Protocol TG/DTG + DTA or DSC:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by simultaneous thermal analysis methods (TG + DTA) or TG + DSC;

- **Protocol DSC-water:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by differential scanning calorimetry (DSC) applied for samples immersed in water;

- **Protocol DSC-N_2:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by

differential scanning calorimetry (DSC) applied for samples in nitrogen flow;

- **Protocol DMA:** Analytical protocol for quantitative and qualitative evaluation of collagen based materials (pure collagen, parchments, and tanned leathers) by dynamic mechanical analysis (DMA) applied for samples in air atmosphere.

In this purpose, the following thermal analyses were performed:

- TG/DTG + DSC or DTA analysis of: recent parchment manufactured from lamb skin, recent parchment manufactured from goat skin, old parchment "Hrisov Matei Voievod, 1618 year", old Italian parchment –bookbinding- A3 – 1845 year, recent leather manufactured from goat skin and tanned with chestnut;

- DSC analyses in water excess of: collagen produced by Sigma-Aldricht , collagen produced by Ridel de Haen-AG, recent parchment E manufactured from deer skin, recent parchment F manufactured from deer skin, old parchment "Hebraic scroll", recent parchment (SC79) manufactured from calf skin, recent parchment (SC80) manufactured from calf skin, recent parchment (SC82) manufactured from calf skin, old parchment "Divan legislativ – 1820 year", old parchment "Grigore Alexandru Ghica Vodă – Sigiliu roşu", old parchment "Ton Basilicon – 1647 year", old Italian parchment – ASUTO 1-2, old Italian parchment – ASUTO 1-3, old Italian parchment –TO 107-2-1375 year, old Italian parchment –TO 108-2-1415 year, Byzantine parchment –GR-350_2, Byzantine parchment –GR-350_3, recent leather manufactured from sheep skin, old leather "Dogmatica ortodoxa – XVIII century", old leather "Evangheliar Bucuresti -1760 year", old leather "Apostol – 1784 year", old leather " Religious slavon book – XVIII century", old leather " Slavon manuscript- XVIII century";

- DSC analyses in N_2 flow of: collagen produced by Sigma-Aldricht , collagen produced by Ridel de Haen-AG, recent parchment E manufactured from deer skin, old parchment "Hebraic scroll";

- DMA analyses of: recent parchment E manufactured from deer skin, old Italian parchment –bookbinding-4A – 1845 year, old Italian parchment – ASUTO 1-2, old Italian parchment – ASUTO 1-3, recent leather manufactured from calf skin with quebracho, recent leather manufactured from sheep with mimosa, old leather "Antologhian – 1726 year", old leather "Evangheliar Rm. Valcea – 1794 year", old leather " Slavon manuscript- XVIII century".

The experimental results show that **Protocol TG/DTG + DTA or DSC, Protocol DSC-N_2** and **Protocol DMA** need not important modifications. Some small corrections were operated into the texts of these Protocols.

The **Protocol DSC-water** was improved for comparison of the values of shrinkage temperature (T_s) obtained by DSC method with those obtained by Micro Hot Table (MHT) method. The DSC determinations were performed at heating rate of 10 K.min^{-1}, while the MHT determinations were performed at 2 K.min^{-1}. In this purpose, the dependencies of T_s on the heating rate were investigated for the following collagen-based materials: collagen produced by Sigma-Aldricht, collagen produced by Ridel de Haen-AG, recent parchment E manufactured from deer skin, recent parchment F manufactured from deer skin and old parchment "Hebraic scroll". It was obtained that the extrapolation of T_s values obtained by DSC method at heating rate of 10 K.min^{-1} to those obtained at heating rate of 2 K.min^{-1} involves a correction of 6^{0}C (T_s(DSC-2) = T_s(DSC-10)-6^{0}C). The application of this correction leads to a good agreement between the T_s values determined by MHT and DSC methods. *Such correction is necessary because the accuracy of DSC measurements is very good for the heating rate of 10 K.min^{-1}, but is relatively lower for the heating rate of 2 K.min^{-1}, which is used for MHT determinations.*

The improving of Protocol DSC-water keeps into account these results.

Dissemination of the obtained results by publication of scientific articles

1. Petru Budrugeac, Andrei Cucos, Lucreţia Miu, *Use of thermal analysis methods to asses the damage in the bookbindings of some religious books from XVIII century*, stored in Romanian libraries, **Journal of Thermal Analysis and Calorimetry**, (2014) 116:141–149.

2. Petru Budrugeac, Phase *transitions of a parchment manufactured from deer leather: A calorimetric and kinetic analysis*, **Journal of Thermal Analysis and Calorimetry**, accepted for publication.

3. Cristina Carşote, **Petru Budrugeac**, Roumiana Decheva, Nikifor Stefanov Haralampiev, Lucreţia Miu, Elena Badea, *Characterization of a byzantine manuscript by infrared spectroscopy and thermal analysis*, **Revue Roumaine de Chimie**, accepted for publication.

4. Petru Budrugeac, Andrei Cucos, *DSC analysis in cultural heritage for damage assessment and certification of historical leathers and parchments*, **ONSET, Netzsch**, accepted for publication.

Dissemination of the obtained results by participation at conferences, symposia and workshops

1. Romanian Academy. Department of Chemical Sciences. Commision of Thermal Analysis and Calorimetry. 23th Annual Symposium of scientific communications. Bucharest February 2014.

1.1. Andrei Cucos, Petru Budrugeac, Lucreţia Miu, *DMA and DSC studies on denaturation in water and in dry state of parchments subjected to accelerated ageing*

1.2. Cristina Carşote, **Petru Budrugeac**, Irina Petroviciu, Lucreţia Miu, Elena Badea, *Leather characterization by thermal analysis for improved microclimate conditions*

2. "Chemistry for Cultural Heritage" (ChemCH 2014), Vienna, July 2014

2.1. Cristina Carsote, Elena Badea, Lucretia Miu, Giuseppe Della Gatta, **Petru Budrugeac**, *Differential Scanning Calorimetry for quantifying damage in artificial aged leather*

3. The 11th European Symposium on Thermal Analysis and Calorimetry, Helsinki, August 2014

3.1. Petru Budrugeac, *Phase transitions of a parchment manufactured from deer leather: A calorimetric and kinetic analysis*

4. European Chemistry Congress - 5th EuCheMS August 31 - September 4, Istanbul 2014

4.1. Cristina Carsote, Elena Badea, Fatih Yalçin, Hüseyn Ata Karavana, **Petru Budrugeac**, Lucretia Miu, *Damage assessment of vegetable-tanned leather artefacts bz thermal microscopy and differential scanning calorimetry*

5. XII Congresso Nazionale IGIIC – Lo Stato dell'Arte – Accademia Di Belle Arti di Brera – Milano 23/24 ottobre 2014

5.1. Elena Badea, Lucretia Miu, Cristina Carsote, Irina Petroviciu, Rosetta Granziero, Silvia Perona, Veronique Cachia, Battista Pittari, Cecilia Laurora, Giuseppe Della Gatta, Andrei Cucos, **Petru Budrugeac**, Alessandro Vitale Brovarone, *Validazione di interventi di recupero conservativo di manufatti in pergamena*

6. Chemistry for Cultural Heritage" (ChemCH 2014), Viena, July 2014

6.1. Cristina Carsote, Elena Badea, Lucretia Miu, Giuseppe Della Gatta, **Petru Budrugeac**, *Differential Scanning Calorimetry for quantifying damage in artificial aged leather*

7. 2013rd International Seminar and Workshop on Emerging Technology and Inovation for Cultural Heritage (ETICH 2014), Sibiu, October, 2014

7.1. Cristina Carşote, Elene Badea, Lucreţia Miu, Giuseppe Della Gatta, **Petru Budrugeac**, *Differential scanning calorimetry. A valuable technique for characterising vegetable tanned lea*ther

7.2. Andrei Cucoş, Elena Badea, Lucreţia Miu, Cristina Carşote, Irina Petroviciu, **Petru Budrugeac**, *Evaluation of some conservation treatments for parchment artefacts*

8. ICAMS 2014 – 5th International Conference on Advanced Materials and Systems, Bucharest, October 2014

8.1. Cristina Carşote, **Petru Budrugeac**, Lucreţia Miu, Hüseyn Ata Karavana, Elena Badea, *Study of the environmental impact on vegetable tanned leather by thermal analysis*

8.2. Wuyong Chen, Yanping Gao, Gong Ying, Madalina Ignat, Lucretia Miu, **Petru Budrugeac**, *Testing of leather artificially aged in acid rain*

CONCLUSIONS

The analytical protocols for qualitative and quantitative thermal analysis of collagen-based materials, elaborated in the previous phase of the project, were checked and improved.

The dissemination of the obtained results was made by:

- publishing of an article in "Journal of Thermal Analysis and Calorimetry" (this journal is ISI quoted);
- 3 articles accepted for publication in scientific journals;
- 11 scientific communications at National and International Conferences and Symposia.

REFERENCES

[1] P. Budrugeac, L. Miu, V. Bocu, F. J. Wortmann, C. Popescu, *Thermal degradation of collagen-based materials that are supports of cultural and historical objects*, J. Therm. Anal. Calorim., 72, 2003,1057-1064.

[2] P. Budrugeac, L. Miu, C. Popescu, F. J. Wortmann, *Identification of collagen-based materials that are supports of cultural and historical objects*, J. Therm. Anal. Calorim., 74, 2004, 975-985.

[3] P. Budrugeac, L. Miu, M. Soukova, *The damage in the patrimonial books from Romanian libraries. Thermal analysis methods and scanning electron microscopy,* J. Therm. Anal. Calorim., 88, 2007, 693-698.

[4] P. Budrugeac, L. Miu, *The suitability of DSC method for damage assessment and certification of historical leathers and parchments,* J. Cultural Heritage, 9, 2008, 146-153.

[5] P. Budrugeac, L. Miu, *Effect of accelerated thermal ageing on the thermal behaviour of the recently made parchments*, J. Therm. Anal. Calorim., 94, 2008, 335-342.

[6] V. Plăvan, M. Giurginca, P. Budrugeac, M. Vîlsan, L. Miu, *Evaluation of the physico-chemical characteristics of leather samples of some historical objects from Kiev,* Rev. Chim. (Bucharest), 61, 2010, 627-631.

[7] Andrei Cucos, Petru Budrugeac, *Preliminary studies on the influence of sodium chloride on the melting temperature of collagen crystalline fraction in parchments,* Int. J. Conservation Sci., 1, 2010, 13 – 18.

[8] A. Cucos, P. Budrugeac, L. Miu, S. Mitrea, G. Sbarcea, *Dynamic mechanical analysis (DMA) of new and historical parchments and leathers: Correlations with DSC and XRD,* Thermochim. Acta, 516, 2011, 19–28.

[9] C. Popescu, P. Budrugeac, L. Miu, Cornelia Iditoiu, F. J. Wortmann, *Thermal analysis of patrimonial leather objects,* 30th Aachen Textile Conference, Aachen - Germany, 2003.

[10] C. Popescu, P. Budrugeac, F. J. Wortmann, *Investigating Patrimonial Leather and Parchment Objects by Thermal Analysis,* NATAS 2003 - North American Thermal Analysis Society 2003 Conference, Spring/Summer 2003 vol. 35, no. 1 & 2.

[11] Lucretia Miu, Carmen Gaidau, Victoria Bratulescu, Viorica Deselnicu, Petru Budrugeac, Aurelia Meghea, Rodica Antonescu, Alexandrina Olariu, Roxana Diaconu, Ion Neacşu, Doina Seclaman, *Research on old and new leathers for patrymony objects restauration,* ICOM 93, Atena 2004-05-02.

[12] Lucretia Miu, Carmen Gaidau, Victoria Bratulescu, Petru Budrugeac, Aurelia Meghea, Maria Giurginca, Adriana Ioniuc, Maria Geba, *Physical-Chemical Investigation of some Archeological Leathers from Romanian Sites,* The 9th ICOM-CC – WOAM Conference, Copenhagen, 6th – 11th June 2004.

[13] Petru Budrugeac, Lucreţia Miu, Virgil Marinescu, *Aplicarea tehnicilor de analiză termică pentru autentificarea obiectelor de patrimoniu confecţionate din piele,* Simpozion „Patrimoniul cultural din piele şi pergament – Abordări moderne pentru caracterizare, conservare şi/sau restaurare", Bucharest, 2006.

[14] Elena Badea, Lucreţia Miu, Petru Budrugeac, Maria Giurginca, Admir Maşi , Giuseppe Della Gatta, *Damage assessment of historical parchments by DSC and thermal analysis, complemented by SEM, FTIR, UV-VIS-NIR and unilateral RMN*, XXVIII National Conference on Thermal Analysis and Calorimetry, 11-15 December 2006, Milan, Italy.

[15] Lucretia Miu, Petru Budrugeac, Maria Giurginca, Aurelia Meghea, Nicoleta Badea, Carmen Gaidau, Doina Seclaman, *Use of thermal, spectral and scanning electron microscopy methods to assess the damage of Romanian heritage leather and parchments objects,* 7-th European Conference "SAUVEUR" Safeguarded Cultural Heritage, Prague, 31st May - 3rd June 2006.

[16] P. Budrugeac, Lucreţia Miu, *Aplicarea metodei DSC pentru determinarea gradului de degradare a pieilor şi pergamentelor ce fac parte din obiecte de patrimoniu cultural şi istoric,* Romanian Academy. Department of Chemical Sciences. Commision of Thermal Analysis and Calorimetry. 16th Annual Symposium of scientific communications, Bucharest, February 2007.

[17] E. Badea, Lucreţia Miu. Petru Budrugeac, Maria Giurginca, Giuseppe Della Gatta, *Multidisciplinary approach and correlation analysis in the assessment of parchment deterioration,* Patrimoniul Cultural din piele şi pergament – abordări moderne pentru caracterizare, conservare şi/sau restaurare, Bucharest, 10-11 September 2007.

[18] E. Badea, L. Miu, P. Budrugeac, M. Giurginca, G. Della Gatta, *Damage assessment of parchments. I. An innovative multidisciplinary approach*, The 2-nd Intermational Conference on Advanced Materials and Systems-ICAMS-2008, Buchares, 23-24 October 2008.

[19] L. Miu, M. Giurginca, P. Budrugeac, *Study of deterioration of Romanian historical parchments by thermal analysis, FTIR, UV-VIS-NIR investigation techniques,* The 2-nd Intermational Conference on Advanced Materials and Systems-ICAMS-2008, Bucharest, 23-24 October 2008.

[20] P. Budrugeac, Elena Badea, G. Della Gatta,Lucretia Miu, Alina Comanescu, V. Marinescu, *DSC study of deterioration of parchment exposed to gaseous chemical pollutants (SO_2, NO_x),* International Seminar and Workshop "Conservation and Restoration of Parchments (CRP2008)", Torino, 2008.

[21] E. Badea, L. Miu, P. Budrugeac, M. Saczuki, G. Della Gatta, *Thermal stability of parchments by MHT: a reliable method for grading deterioration of archival funds,* TECHNART 2009 - Non-destructive and Microanalytical Techniques in Art and Cultural Heritage, Athens, 27 - 30 April 2009

[22] P. Budrugeac, E. Badea, G. Della Gatta, L. Miu, *Use of the thermal analysis methods for investigation of the environmental factors impact on parchments,* MATCONS 2009 Matter and Materials in/for Heritage Conservation, Craiova, 15-19 September 2009.

[23] Andrei Cucos, Petru Budrugeac, *The suitability of DMA method for the characterization of recent and historical parchments and leathers*, Academia Română. Secţia de Ştiinţe Chimice. Comisia de Analiză Termică şi Calorimetrie. Al 19-lea Simpozion Anual de Comunicări Ştiinţifice – februarie 2010.

[24] P. Budrugeac, A. Cucoş, Lucreţia Miu, *The use of DSC method for authentication of historical and/or cultural objects manufactured from leather,* 2nd International Conference Matter and Materials in/for Heritage Conservation Matcons'2011, Craiova, Romania – 24–28 August 2011.

[25] A. Cucos, P. Budrugeac, *Influence of NaCl on the melting temperature of the collagen crystalline region from parchments,* 2nd International Conference Matter and Materials in/for Heritage Conservation Matcons'2011, Craiova, Romania – 24–28 August 2011.

[26] Petru Budrugeac, Andrei Cucos, *Non-isothermal kinetics of denaturation and melting of crystalline phase of collagen, and of new and old parchments,* The 11th Conference on Calorimetry and Thermal Analysis (CCTA 11), Zakopane – Poland, September 2012.

[27] Andrei Cucos, Petru Budrugeac, *Investigations of thermal denaturation and melting of crystalline phase of collagen,* 11th Conference on Calorimetry and Thermal Analysis (CCTA 11), Zakopane – Poland, September 2012.

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ENERGY

Growing of the efficiency of technological equipment and processes for energy conversion from regenerative resources

ABSTRACT

A light rig for water wells drilling was realized within this project. It is a low power driven drilling rig, mechanically actuated from a small gasoline engine, with vertical shaft, functioning based on the principle of hydraulic rotary drilling with direct circulation of the drilling fluid [1].

The following results were achieved during the project phases in 2014:

- *Fabrication and testing the rig prototype;*
- *Working procedures for the rig exploitation.*

FOREWARD

The light drilling rigs are intended for the following applications:

- potable, domestic and irrigation water supply;
- heat pumps installation (water-water and soil-water)
- foundations reinforcement;
- soil geological sampling;
- mounting of electrical grounding systems.

The project scope is to establish solutions intended to grow the efficiency of technological equipment and processes for energy conversion from regenerative resources.

The project objective is to manufacture and test a light rig for water wells drilling of an upper class, with a higher power drive, allowing drilling also in hardness media.

Research staff of the project
Project manager:
Eng. Sorin Alexandru Fica
PhD. Eng. Dorian Marin
PhD. Eng. Georgiana Marin
Eng. Adrian Dobre

TESTING

The FA 100 prototype was testing drilling two water wells; table no.1 indicated the most representative drilling performances.

Table 1 – FA100 testing parameters

zone / parameter	Ciofliceni (manual drawwork)	Săftica (electric drawwork)
Lifting speed at hook	0,023m/s (1,38 m/min) "slow speed" 0,032m/s (1,92 m/min) "fast speed"	0,067m/s (4 m/min)
Drilling time	4 days	
Drill rod rotative speed	144 rpm	
Gas consumption	2,5 l/h	

RESULTS AND DISCUSSIONS

The project results are as follows:

- fabrication and testing drilling rig FA100;
- working procedures for the rig exploitation for open holes, cased holes and medium depth water wells.

The light rig for water wells drilling FA100 (Fig.1) is a mechanical operated hydro-geological drilling rig suitable for water wells up to 100 m depth, with diameters up to 230 mm [2].

Fig. 1. FA100 Drilling rig

Table 2 – FA100 technical features

hook load	1200÷1400 daN
power	7,5 – 9 kW (10-12 HP)
drilling depth	100 m
drilling diameter	230 mm
pipe length	1,5 m
rig mast height	2,5 m
drilling rig weight (mud pump, drilling stem and drilling bits excluded)	300 kg

FA 100 can use the following drilling methods:

hydraulic rotary drilling rig with direct flow of the drilling fluid;

dry drilling up to 20m maximum depth.

CONCLUSIONS

Given that the attention is increasingly greater in energy savings and alternative sources usage, solutions are required for groundwater exploitation as a source of potable and domestic water supply.

Considering these, it was realized water wells drilling rig with high technical performances, which includes technical solutions adapted to the problems induced by the soil particularities.

The testing performed in different locations has shown that the rig behaved as expected, at the design parameters.

FA100 has the following advantages:

- quick and easy layout on the location;
- easy operation;
- high drilling speed;
- low cost per drilled meter;
- drilling in multi stages for the whole depth of the well;
- maintaining the direct and efficient circulation of the drilling fluid during work.

It is considered that there is a real potential to exploit the technical and economic potential of these facilities mainly to provide the necessary water in isolated areas.

BIBLIOGRAPHY

[1]. S. Seiceanu, T.Justel, Tehnologia forajului rotativ, Editura Tehnică, Bucharest, 1974

[2]. I. Costin, Elemente de calcul utilaj petrolier, Editura Didactică şi Pedagogică, Bucharest, 1986

The research was financed by the Nucleus National Programme, contract no. 0935-0201/2009.

Optimization of climate protection and energy efficiency of aluminium radiators

SUMMARY

It was made:

- a theoretical study that covers a mathematical modelling of thermal processes in a system with multiple layers;

- experimental determination of the thermal conductivity for various layers of protection against the climate.

INTRODUCTION

At present, aluminium radiators are painted in electrostatic field with the following types of paint:

- corrosion liquid neo-acrylic paint code: 850V;
- E607016RTEXL-type paint K20.

The project's goal is to optimize the protection of the climate and the energy efficiency of aluminium radiators.

The objectives of the present phase are:

- study on the heat transfer process in aluminium radiators;
- comparative analysis of heat conduction for various layers of climate protection.

Research staff of the project

Eng. Adrian Dobre, IDT II – project responsible

Dr. Eng. Violeta Tsakiris, CS II

EXPERIMENTS

Following the experimental determinations carried out the thermal conductivity is:

- neo-acrylic corrosion paint code: 850V: λ = 8.28 [W/mK] for a thick layer of 12.4 μm,
- E/P 7016 GRI paint RADIATORS TEXL - K20 λ = 3.25 [W/mK] for a layer of 110.6 μm thickness,
- aluminium anodising with H_2SO_4/10min: λ = 9, 12 [W/mK] for a thick layer of 10,72 μm,
- aluminium anodising with $H_2C_2a_4$/10min: λ = 13,98 [W/mK] for a thick layer of 10.72μm.

RESULTS AND DISCUSSION

The project results consist in climate protection methodology of aluminium radiators with aluminium anodising, implicitly removing the radiator in dyeing manufacturing process thereof.

CONCLUSIONS

Following the analyses of the results was demonstrated that the climate protection made by aluminium anodising is optimum from the point of view of thermal transfer.

This methodology of climate protection should be implemented in the manufacture of aluminium radiators made by Romanian companies, helping to increase their competitiveness on the internal/external markets.

REFERENCES

[1]***, ASTM E 1461:2007 "*Standard Test Method for Thermal Diffusivity by the Flash Method*".

[2] http://www.tprl.com/Laser_Flash.html.

[3] W. J. Parker, R. J. Jenkins, C. P. Butler, G. L. Abbott, *„Flash Method of Determining Thermal Diffusivity, Heat Capacity and Thermal Conductivity"*, Journal of Applied Physics, vol. 32 (9) (1961), p. 1679 – 1684.

[4] http://www.chem.mtu.edu/org/ ctc/ pdf/ Nanoflash%20web%20page%201-29-09.pdf.

[5]*** Nanoflash Instruction manual LFA 447-MGF-MAN-001-Rev0.

[6] En. A. Bratu, *Operaţii unitare în ingineria chimică*, Vol. I-III, Editura Tehnică, Bucureşti, 1984.

[7] N. Leonăchescu, *Termotehnica*, Editura Didactică şi Pedagogică, Bucureşti, 1981.

[8] M. Nagi, *Schimbătoare de căldură din aluminiu*, Editura Mirton, Timişoara, 1997.

[9] S. Neacşu, *Termotehnica şi maşini termice*, Editura Printech, Bucureşti, 2009, ISBN 978-606-521-373-3.

[10] www.galvanoserviceelectrice.ro 05.06.2014.

[11] www.margstainlessgroup.home.ro 12.06.2014.

[12] www.romradiatoare.ro 19.06.2014.

[13] *** SR EN ISO 2808:2002, *Vopsele şi lacuri. Determinatea grosimii peliculei.*

[14] *** SR EN ISO 7273:2002, *Vopsele şi lacuri. Determinarea la ceaţă salină neutră.*

[15] *** SR EN 60068-2-11:2001, *Încercarea la ceaţă salină. Metoda de încercare Ka.*

[16] *** SR EN 60721-2-5-92, *Clasificarea condiţiilor de mediu. Partea 2: Condiţii de mediu prezente în natură. Secţiunea 5: Praf, nisip, ceaţă salină.*

[17] *** STAS 5624-68, *Lacuri şi vopsele. Pregătirea epruvetelor suport pentru aplicarea peliculelor.*

[18] *** SR EN 12373-1:2002, *Acoperiri nemetalice (anorganice). Acoperiri prin oxidarea anodică a aluminiului şi a aliajelor de aluminiu. Condiţii tehnice de calitate.*

[19] *** SR EN 12373-3:2002, *Acoperiri*

nemetalice. Acoperiri prin oxidare anodică a aluminiului și a aliajelor de aluminiu. Metode pentru determinarea grosimii stratului de oxid.

[20] *** STAS 12914-90, *Acoperiri metalice. Băi de eloxare. Metode de analiză.*

[21] *** STAS 12926-1995, *Acoperiri metalice. Băi de decapare. Metode de analiză.*

[22] *** STAS 12927-90, *Acoperiri metalice. Băi de degresare. Metode de analiză.*

[23] *** STAS 6535-83, *Protecția climatică. Împărțirea climatică a pământului în scopuri tehnice.*

[24] *** STAS 6692-83, *Protecția climatică. Tipuri de protecție climatică.*

The research was financed by the Nucleu Programme, contract no. PN 09-35-02-01.

Power generation system which uses a double - effect wind turbine in order to ensure the energy autonomy in specific applications

ABSTRACT

This project intends to develop a system for power autonomy based on a double-effect wind turbine. Thus, the project proposes the development up to the prototype stage, of a new type of wind turbine with a rated power in the range of 10 - 15 kW, based on innovative aspects: two wind rotors co-axially positioned onto the same direction drive simultaneously an electrical generator, achieved especially for this purpose. Based on this turbine, a system for electric energy generation is developed, offering an increased safety in the electric power supplying of a unit specialized in the food industry production activities, beneficiary of the prototype.

INTRODUCTION

The study of double effect wind turbines (counter-rotating or not) has begun in the last decade. At international level, the research is focused on prototypes in the power range of 0.5 ÷ 50 kW. Thus, during 2003 in California, Appa Technology Initiatives tested for 3 months [1] a prototype of 6 kW counter-rotating wind turbine. The optimum operating conditions of turbines are investigated also by numerical simulations, using CFD (Computational Fluid Dynamics) software. Thus, in [2], a counter-rotating system composed by two 500 kW turbines was studied. Simulations showed that when operating the turbine at a speed of 10 m/s, the annual energy production increases with 43.5% comparing to the case of a single turbine operation.

Electrical generators suited for energy conversion systems using counter rotating turbines can have a specific design (both armatures mobile and horizontal or vertical shaft) or can be developed as classic generators (in this case requiring a complex system for power transmission).

The use of permanent magnets simplifies significantly the design of the electrical machine.

The objectives of the project for the year of 2014 have regarded the testing of the 1 kW experimental models for a wind speed equal to 10 m/s and the design of the double effect wind turbine prototype supplying a 10 to 15 kW rated power, respectively, under the same conditions.

The project implementation in 2014 has included the following activities:

1. Experimental model of double effect wind turbine testing.

- Design and achievement of a double effect wind turbine, with vertical axis.
- Testing of double effect wind turbine, with horizontal axis.
- Wind rotor simulations of the double effect wind turbine, with vertical axis.

2. Design of double effect wind turbine prototype.

- Establishment of the technical theme and elaboration of the constructive solution;
- Design of the electric generator for the double effect wind turbine;
- Design of the double effect wind turbine assembly;
- Design of the connection utility to the national electrical grid;
- Design of the wind rotor for the double effect wind turbine prototype;
- Wind rotor modelling and numerical simulations.

Research staff of the project

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PhDs Eng. Rareş Chihaia, ACS
Techn. Florea Sorescu
Techn. George Paraschiv
Techn. Marius Miu

RESULTS AND DISCUSSIONS

The main results of the current project phase regard:

- Design and achievement of a double effect wind turbine, with vertical axis;
- Determination of the functional characteristics for the experimental model of double effect wind turbine, with horizontal axis and 1 kW power;
- Design of both double effect wind turbine prototype, with horizontal axis and which supplies 10 to 15 kW rated power and of the connection utility to the national electrical grid;
- Wind rotor modelling and numerical simulations of the double effect wind turbine prototype, with horizontal axis and 15 kW power, along with determining the aerodynamic characteristics of the two wind rotors (power coefficient, moment coefficient, power, torque, axial force).

Apart the main objective of the project, namely the development of the counter rotating wind turbine experimental model and prototype with horizontal axis, there have been taken into account the ***assessment of the possibilities regarding the extension of the two counter rotating rotors application to vertical axis facilities***. As a result, the implementation plan has proposed the achievement of both the project and of a reduced experimental model of a vertical axis wind turbine.

Thus, the design theme regards an electrical power of 30 W for a wind speed value of 10 m/s. In this regard, two vertical axis micro turbines with three blades have been taken into account, each compatible to an available power conversion to the shaft of approx. 20 W. The electric generator is provided with a total capacity of conversion of 100 W for the electric load.

The constructive solution developed for the assembly structure under the conditions of the mentioned technical theme is presented within the figures 1 and 2.

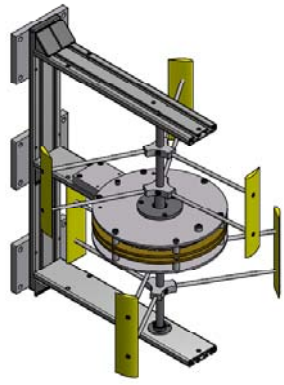

Fig. 1. Cross section of a double effect wind turbine with vertical axis

Fig. 2. The assembly of the double effect wind turbine with vertical axis

The experimental model of double effect wind turbine, with horizontal axis was tested on the specialized stand from INCD INCAS. The experimental testing has been achieved for the following conditions, as follows: a) the up-wind rotor is in operation while the down-wind rotor is blocked; b) the down-wind rotor is in operation while the up-wind rotor is blocked; c) both wind rotors are in operation (counter rotating regime). The testing was achieved for different values of the wind speed (3.5 ÷ 10.5 m/s) and various mechanical loads, by connecting several electrical resistances to the counter-rotating electric generator armatures.

The wind tunnel experiments have aimed at determining the energy provided by the down-wind rotor with a similar diameter to the up-wind rotor.

There was determined a 39.4% increase of the power supplied by the counter rotating turbine than the one supplied by a single turbine.

The project also includes the development of a wind turbine which will provide 10 to 15 kW rated power and will be characterized by the parameters of the public low-voltage grid, for a 10m/s wind speed. The wind turbine will be equipped with two counter rotating rotors which drive directly the armatures of the electric synchronous generator with permanent magnets (both the inductor and induced armatures).

The characteristics of ***the electric generator for the***

double effect wind turbine, with horizontal axis, have been determined by using FLUX 2D software package, from CEDRAT Company. Following the pre dimensioning calculations, an existing armature coil was selected with the outside diameter of 390 mm, 285 mm inner diameter and 36 notches. The length of the rotor package is 140 mm, while the number of poles is 26 (13 pairs).

Starting from the design of the wind rotor as well as from the design of the electric generator (shape, dimensions and functional characteristics), the assembly mechanical project for the wind turbine was achieved as is presented within figure 3.

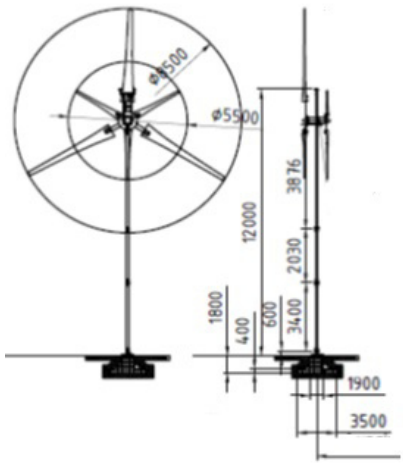

Fig. 3. The prototype of the double effect wind turbine, with horizontal axis

Given the available blades from the internal market, the modified NACA 63 (3)-618 profile was selected. In order for the wind turbine to produce 10 to 15 kW, the following geometrical information is considered:

- up-wind rotor with the diameter D_1 = 5.5 m;
- down-wind rotor with the diameter D_2 = 8.5 m.

The overview construction of the double effect wind rotor is shown in Figure 4.

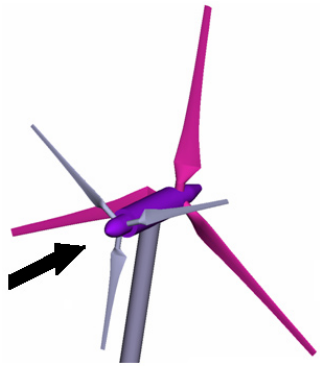

Fig. 4. The constructive solution of the double effect wind rotor, with horizontal axis

CONCLUSIONS

The main objectives of the current project phase have regarded the design and achievement of a reduced experimental model of double effect wind turbine, with vertical axis, the testing of the double effect wind turbine, with horizontal axis which was designed and achieved in the previous stages as well as the prototype design of double effect wind turbine. Furthermore, achieving the prototype of double effect wind turbine with horizontal axis is considered.

REFERENCES

[1] Jung S.N., No T.-S., Ryu K.-W., *Aerodynamic performance prediction of a 30 kW counter-rotating wind turbine system,* Renewable Energy, 2005, 30, (5), 631 – 644.

[21] Shen W.Z., Zakkam V.A.K., Sorensen J.N., Appa K., *Analysis of counter-rotating wind turbines*, The Science of Making Torque from Wind, IOP Publishing, Journal of Physics: Conference Series **75** (2007), 012003, doi:10.1088/1742-6596/75/1/012003.

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Linear electromagnetic generator type harvesting for ambient vibration energy conversion into electrical energy by electromagnetic induction

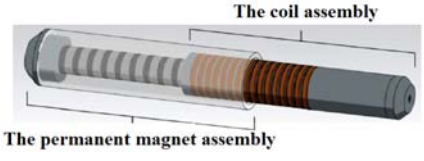
ABSTRACT

The phases from 15.03.2014 and 06.15.2014 of the project had the following main objective, namely the conception, design and realization of a linear electromagnetic generator type harvesting for ambient vibration energy conversion into electrical energy by electromagnetic induction, having a main application the electromagnetic shock absorber a used in regenerative automotive suspensions. Electrical parameters design of the generator is:

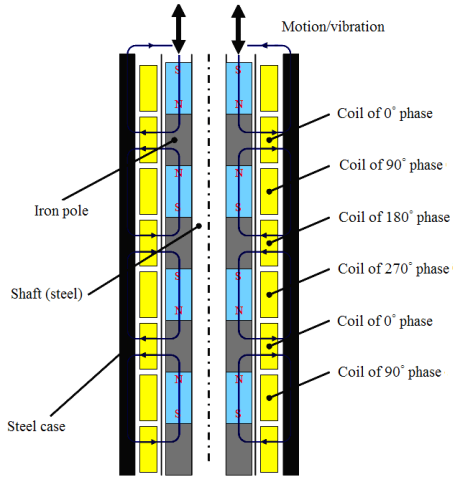
- *maximum power generator: P = 20W;*
- *frequency: 1-100Hz;*
- *maximum voltage: U_{max} = 40V.*

INTRODUCTION

In Fig. 1 shows the concept of linear electromagnetic generator type harvesting- the electromagnetic shock absorber [1, 2, 4, 5]. The linear electromagnetic generator construction is shown in Fig. 1a).



a) Overview of linear elmg. generator



b) Schematic view of linear elmg. generator
Fig. 1. Model construction for linear electromagnetic generator

In Fig. 1b) is shown operating principle of electromagnetic generator which is a linear synchronous permanent magnet generator, which the coil consists a disk winding, and inductor in an assembly of permanent magnets in succession NS - SN.

Operating principle

The basic principle of operation of an electromagnetic generator is based on Faraday's law of induction, inducing coil is a current movement opposes the field created by the magnetic system

$$V = -\frac{d\phi}{dt} \qquad (1)$$

where V is the voltage generated, and ϕ is the inducing flow. In most cases, the electrical circuit consists of a copper coil consisting of windings with several turns (N), the magnetic field being created by magnetic assembly consists of an permanent magnet stack. Movement between coil and magnet

is performed in one direction (z) (see in Fig. 2) and the magnetic field (B)has no variation in time so that the open circuit voltage across the electromagnetic generator

$$V_{gol} = -NS\frac{dB}{dz}\frac{dz}{dt} = -k\frac{dz}{dt} \qquad (2)$$

where: S - effective area of the coil, $\frac{dB}{dz}$ - gradient of the magnetic field, $k = NSdB/dz$ - coupling factor.

Fig. 2 shows a circuit representation of an electromagnetic generator, [3, 5].

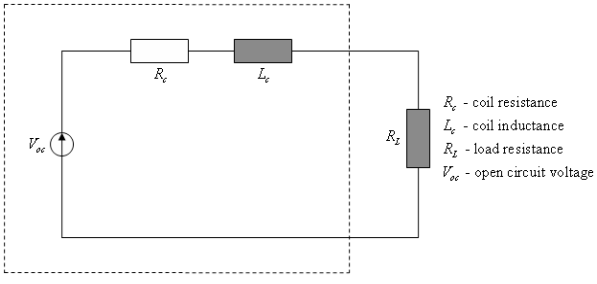


Fig. 2. Circuit representation of an electromagnetic generator

Generic model of the converter vibration energy into electricity is the system formed by a material point mass M , attached the spring with spring constant k and has one degree of freedom, shown in Fig. 3. The movement equation is:

$$M\ddot{z} + (c_e + c_m)\dot{z} + kz = -M\ddot{y} \qquad (3)$$

in which: y - displacement caused by vibration, z - deformation of the spring, c_m - mechanical damping coefficient, c_e - electrical damping coefficient.

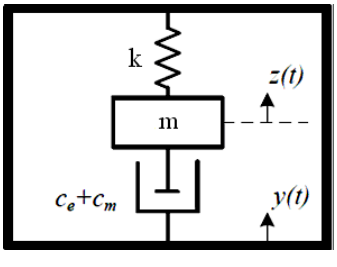


Fig. 3. Mechanical circuit of the electromagnetic generator

The electrical power converted from the mechanical system is equal to the electrical damping loss; the harvested electrical power can be expressed as

$$P_e = \frac{1}{2}c_e\dot{z}^2 = \\ = \frac{m\zeta_2\omega_n\omega^2Y^2(\omega/\omega_n)^4}{(2\zeta_T\omega/\omega_n)^2 + [1-(\omega/\omega_n)^2]^2} \qquad (4)$$

where $\omega_n = \sqrt{k/m}$ - resonant frequency,

$\zeta_m = c_m / 2m\omega_n$ - mechanically damping factor,

$\zeta_e = c_e / 2m\omega_n$ - electrically damping factor,

$\zeta_T = \zeta_m + \zeta_e$, ω - excitation frequency, Y - excitation amplitude.

At resonance, i.e. $\omega = \omega_n$, the electrical power can be maximized to

$$P_e = \frac{1}{2}c_e\dot{z}^2 = \frac{M\zeta_e\omega_n^3Y^2}{4\zeta_T^2} = \frac{M\zeta_eA^2}{4\omega_n\zeta_T^2} \qquad (5)$$

where $A = \omega_n^2Y$ is the acceleration magnitude of input vibrations.

Calculation of electromagnetic parameters

The horizontal movement of the car with velocity $V[m/s]$, at the appearance on the road bump the car is accelerated vertically with $a[m/s^2]$ so it gets vertical velocity $V_x[m/s]$ (see Fig. 4).

The maximum value $V_{x\max}[m/s]$ is given by

$$V_{x\max} = \alpha V \qquad (6)$$

where range of α is $0{,}01 \div 0{,}005$, road to the quality [3]. For ease of calculation is convenient introduction of the average vertical velocity squared:

$$V_x = \sqrt{\frac{1}{T}\int_0^T at^2dt} = \frac{V_{x\max}}{\sqrt{3}} \qquad (7)$$

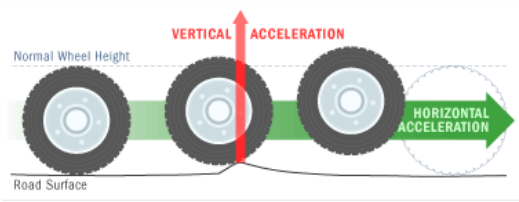


Fig. 4. Over a bump car wheel tread

It is calculated as follows:

- The induced voltage

$$U_{\max} = \pi D_m N V_x B_r [V] \quad (8)$$

in which: $D_m[m]$ - average diameter of coil, N - the number of turns, $B_r[T]$ - radial magnetic flux density.

- The current of the coil

$$I_{\max} = \sigma \frac{\pi d^2}{4} V_x B_r [A] \quad (9)$$

in which: $d[m]$ - diameter of conductor, $\sigma[\Omega^{-1}m^{-1}]$ - electric conductivity of coil material (for Cu, $\sigma = 10^7 \Omega^{-1}m^{-1}$).

- The damping force

$$F_{d\max} = \sigma V_x B_r^2 V_c [N]; \; V_c = \pi D_m N \frac{\pi d^2}{4} [m^3] \quad (10)$$

in which V_c - volume of coil.

Based on the calculation of design parameters of linear electromagnetic generator type harvesting has been made functional model with the following electrical parameters:

- maximum power generator: P = 20W;
- frequency: 1-100Hz;
- maximum voltage: U_{max} = 40V.

The project was completed with the design and implementation of linear electromagnetic generator type harvesting in automotive applications (elmg. damper) is shown in Fig. 5.

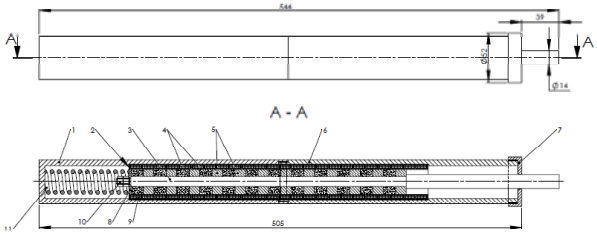


Fig. 5. Drawing overall electromagnetic generator (electromagnetic damper)

The main structural elements of linear electromagnetic generator (elmg damper) are:

- Electromagnetic Generator - electromagnetic damper - general assembly;
- 1 – Lower case;
- 2 - Coil support;
- 3 - Piston shaft;
- 4 - Permanent magnet;
- 5 - Spacer;
- 6 - Upper case;
- 7 - Casing cover;
- 8 - Washer;
- 9 - Coil;
- 10 - Nut M6;
- 11 – Spring.

Research staff of the project

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CONCLUSIONS

To achieve regenerative suspension with active damping control, according to the design and technical characteristics imposed linear electromagnetic generator type harvesting - the main application as electromagnetic damper.

It has been a model for calculating the electromagnetic parameters of the generator. It adopted a numerical calculation of electromagnetic linear generator parameters imposed by the project after which was done folder of working drawings and a prototype was made linear electromagnetic generator type harvesting.

Applications of linear electromagnetic generator type harvesting

– electromagnetic regenerative shock absorber;

– power energy wireless sensor networks for structural health monitoring;

– wireless monitoring of civil engineering structures such as bridges and overpasses;

– sensors used in military applications.

Advantages of linear electromagnetic generator type harvesting

– alternative energy source to batteries;

– simple construction;

– low maintenance costs and installation costs;

– provide long-term solutions;

– reduce environmental impact.

REFERENCES

1. A. Gupta, "*Electromagnetic Schock Absorbers*", Northern Illinois University, Mechanical Engineering Department, Dekalb, IL 60115.

2. B. Ebrahimi, "*Development of Hibrid Electromagnetic Dampers for Vehicule Suspension System*" – A thesis presented to the University of Waterloo for degree of Doctor of Philosophy in Mechanical Engineering., Ontario, Canada, 2009.

3. Z. Longxin and W. Xiaogang, "*Structure and Performance Analysis of Regenerative Electromagnetic Shock Absorber*", *J. Networks*, vol. 5, no. 12, December 2010, pp. 1467 - 1474.

4. E. Arroyo, A. Badel, "*Electromagnetic vibration energy harvesting device optimization by synchronous energy extraction*", *Sensors and Actuators A*, 171 (2011), pp. 266 – 273.

5. Lei Zuo, Brian Scully, Jurgen Shestani and Yu Zhou, „*Design and characterization of an electromagnetic energy harvester for vehicle suspensions*", *Smart Mater. Struct.*, 19 (2010) 045003 (10pp), doi:10.1088/0964-1726/19/4/045003.

The research was financed by the Nucleu Programme, contract no. PN 09-35-01-01/2009 (5101/2009).

Innovative electric power grid protection device against low power factor electronic loads

ABSTRACT

Phase 1: - Partner 1 - ICPE-CA: Analyzing studies achieved at European or global level on how to release electronic equipment for household and industrial level, future trends of regulations.

INTRODUCTION

he work is based largely on *"Study about market survey on the competitiveness of electrical and electronic goods in the EU, focusing on pricing and pricing strategies",* which was finalized by DG Enterprise and Industry in early 2011. Competitiveness Study it is based on the results of the study "Comparison of the prices of electrical appliances throughout the European Community", carried out on behalf of DG Health and Consumers in 2009.

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STUDY

The increasing number of consumer electronics (digital devices) in the home along with a higher level of their use have led to a significant increase in energy consumption over the past decade. It is an opportunity for consumers to save energy bills directly by using a technology neutral.

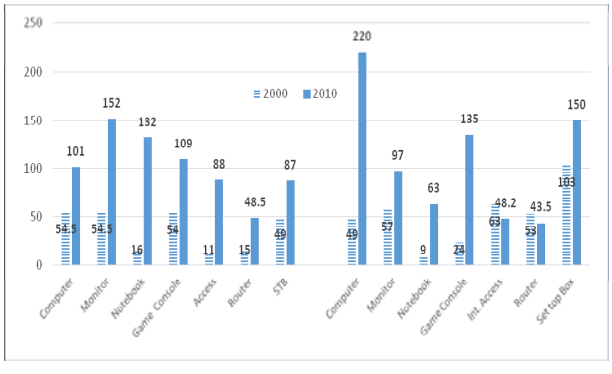

Fig. 1. Penetration and Use of Computers, Game Consoles and Network Connectivity Devices

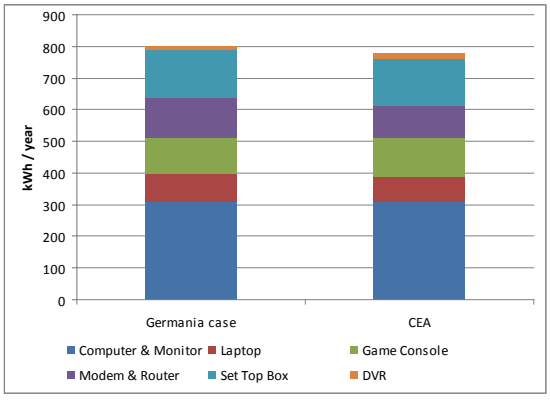

Fig. 2. Annual consumption of a household with one of each of the devices

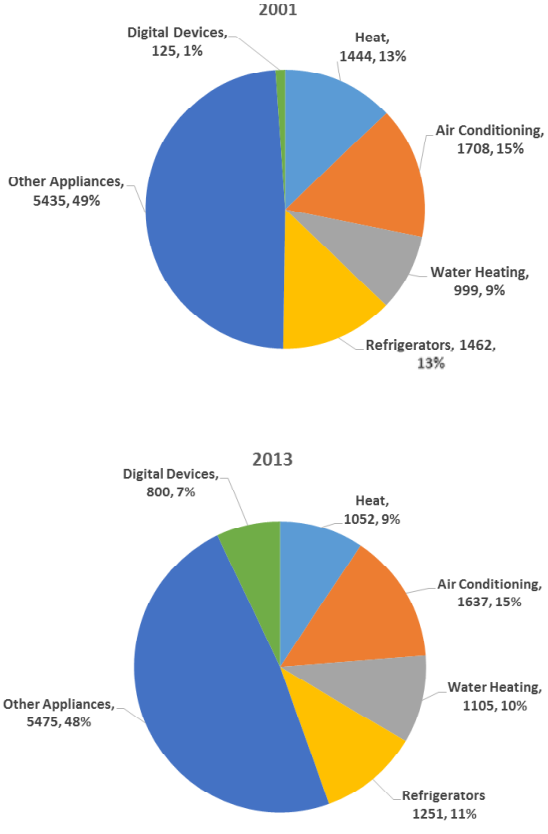

Fig. 3. National weighted average electricity consumption kWh/household

European Union nations imposed energy efficiency standards for vehicles, buildings, appliances and other electronics. Now, it can be again a leader to move on to standards of efficiency and, why not, performance standards for consumer electronics and digital devices. These standards should encourage the adoption of efficient technologies into products for energy savings.

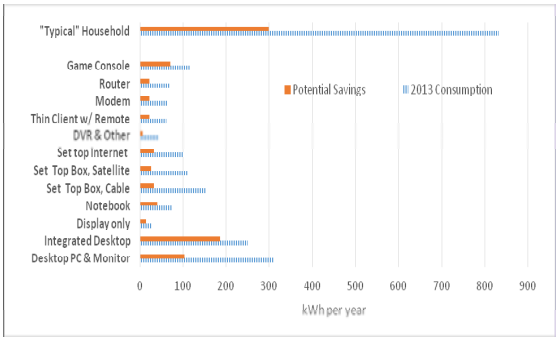

Fig. 4. Current electricity consumption and potential reductions

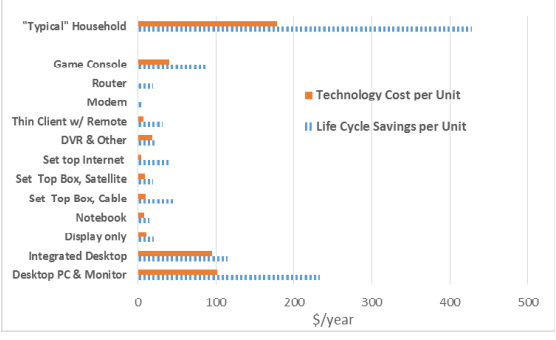

Fig. 5. Life Cycle Costs and Benefits of Reducing Electricity Consumption

RESULTS AND DISCUSSION

Technology Neutral: an approach by technology neutral to a long-term standard launched competition around the standard value that allows the industry to present consumers a wide range of options at the lowest possible cost.

Product neutral: performance standards are established for different levels of performance and features. Therefore, the standards may include preferences of the buyer and not seek to replace. Standard levels represent the playing field for the devices effectiveness.

Responsive to industry needs: Establish a long-term performance standard recognizes the need to maintain standards in contact with reality. The standards should be set at a moderately aggressive level, which is clearly beneficial, feasible and may take into account dynamic changes in technology.

Responsive to market needs: establishing standards in accordance with market needs. The standards do not require radical changes in the types or sizes of equipment in the industry, so the full range of options will be available on the market.

CONCLUSIONS

The opportunity objective of this research carried out in this stage of the project, both in terms of power quality and in terms of energy performance that must perform too these low power loads has been achieved by achieving report on how dispersion electronic equipment household and industrial level, and future trends of the regulations.

REFERENCES

Report based on findings of:

- Study on "Comparing electric appliances prices across the European Community" by GfK Retail and Technology on behalf of the European Commission, Directorate General for Health and Consumers, 2009
- "Study on the Competitiveness of EU electrical and electronics goods markets with a focus on pricing and pricing strategies" by Ecorys on behalf of the European Commission, Directorate General for Enterprise and Industry, 2011

The research was financed by PNCDI II Programme, contract no. 60/2014 (7105/2014).

Increasing the efficiency of the driving systems in the pumping equipments of the progressive cavity pumps used in the exploitation of oil and gas

ABSTRACT

Reducing production costs in oil exploitation industry requires the use of technologies and equipments with high efficiency. In this sense, for extraction of viscous crude oils from wells relatively high depths, lately was introduced and perfected the exploitation technology that uses progressive cavity pumps. Within this technology the researches have been oriented towards the development of durable equipments, with operating characteristics that meet the requirements of highly technical and economic indicators.

Innovative design solutions have been established and execution projects have been elaborated for pumping system with progressive cavity pump. These have focused on four distinctive categories system: electrical equipment, power transmission, drive device and progressive cavity pump.

INTRODUCTION

In the last period, for the extraction of the viscous crude oils with a high content of sand, it has been introduced and perfected the exploitation technology which uses progressive cavity pumps.

The pumping system of the progressive cavity pumps has several unique characteristics rendering it more advantageous over other methods of artificial lift, one of the most important its qualities the volumetric efficiency of the pump is the progressive cavity of the pump as compared to the one of the classic piston pump [1, 4, 5].

A progressing cavity pump system includes: downhole equipment (progressive pumps, sucker rod and production tubing strings) and surface drive equipment (a wellhead drive unit - drive head, power transmission equipment, a prime mover).

The power transmission equipment is used to transmit power (torque and speed) from the prime mover to the polished rod. This equipment almost always incorporates some type of speed reduction/ torque transfer system that allows the prime mover to operate at a higher speed and lower torque than the polished rod [1, 2, 5]. In some cases, power transmission components, such as gearboxes and fixed speed belts and sheaves, are integrated into the drive head [6, 7].

A variable speed drive system maximizes production by adapting to the changing conditions of the downhole production environment. This provides a critical advantage over constant speed controllers by allowing operators to adapt the operation of the system to meet the dynamics of the reservoir.

The prime mover provides the energy to drive the surface equipment and ultimately the rod string and downhole pump. The amount of power that the prime mover must deliver depends on the power demand at the polished rod and the efficiency of the power transmission system. In recent years, theuse of efficient permanent magnetic motors and innovative torque converters has shown gains in efficiency and costs as well as use in more diverse environments [2, 6, 7].

Surface-driven progressing cavity pumps systems require a sucker-rod string to transfer the torsional and axial loads from the surface drive system down to the bottomhole progressive cavity pump.

Surface-driven progressing cavity pumps systems require a sucker-rod string to transfer the torsional and axial loads from the surface drive system down to the bottomhole progressive cavity pump.

The pump consists of a rotating steel helical rotor and a helical rubber/elastomer stator. To improve the performance of the pump, the rotor is made of high strength hardfaced steel with abrasive resistent coatings, usually chrome plating and thermal spraying with WC-based and ceramic powder [4, 5, 6, 7].

The stator is made of a molded elastomer inside a metal tube body. To comply with the pumped fluid composition and its aggressivity, the companies elaborate different types of elastomer [1, 3, 4, 6, 7].

EXPERIMENTS

Using finite elements method for the predimensioning of the transversal geometry synchronous electric machine.

The analysis was performed by using a numerical calculation in the field of the electric machines with the help of the software package FLUX 2D, manufactured by CEDRAT, France.

Geometric Modeling in FLUX 2D

The 2D structure of the electromagnetic field from Fig. 1 contains the following regions with distinct physical properties:

- Tola stator, nonlinear magnetic region,, nonconductive;
- R+, R-, S+, S-, T+, T-, Nonconductive and non-magnetic regions characterizing the duction and return sides of the three windings of synchronous machine;
- Gap clearance, a delimitative region, located

between the statoric and the rotoric magnetic circuit for which the mesh grid reforms for each calculation separately;

- Air stator, air rotor, non-magnetic and nonconductive regions, located in the two reinforcements of the synchronous machine;
- MAGNETS, permanent magnet type regions, nonconductive.

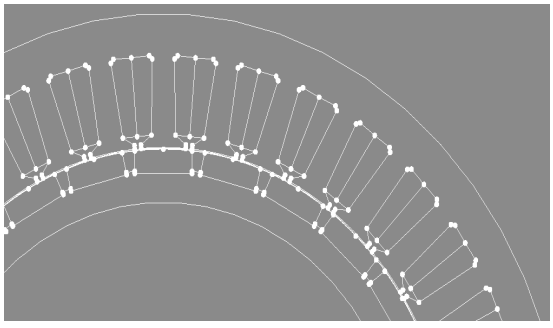

Fig. 1. Geometric Modeling of synchronous machine and map magnetic induction generated by presence of permanent magnets

The construction of the mesh in Fig. 2 is based largely on the use of option through which various characteristic lines of the computational domain are associated to the predefined desired size of the mesh.. This provides a finer grid in the area of the stator and rotor air gap from, where the magnetic induction has most important values and variations.

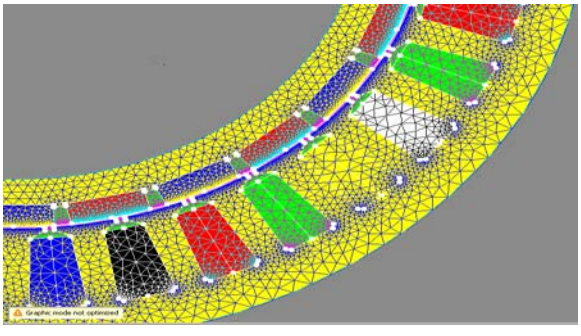

Fig. 2. The grid of finite elements of the computational

The determination couple of teeth

For the considered experimental model the problem of electromagnetic was solved field by using professional program FLUX 2D. It has been resolved the problems of the field in the magnetostatic regime and in the stationary magnetic regime with a very low rotation speed, n = 1/6 rpm (the equivalent performing a complete revolutions in 360 seconds, in order to equate to a multi-statics problem).

The results obtained from this program are represented by the maps induction in machine (fig.3).

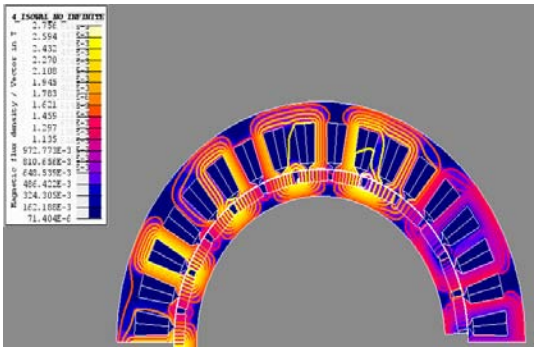

Fig.3. The distribution of Magnetic induction from the transverse geometry of permanent magnets synchronous

RESULTS AND DISCUSSIONS

To select a suitable configuration of the pumping system it was required a thorough analysis of a large number of factors such as: suction depth, the degree of improvement of system balancing, the volumetric efficiency of the pump, friction forces and the yield of surface mechanical of equipment.

Predimensioning of the pumping system with progressive cavity pump was made in two versions for the surface equipment:

1. variant A - drive permanent magnet synchronous electric motor;
2. variant B - asynchronous electric motor drive.

Both models are capable of ensuring the necessary rotational speed and of adapting the system depending on the flow rate of the probe in continuous mode (without having to stop the machine).

Using finite elements method for the predimensioning of the transversal geometry synchronous electric machine.

The execution documentation was carried out for the pumping system of the progressive cavity pump with electric motor asynchronous execution and it projects for: wellhead drive units (speed variator, reducer, drive heads, rod string backspin control devices) and depth equipment (progressive cavity pump, tubing anchors, tubing centralizers, protector).

In the proposed innovative solutions of equipments system, allow the use of operating technologies at the actual requirements, the high efficiency of the works and perform the functions necessary for safety operation conditions:

1. Suspension of the sucker rods string, ensuring the axial loads and torque required to the drive shaft,
2. Rotating the drive shaft to the necessary speed, reducing the power installed (and consumed) on each location for oil extraction, increasing the power factor of the electricity consumed. The construction solution allows engine the speed adjustment to the required value of progressive cavity pump and its variation depending on the value of the product flow rate through a frequency converter.
3. Ensuring the release of stored energy during stops, dynamics braking by passing the electric

machine engine from operating regime to generator regime and control debiting of generated energy on a load resistance. With this type of braking, the electric motor is loaded during reverse rotation, driven to act as a generator and making the transition recoil energy into electricity to be cut, in a controlled way on a load resistance, or sent back to network.

4. Increased drive reliability by reducing the moving mechanical elements.

5. Perfect sealing, electrical and mechanical parameters monitoring during oil extraction.

CONCLUSIONS

The innovative solutions present significant advantages contributing to increasing energy of energy efficiency, compared with the asynchronous motor the proposed solution shall submit a power factor greater than 95%, an yield higher than 92%, to yield losses lower than 27%, the quantity of active power saved $P_{ec.} \approx$ 30265 kWh/ year, the value of electric power savings in a year, $C_{ec.} \approx$ 5313 €/ year.

In this context, it is proposed that for the next step to draw predimensioning the drive system for an experimental model, formed consisting in: synchronous electric motor with permanent magnets, flexible coupling, the drive device of the sucker rods. Elaborating the technical documentation of the experimental model; the achievement and the testing of the experimental model under field conditions, in an crude oil production well.

REFERANCES

1. Klein, S.T., Thrasher, W.B., Mena, L. et al. 1999. Well Optimization Package for Progressive Cavity Pumping Systems. Presented at the SPE Mid-Continent Operations Symposium, Oklahoma City, Oklahoma, 28-31 March 1999. SPE-52162-MS.

2. Cholet, H. 1997. *Progressing Cavity Pumps*. Paris, France: Inst. Francais du Petrole.

3. Matthews, C.M. and Dunn, L.J. 1993. Drilling and Production Practices To Mitigate Sucker-Rod/ Tubing-Wear-Related Failures in Directional Wells. *SPE Prod & Oper* 8 (4): 251-259. SPE-22852-PA.

4. Wright, D. and Adair, R. 1993. Progressive Cavity Pumps Prove More Efficient in Mature Waterflood Tests. *Oil & Gas J.* 91 (32): 43.

5. Saveth, K.J., Klein, S.T., and Fisher, K.B. 1987. A Comparative Analysis of Efficiency and Horsepower Between Progressing Cavity Pumps and Plunger Pumps. Presented at the SPE Production Operations Symposium, Oklahoma City, Oklahoma, 8-10 March 1987. SPE-16194-MS.

6. *** Progressive cavity pump. Wikipedia, the free encyclopedia;

7. *** Progressive cavity pump, (PCP) systems. Petrowiki, SPE Internațional;

The research was financed by the Nucleu Programme, contract no. PN 09350201/2014 (F9/2014).

Membranes designed for forward osmosis process

(Increasing the efficiency of equipment and processes for the conversion of energy from renewable resources)

ABSTRACT

Separation of mixtures of constituents forming homogenous or heterogeneous systems existing in their natural state or operations resulting from physical and / or chemical processes is an important stage of a technology

Separations using membranes have been developed in the last 30 years up to industrial level , although the basic principles were known long ago. Currently, the field of membrane separations, aimed at researching and developing new materials to obtain membranes as well as related systems design. In this project was approached tackled topics of forward osmosis membrane materials, particularly self-assembled membranes. The main result of this project is to obtain self assembled membranes of based graphene oxide.

INTRODUCTION

Given the objective of this project is to study alternative energy aspects in osmotic processes, investigations conducted during 2014 aimed original approach to a very important element in an osmotic process , namely separation membrane. In this sense, the project open a new stage in the actual scientific trend, namely to address the self- assembly process by self-assembled graphene oxide membranes perspective.

Self-assemblied films / membranes based graphene

oxide is a topic widely publicized and discussed internationally by recognized research centers. Latest achievements in the field are mentioned by Massachusetts Institute of Technology (MIT) , Oak Ridge National Laboratory and King Fahd University of Petroleum and Minerals who began to make known its research since 2009 on the possibilities of making graphene-based membranes for desalination and nanofiltration processes.

Although the main US contractor on security issues, Lockheed Martin - (main contractor for the US Department of Energy and NASA) announced in 2013 the successful completion of a graphene -based membranes called "Perforene" for water desalination – *the moment of its commercialization is still far away.* However, in the WDR (water desalination report2014http://www.desalination.com/wdr/50/9/graphene-membrane-technology-update) states that research in this area are still emerging and the development of graphene based membrane for desalination applications at an industrial scale will require extensive research.

Research personal project

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Dr. Eng. Phys. Delia Pătroi, IDT 3

EXPERIMENTAL

Experiments held throughout 2014 aiming to produce self-assembled films based on graphene oxide. As a synthetic method for obtaining self-assembled films was approached top-down technique chemical exfoliation of graphite.

Overall, the suggested methodology by Hummers and Offeman [1] was applied to obtain graphite oxide.

Briefly, are presented the main steps of the applied technique is to remind:

1. Oxidation step : oxidation of a graphite substrate (natural graphite - 10mesh , 99.9 % (metal basis) Alfa Aesar) with a sulfonitric mixture - in the presence of an accelerator- followed bay a secondary oxidation with H_2O;
2. Filtration, removal of reagent excess by washing with HCl, up to a neutral pH;
3. Freeze drying;
4. Sonication in water/organic solvents;
5. Self-assembly - the self-assembled film-forming by heat treatment (temp. $<60°C$) of graphene oxide dissolved in deionized water / various organic solvents.

Fig. 1. Formation of self-assembled film based graphene oxide

The obtained films/self-assembled membranes were subjected to a first set of characterization which included primarily scanning electron microscopy investigations, FTIR analysis and electrochemical characterization (impedance spectroscopy and cyclic voltammetry) - analyses designed to establish applicative potential of synthesized graphene based materials.

RESULTA

Membrane-based materials of graphene oxide have recently been promoted for applications such as water filtration (direct osmosis, desalination). Capillarity developed in such membranes allows rapid permeation of water - such membranes /films behave as molecular sieves (*Science 14 February 2014: Vol.343, no.6172, pp.752,754, DOI: 10.1126 / science.12457*).

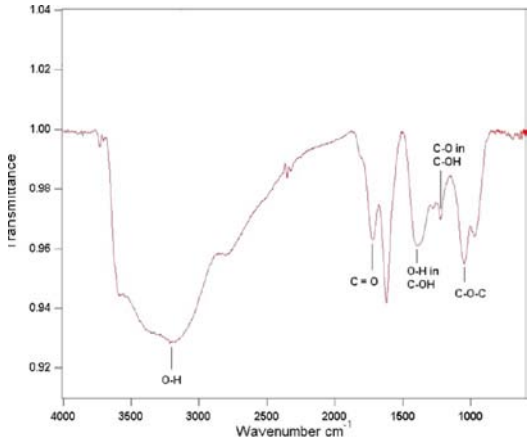
In the described context during 2014 was made a theoretical study on the self-assembly process (from natural processes to self-assembling synthetic materials) based on 117 citations meant to highlight the importance of this area in terms of application and scientific impact.

However, colloidal suspensions were obtained by sonication of graphite oxides obtained by: Hummers method, Brodie [2] and Hummers modified.

The self-assembly process has been highlighted by the formation of homogeneous and compact films without external intervention in aqueous graphene oxide

Have been obtained four (4) experimental self-assembled films based graphene oxide.

To obtain self-assembled films based on graphene oxide was used different concentrations of graphite oxide.



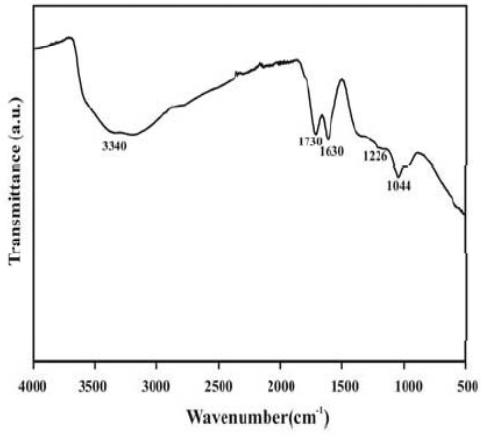


Fig. 2. FTIR spectra recordewd for graphene oxide films

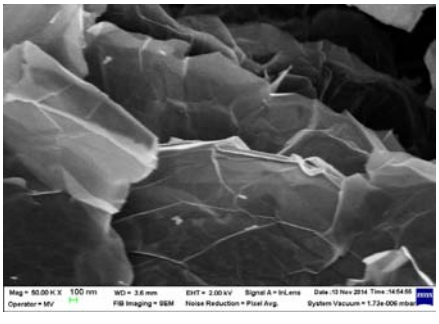


Fig. 3. SEM image of a self-assembled film based graphene oxide

Electrochemical characterisation

Were tested two types of self-assembled films in 2 experimental systems: a cell with two compartments, using a 2 - electrode system, and an open-cell - in a 3 - electrode system (the membranes were tested as the electrode);

Has been observed that:

- the stationary potential is maintained at a constant value, indicating a steady state of the system, both in the case of the system with membrane, as in the case of membranes placed in the test cell;
- on samples tested by electrochemical impedance spectroscopy was observed a well defined Debye semicircle which highlights their capacitive behavior;
- the value of the electrical double layer capacity determined by circular regression tests of electrochemical impedance spectroscopy (Nyquist diagram) is much higher in the case of the system without membrane (319.3 μF / cm^2) as compared with the capacities of the membranes placed in the test cell;
- the cyclovoltamogrames highlight the different nature of the electrochemical activity of the two types of membranes; practically one of them is active, the other insulates the electrode holder.

CONCLUSIONS

In the stages carried over to 2014, colloidal suspensions of graphene oxide were obtained by sonication of different types of graphite oxide obtained by: Hummers method, Brodie and Hummers amended [1].

The self-assembly process has been highlighted by the formation of homogeneous and compact films without external intervention in graphene oxide aqueous solutions.

4 variants of self-assembled graphene oxide based experimental films were obtained. The obtained films were characterized by:

- FTIR analysis to highlight any existing functional groups on the surface / in the base graphenic plan of the obtained graphene oxide;
- X-ray structural analysis - in order to highlight the peak corresponding to the graphene oxide (9-100, 2);
- Measuring the contact angle with water - in order to determine the hydrophobic / hydrophilic character of the films;
- Electrochemical characterization of films (as electrode and / or potential membrane material).

The conditions of the electrochemical test system are strongly dependent on the target application - therefore the measuring/test system should be re dimensioned - depending on the optimized target application for such materials.

The SEM analysis shows that the self-assembled films based on the graphene oxide layers consist of tightly packed, curved and raised units. The thickness of the curved regions was identified by electron microscopy data as being between 2 and 7 nm. These data suggest the formation of chemically reduced graphene oxide individual layers.

The results (the morphology of self-assembled films based on graphene oxide) are comparable with literature data (see report phase 2/2014) and certifies that the obtained films are based on graphene nanostructures.

At the macro level (5-10 cm diameter relative to films synthesized) the obtained samples are uniform.

At this experimental stage, the non-optimized method utilized to obtain the graphene-oxide based self assembled films can lead to large self-assembled membranes.

In order to establish the potential applications of these types of materials (self-assembled films based on graphene oxide) a comprehensive analysis is envisaged in the next stages of the project, on the dependence of the graphene films physicochemical characteristics related to graphene oxide synthesis stages and to graphene oxide reduction conditions.

REFERENCES

[1]. Hummers WS, Offeman RE, *Preparation of graphitic oxide*, J Am Chem Soc 1958; 80:1339–40.

[2]. Brodie BC, *Hydration behavior and dynamics of water molecules in graphite oxide*, Ann Chim Phys 1860; 59: 466–72.

The research was financed by the NUCLEU Programme, contract no. PN 09-35-02-01.

High-tech innovative cogeneration micropower plants with installed power of 200 kW

ABSTRACT

In the first phase of project was presented a state of art *for structures of electrical generators until 200 kW, 45000 rpm to 100000 rpm, which included overall structure, specific aspects, specific and critical electromechanical requests, performance, technological elements.*

There have been presented design elements for a 30 kW generator and 50000 rpm.

INTRODUCTION

A new field of applications which created particular pressure on designers of electrical generators, it was represented the gas exploitations or the biogas, exploitations that can generate high and very high pressures. Applications were correlated with another industrial and economic trend that of having local energy sources replacing the big powerplants, at which energy transmission proves to be expensive [1, 2, 3, 4]. Figure 1 presents a characteristic about power vs. speed with indicating applications, actually turbomachinery and it is estimated by authors between 2005 - 2020 [5].

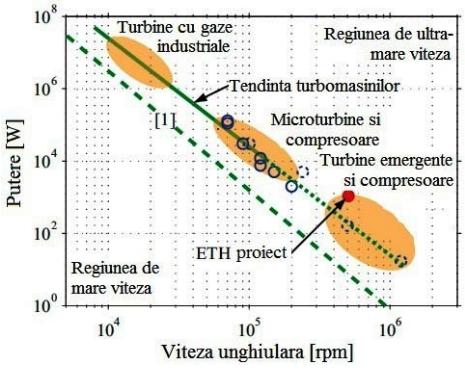


Fig. 1. Specific domain power versus speed [1]

These mutations due to objective requirements even led to the initiation and training, manufacturers and specific technologies of high speed machine [6].

The structures or topologies of high speed generators are generally synchronous machines with permanent magnets [7, 8]. They are most common. In figure 2 is shown such a topology, in which are shown: rotor with permanent magnets, the sleeve is inserted the permanent magnets and stator.

It adds structure of electrical machine with variable reluctance. In figure 2, sections through the two of generators with permanent magnets and the sleeve (a) and variable reluctance (b).

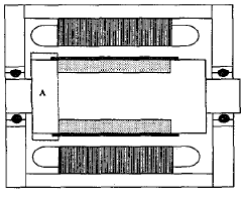
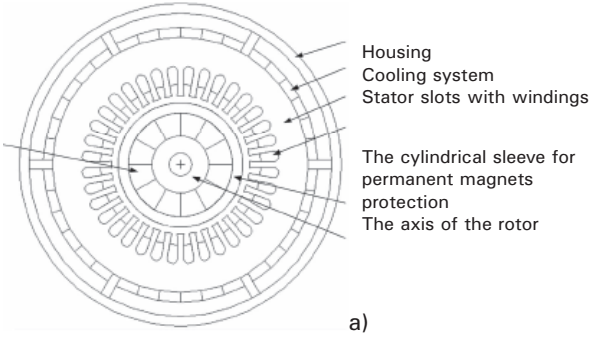


Fig. 2. High speed synchronous generator structure



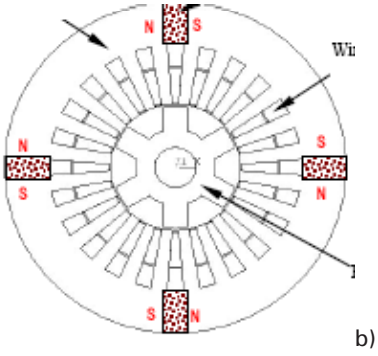


Fig. 3. Structures of rotor: a) Permanent magnet synchronous generator [2]; b) variable reluctance generator [3]

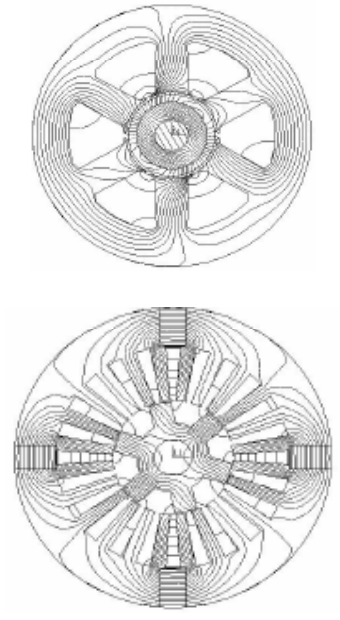


Fig. 4. Spectrum magnetic field in the two types of structures: a) with cylindrical permanent magnets and sleeve; b) with variable reluctance

Below is overheating in a high- speed turbine generator.

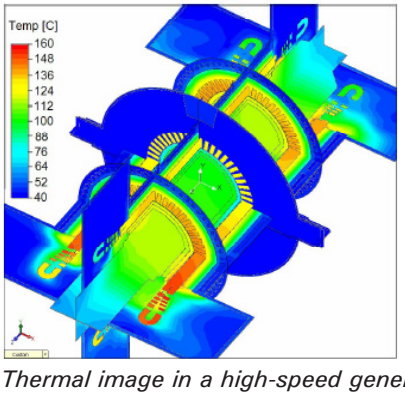


Fig. 5. Thermal image in a high-speed generator [9]

A table summarizes the elements of design for a 300 kW generator, 50000 rpm is shown in Table 1.

Using Flux 2D program, are presented below:

- figure 6 - Hanging torque characteristic (parasite);
- figure 7 - characteristic torque and acceleration;
- figure 8 - magnetic field (induction) in the magnetic circuit.

Table 1. Electrical parameters starting from the first iteration

Active power	30kW
Number of phases	m = 3
The number of pole pairs	2p = 2
Number of slots	18
Voltage [V]	220
Effective power [%]	85
Speed [rpm]	50000
Permanent magnets	Neodymium Iron Bor
Flux density (remanent) [T]	1,2
Diameter of permanent magnets [mm]	28
Diameter of titanium sleeve [mm]	30
Stator outside diameter [mm]	70
Active length generator [mm]	30
Electrical gap [mm]	2
Estimated losses in the stator core [kW]	0,65
Losses estimated in the winding [kW]	0,54
Bearings	with permanent magnets or self-supporting

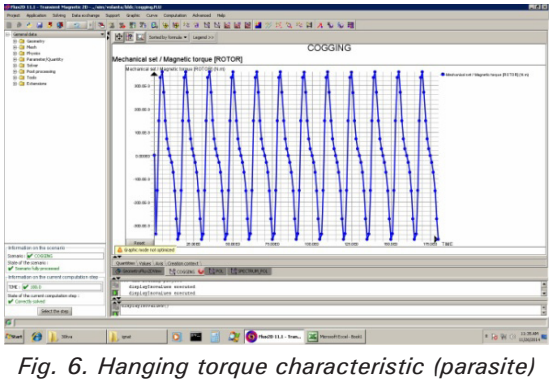


Fig. 6. Hanging torque characteristic (parasite)

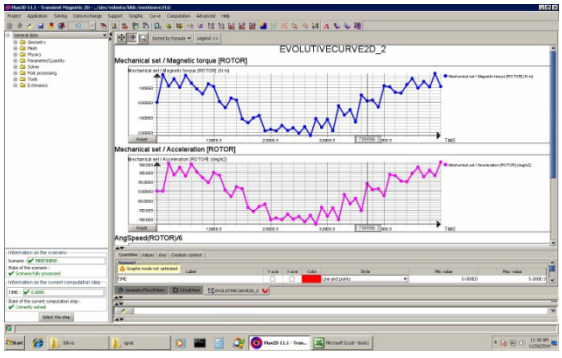


Fig. 7. The characteristic torque and acceleration

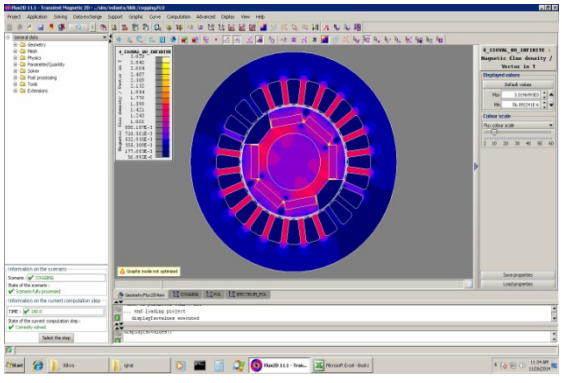


Fig. 8. The magnetic field (induction) in the magnetic circuit

A particular problem is the stresses which may occur: vibration, centrifugal forces, high linear speeds at the periphery of the rotor dynamic balancing technology which compared to the layout generator can not be performed only in one plane (see in fig. 9).

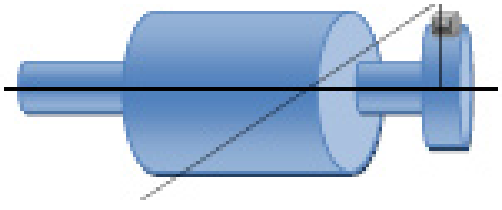


Fig. 9. With regard to the dynamic balance

Personal research project
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Techn. Ion Tinca
Techn. Luminiţa Gîrjoabă

RESULTS AND DISCUSSION

Results of the project whose completion date is November 2016 include: a prototype turbine generator 30 kW, 100000 rpm.

In phase were commented possible electromechanical structures and performed a design for a 30 kW generator.

It should be noted that the speed limit is linear on the periphery of the rotor does not exceed 200 m/s.

With increasing rotor speed and hence the size of the generator is reduced; for example, reaching a rotor diameter of 30-35 mm (the permanent magnets of the rare earths are introduced into a sleeve of titanium in order not to be destroyed by centrifugal force).

CONCLUSIONS

Development of a prototype turbine and generator will be possible at the end of 2015, when it will be possible to estimate with COMOTI technology that will achieve and the main turbine.

REFERENCES

[1] L. Novak, J. Novak, M. Novak, "*Electrically-driven compressors on turbocharged engines with high speed synchronous motors*", in: 8th International Symposium on Advanced Electromechanical Motion Systems & Electric Drives Joint Symposium, 2009, pp. 1-6.

[2] Hentz Bloch and Claire Soares, "*Turbo-expanders and Process Applications*", GP, 2001.

[3] A. El. Shahat, A. Keyani, H. El. Shewy, "*400 kW Six Analytical High Speed Generator Designs for Smart Grid Systems*", International Journal of Electrical and Electronics Engineering, 4:8, 2010, pp. 520-536.

[4] W. Fengxiang, Zh. Wenpeng, Z. Ming, W. Baoguo, "*Design Considerations of High Speed PM Generators for Micro Turbines*", Gas Turbine Generation Technology, Vol.1, jan.2001.

[5] C. Zwyssig, M. Duerr, D. Hassler, J. W. Kolar, "*An Ultra High Speed, 500000 rpm, 1 kW Electrical Drive System*", World Academy of Science, Engineering and Technology, 68, 2012, pp. 1577 - 1582.

[6] S. J. Chapman, Electric Machinery Fundamentals, Mc.Graw Hill, 4th ed., Boston, New York, 2005.

[7] F. Gieras, Advancements in Electric Machines, Springer, 2008.

[8] C. Deak, A. Binder, "*Highly utilized permanent magnet synchronous machines with tooth wound coils for industrial applications*", Proc. ELECTROMOTION, Lausanne, 2005.

[9] M. Sadeghierad, A. Darabi, H. Lesani, H. Monsef, "*Power to volume of high speed generators*", World Applied Sciences Journal 7(3), 2009, pp.393-398.

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A new low voltage contactor with vacuum commutation, of compact type

ABSTRACT

The overall objective of the project is to design and produce a series of low-voltage contactors with vacuum commutation with rated current of 200A, 315A, 400A and 630A, with small size which can be fitted in place of the classical electromagnetic contactors (with commutation in air) of 200A. The achievement of the general objective is possible through synergistic collaboration between four (4) partners (ICPE SA, INOE2000, INCDIE ICPE-CA, MEDAPTECH SRL) with experience in the field, under the coordination of UPB-CCSA (CO).

The role of INCDIE ICPE-CA is to conduct research in the field of the obtaining of vacuum contact parts with superior functional characteristics, coupled with the miniaturization of the commutation devices, in compliance with the environmental protection.

INTRODUCTION

In general, the requirements for the contact parts of the commutation devices used in vacuum (switches, contactors), such as erosion resistance, low tendency to welding, high electrical and thermal conductivity and high hardness, are dependent on the method of manufacture (infiltration, sintering) and can only be achieved if the contact material has a fine-grained and homogeneous microstructure [1-4].

A modern method for manufacture of the vacuum contact parts with superior functional performance is spark plasma sintering technique (SPS), which allows the obtaining of any composition, densities closer to the theoretical density and microstructures that retain the original properties of the components [5 -9].

In the previous research work (Stage II/2013), functional models (MF) of vacuum contact parts from W-Cu-(Ni), W-Ag and WC-Ag systems have been obtained by SPS method [10]. Among these, the most performant systems were those from the WC-Ag system with 40%Ag, sintered at 930°C, with 5 min. dwell time, that presented a high degree of compactity (95.23%), the highest values of Vickers hardness (136.25 HV) and modulus of elasticity (141.32 GPa) and, as well as the lowest values of the electrical resistivity (2.70 $\mu\Omega$xcm) and of the chopped medium current (I_{mediu} = 0.59 A).

The purpose of the researches in the Stage III/2014, consisted of physical, structural, mechanical, electrical and functional characterization of the FM models of vacuum contact parts from WC-40%Ag and WC-40%Ag-(0.5-5%Co) systems, obtained by SPS technique, as well as in the elaboration of a referential (technical specification) and of a prototype for a vacuum contact part.

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EXPERIMENTAL

For reaching these proposed objectives in 2014, the following experiments were performed:

- *There were performed 15 MF of vacuum contact parts,* with diameter of $20^{+0,5}$ mm and hight of $3^{+0,5}$ mm, from WC-Ag and WC-Ag-Co systems, by SPS technique;
- *There were characterized the MF vacuum contact parts* in terms of physical properties (density, residual porosity, degree of compactness, Vickers microhardness), electrical (conductivity and electrical resistivity), microstructural, mechanical (modulus of elasticity) and functional (chopped current).
- It was performed a technical specification entitled "*Contact parts for contactors with vacuum commutation*";
- It was performed a prototype entitled "*Contact piece for contactors with vacuum commutation*".

RESULTS AND DISCUSSIONS

- *There were characterized the elemental powders and the contact materials elaborated from homogeneous mixtures of* WC-40%Ag and WC-40%Ag-(0.5-5%)Co *powders composites,* in terms of morphological characteristics, chemical composition and particles size;
- *There were performed the following MF vacuum contact parts, with diameter of $20^{+0,5}$ mm and height of $3^{+0,5}$ mm by SPS technique:*

✓ **4 MF vacuum contact parts from WC-Ag system (40%Ag and WC rest),** elaborated from mixtures

of elemental powders made by simple homogenization (OM), in a homogenizer of Turbula type, for 5 hrs. and plasma sintered (SPS-ed) in the interval 925-940°C, with a plateau of 5 minutes;

✓ ***3 MF vacuum contact parts from WC-Ag-Co* (40%Ag, 0.5%Co and WC rest)***, Fig. 1,* elaborated by OM in a homogenizer of Turbula type, for 10 hrs. and SPS-ed in the interval 920-930°C, with a holding time of 5 minutes;

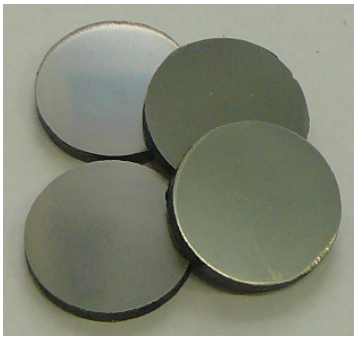

Fig. 1. MF from the WC-Ag-Co system

✓ ***4 MF vacuum contact parts from WC-Ag-Co* (40%Ag, 2%Co and WC rest)***,* elaborated by OM in a homogenizer of Turbula type, for 5 hrs., and SPS-ed in the interval of 920-930°C, with a plateau of 5 minutes;

✓ **4 MF vacuum contact parts from *WC-Ag*-Co system (40%Ag, 5%Co and rest WC)***,* elaborated by OM in a homogenizer of Turbula type, for 5 hrs. and SPS-ed in the interval of 920-930°C, with a holding time of 3-5 minutes;

• *There were characterized MF from the WC-Ag and WC-Ag-Co systems* in regard to the microstructure characteristics, noting the obtaining of fine and homogeneous microstructures, with an uniform distribution of particles into the matrix and a reduced degree of remanent porosity, at the optimum sintering parameters:

- *WC-40%Ag:* 925-930°C/5 min.;
- *WC-40%Ag-0.5%Co:* 920-925°C/5 min. (Fig. 2);
- *WC-40%Ag-2%Co:* 920-925°C/3-5 min.;
- *WC-40%Ag-5%Co:* 920°C/3-5 min.

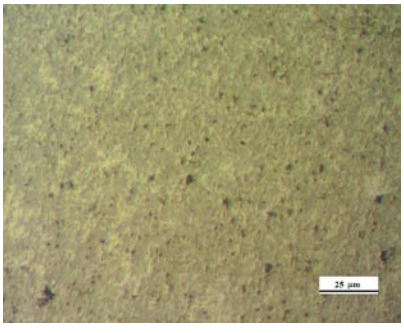

Fig. 2. MO image of the WC-40%Ag-0.5%Co contact piece (MF2.3 specimen code), sintered by SPS at 925°C/5 min (b), state: un-attacked

• *There were analyzed the physical, mechanical, electrical and functional characteristics* of the obtained MF, ascertaining the following:

- **for the *WC-40%Ag* contact parts**

▪ For the contact material plasma sintered at 925°C/5min, the highest value of the relative density (96.66 %), corresponding to a reduced remanent porosity (3.34 %) was obtained;

▪ these contact materials had the highest values of Vickers hardness (178.54 HV) and Young Modulus (206.645 GPa) due to the increasing of the homogeneity degree and decreasing of the porosity when sintered at 925°C, with a holding time of 5 minutes;

▪ the highest values of the electrical conductivity (21.75 m/Ω.mm^2) and the lowest value of the electrical resistivity, respectively, have been obtained for the WC-40%Ag contact materials sintered in the interval of 925-930°C / 5 min., who had the most homogeneous microstructures and lowest residual porosity (3.34 to 4.18%);

- **for contacts parts of WC-40%Ag-0.5%Co, WC-40%Ag-2%Co and WC-40%Ag-5%Co**

▪ introduction of Co content (0.5-5%) in contact materials of WC-40%Ag improves the speed of diffusion of particles, sinter necks grow faster and degree of densification of contact materials increases, while the porosity is reduced to 2.37 -4.74%, corresponding to the degree of compaction from 97.63 to 95.26%;

▪ due to increasing of degree of homogeneity and reduction of porosity at temperatures of sintering between 920-925°C and sintering duration of 5 minutes, the WC - 40% Ag with Co = 0.5-5% contact materials showed the highest values of Vickers hardness (200 HV);

▪ for the vacuum contact parts with structural homogeneity and low porosity and low content of Co (0.5%), the electrical conductivity values were still high (21.50 to 21.75 m/Ω.mm^2).

▪ increasing of Co content from 2 to 5% for the parts with structural homogeneity and low porosity determined the decrease in the electrical conductivity from 19.0-19.5m/Ω.mm^2 to 16-16.25 m/Ω.mm^2, givien that the value of the electrical resistivity for both WC (~ 20 $\mu\Omega$xcm) and for Co (6.24 $\mu\Omega$xcm) are greater than the electrical resistivity of silver (1.613 $\mu\Omega$xcm);

▪ the contact parts with more than 0.5% Co, structurally homogeneous and with low degree of porosity, have shown values of the modulus of elasticity in the range 150-180 GPa;

▪ increasing of Co content from 0.5% to 5% caused a slight increase in average chopped current values, from 0.39 A to 0.53 A.

• *It was developed a referential (technical specification) titled* ***"Contact parts for contactors with vacuum switching"*** *(ST 108/11.12.2014*), with reference to the parts of electrical contact based on tungsten carbide, for contactors with vacuum switching of low and medium voltage.

• ***A prototype of vacuum contact part*** *was developed, called* ***"The contact part for contactors with vacuum switching"*** *with cylindrical form dimensions:*

diameter $20^{+0,5}$ *mm and height* $3^{+0,5}$ *mm, from the contact material of WC-4%Ag-0.5%Co.*

- *The results obtained during the research work of the project were disseminated by three scientific ISI articles and participation in technical and scientific events, respectively:*
- Violeta Tsakiris, *Electrical Contacts for Low Voltage Vacuum* (Product and Data sheet) - International Technical Fair TIB 2014, 15-18 oct., Bucharest;
- Violeta Tsakiris, *Procedure for obtaining of a composite material based on tungsten for electrical contacts* (Technological Sheet), Bucharest, International Technical Fair TIB 2014, 15-18 oct., Bucharest;
- V. Tsakiris, M. Lungu, E. Enescu, D. Pavelescu, G. Dumitrescu, A. Radulian, V. Braic, *W-Cu composite materials for electrical contacts used in vacuum contactors,* Optoelectronics and Advanced Materials,Vol. 15, No. 9 - 10, September – October 2013, p. 1090-1094;
- Violeta Tsakiris, Magdalena Lungu, Elena Enescu, Dan Pavelescu, Gheorghe Dumitrescu, Alexandru Radulian, Nicolae Mocioi, *Nanostructured W-Cu electrical contact materials processed by hot isostatic pressing*, Acta Physica Polonica A, Vol 125 (2014), No. 2, p. 348-352, ISSN: [e]1898-794X; [p]0587-4246;
- M. Lungu, V. Tsakiris, E. Enescu, D. Patroi, V. Marinescu, D. Talpeanu, D. Pavelescu, Ghe. Dumitrescu, A. Radulian, *Development ofW-Cu-Ni electrical contact materials with enhanced mechanical properties by spark plasma sintering process*, Acta Physica Polonica A, Vol 125 (2014), No. 2, p. 327-330, ISSN: [e]1898-794X ; [p]0587-4246.

CONCLUSIONS

All contact materials obtained by simple homogenization for 5 h, and processed by SPS at sintering optimal parameters *(925-930/5 min. pentru WC-40%Ag; 920-925°C/5min. pentru WC-40%Ag-0,5%Co; 920-925°C/3-5 min pentru WC-40%Ag-2%Co; 920°C/3-5min pentru WC-40%Ag-5%Co)*, presented very good results in functional testing, with average and maximum values of the chopped current up to 0.53 A and up to 0.97 A, respectively.

Among all studied compositions, a prototype of vacuum contact part corresponding to the contact material WC-40%Ag-0.5%Co (MF2.3) was selected, which shows a high degree of compactness (97.56%) and structural homogeneity, high values of Vickers hardness (HV 207.52), Young's modulus (182.068 GPa) and electrical conductivity (21.75 m/Ω.mm^2) and the smallest average value (0.39 A) and of the maximum value (0.75 A) of the chopped current, respectively.

REFERENCES

[1]. Slade G., *Electric Contacts for Power Interruption: A Review*, 20th ICEC, 2000, pp. 239 – 245.

[2]. Ludwar, W.F. Rieder, Proc. 13-th Int. Conf. on Electric Contacts, Lausanne, 1986, p.156.

[3]. Kim J C and Moon I H., *Sintering of Nanostructured W-Cu Alloys Prepared by Mechanical Alloying,* J. NanoStructured Materials, 2002, 335(1-2), pp. 283-290.

[4]. Z. Qiaoxin, S. Xiaoliang, Y. Hua, D. Xinglong, *Microstructure and Properties of W-15Cu Alloys Prepared by Mechanical Alloying and Spark Plasma Sintering Process*, Journal of Wuhan University of Technology, Mater. Sci. Ed, 2008, p. 401.

[5]. Z.A. Munir, U. Anselmi-Tamburini, *The effect of electric field and pressure on the synthesis and consolidation of materials: A review of the spark plasma sintering method*, Journal of Materials Science, Vol. 41 (2006), pp. 763–777.

[6]. R. Orru, R. Licheri, A. M. Locci, A. Cincotti, G. Cao, *Consolidation/synthesis of materials by electric current activated/assisted sintering*, Mat. Sci. Eng. R, Vol. 63 (2009), pp. 127–287.

[7]. M. Mulukutla, A. Singh, S.P. Harimkar, *Spark Plasma Sintering for Multi-scale Surface Engineering of Materials*, JOM, Vol. 62, Nr. 6 (2010), pp. 65–71.

[8]. J.J. Raharijaona, J.M. Missiaen, and D. Bouvard, *A Phenomenological Analysis of Sintering Mechanisms of W-Cu from the Effect of Copper Content on Densification Kinetics*, Metallurgical And Materials Transactions A, Volume 42A, August 2011, pp. 2411-2419.

[9]. Wenge Chen, Zhanying Kang, and Bingjun Ding, *Preparation and Arc Breakdown Behavior of Nanocristalline W-Cu Electrical Contact Materials*, J. Mater. Sci. Technol, Vol. 21, No. 6, 2005, pp. 875-878.

[10]. V. Tsakiris, *A new low voltage contactor with vacuum commutation, of compact type* (Contract no. 34/2012), Stage Report 2/2013: Realization of functional models (MF) of contactors.

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Environment energy harvesting hybrid system by photovoltaic and piezoelectric conversion, DC/DC transformation with MEMS integration and adaptive storage

ABSTRACT

Eborating a MEMS micro-transformer experimental model, with magnetic nano-fluid and ferrite core is a central objective of the project. For this purpose, a concept miniature transformer windings planar spiral develops. The transformer case, which is part of the magnetic circuit, is made of ferrite. For the magnetic core between the two windings of transformers are considered two variants: ferrite or super paramagnetic nano-fluid NF-SPM. The planar two windings are made of copper, rectangular profile size 50 × 50 μm, made in MEMS technology LIGA type, on ceramic substrate. The case is made of ferrite and the magnetic core is made of NF-SPM.

INTRODUCTION

The "Environment energy harvesting hybrid system by photovoltaic and piezoelectric conversion, DC/DC transformation with MEMS integration and adaptive storage" project aims to achieve in the Phase 1 development of the experimental model of MEMS micro-transformer with magnetic nano-fluid core and ferrite. Physical and mathematical and numerical models 2D or more detailed 3D are used to electromagnetic field simulation steady and electrostatic field simulation, for both types of magnetic core, ferrite or NF-SPM. The results are used for determination of electrical parameters concentrated of the TPS [1-3], (own inductance, mutual and capacitance own and capacities coupling), which are interesting in its integration in the design of electrical circuit of the converter which includes TPS. In this study, for the NF-SPM core is studied the core fluid movement under the forces of magnetization, for different winding power schemes, [4-5]. Also, in order to achieve transformer coils, [6], TPS 2: 1 magnetic core hybrid NFSPM / ferrite LIGA technology is proposed. A method of synthesis by chemical co-precipitation of magnetite nanoparticles (NPM) surfactant (hydrophobic or hydrophilic) and a laboratory preparation scheme of magnetic fluids based on non-polar organic solvent (transformer oil) is proposed.

Using a magnetic nanofluid as a liquid core in a planar high frequency microtransformator requires analyzing electrical characteristics of the base fluid, [7], (resistivity and electrical conductivity, electrical permittivity) and analyzing the electrical characteristics of magnetic nanoparticles (which depend primarily on their nature) as well those of the surfactant used for estimate working conditions (voltage, current, frequency, etc.).

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RESULTS AND DISCUSSIONS

For TPS with ferrite magnetic core, Fig. 1, were conducted parametric studies on 3D models to determine the μ_r influence of ferrite and the distance between planar coils "d" on their inductance. Thus, L_{ii} varies quasi-linear with ferrite μ_r (variation <2%). L_{ii} increases with d, tending to a constant value for d> 1.5 mm. L_{ij} decreases with d, and tends to a constant value for d <1 mm. It was studied the dependence of the coupling factor $k = M/\sqrt{L_1 L_2}$ of d. One explanation for poor coupling factor is high relative permittivity value of the core (μ_r = 1000) than that of the ceramic substrate (μ_r = 1). A method of improving the coupling factor can be using supports made from ferrite, for example. Replacing ceramic supports with ferrite leads to a substantial increase in own inductance of TPS. Significant improvements were observed for both the mutual inductance, L_{ij}, and the coupling factor, which in this configuration get to k = 0.5 for a core d = 0.25 mm height. Planar transformer capacity was calculated analytically by reducing the problem of electrostatic field to numerical model of the planar capacitor (2D and 3D models). For TPS model 1:2 Fig. 2, which was reduced for reasons of symmetry to one-eighth, a series of numerical parametric studies, on 3D computational domain were made. The effects of the field produced by the winding terminals were neglected.

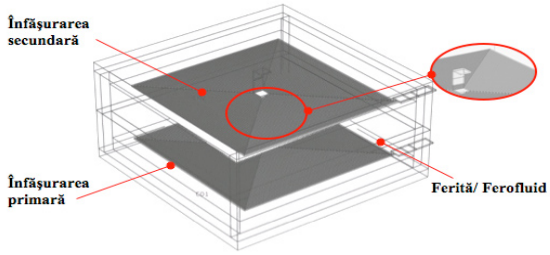

Fig. 1. TPS CAD model for galvanic isolation – turns ratio 1:1

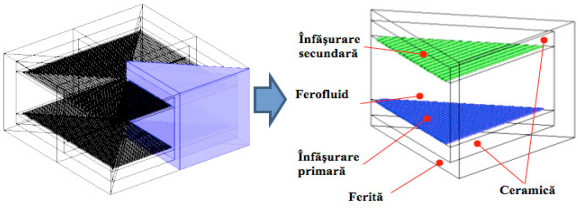

Fig. 2. TPS CAD model – turns ratio 1:2

Core magnetic nano-fluid flow was modeled for the four modes of supply of the windings. Magnetization forces which drives the flow was taken from the magnetic field problem. It took into account the contribution of gravity.

Published work:

Lucian Pîslaru-Dănescu, Laurenţiu Constantin Lipan, Ioana Pisică, Ion Daniel Ilina, Alina Dumitru, *New energy harvesting systems, designed for new piezoelectric transducers, with charging energy management*, 2014 International Conference and Exposition on Electrical and Power Engineering, EPE 2014, October 16-18, 2014, Iasi, ISSN: 978-1-4799-5848-1, **IEEE Catalog Number CFP1447S-USB, IEEE meetings database as conference record #33577**

CONCLUSIONS

A physical model and numerical mathematics was developed. Two types of electrical transformers with planar spiral windings realized in MEMS LIGA technology were analyzed: a model with transformation ratio 1:1, for galvanic isolation and a model with transformer ratio 1:2. It evidenced the production technology of transformer TPS 2:1 with hybrid magnetic core, NFSPM / ferrite. Laboratory technology for producing magnetic nanofluids in order to use as liquid core, including laboratory preparation scheme of magnetic fluids based on non-polar organic solvent are presented. There are also studied required magnetic, rheological, structural, electrical and heating properties of magnetic nanofluids to be used as magnetic core liquid.

Also in this phase of the project functional parameters of a model of MEMS micro-transformer with magnetic nano-fluid and ferrite core are analized using numerical simulation in the following cases: TPS for galvanic isolation, TPS with transformation ratio 1: 2.

REFERENCES

[1] Jean Bogdan Dumitru, Alexandru Morega, Lucian Dănescu Pîslaru, Mihaela Morega, "*Numerical modelling of the electric and magnetic phenomena in a planar transformer made in MEMS technology*", Electric Machinery Symposium SME'12.

[2] Jean Bogdan Dumitru, Alexandru Morega, Mihaela Morega, Lucian Pîslaru-Dănescu, "*Analysis of a miniature planar transformer with core magnetic nanofluid*", Electric Machinery Symposium SME'13.

[3] A.M. Morega, M. Morega, L. Pîslaru-Dănescu, J.B. Dumitru, V. Stoica, "*Magnetic and electric sizing of a miniature planar spiral transformer*", Proc. of the 7th International Conference on Electrical and Power Engineering, EPE 2012, 25-27 October 2012, Iaşi, Romania. IEEE Xplore.

[4] A.M. Morega, L. Pîslaru-Dănescu, M. Morega, "*A novel nanoparticles magnetic fluid microactuator device*", Proc. of the 13th Int. Conference on Optimization of Electrical and Electronic Equipment, OPTIM 2012, 24-26 May 2012, Brasov, Romania, paper RD-006602, IEEE-Xplore.

[5] J.B. Dumitru, A.M. Morega, L. Pîslaru-Dănescu, M. Morega, "*A parametric study of lumped circuit parameters of a miniature planar spiral transformer*", ATEE 2013, ISBN 978-1-4673-5978-8, IEEE Xplore.

[6] Sadler, D.J., Gupta, S., Ahn, Chong H., "Micromachined spiral inductors using UV-LIGA techniques", Magnetics, IEEE Transactions on,Volume:37, Issue: 4, 2001.

[7] Alexandru M. Morega, Mihaela Morega, Jean B. Dumitru, *"Magnetic Field* – Flow Interactions in a Miniature electric power Transformer with Magnetic Nanofluid Core and solenoid type coils", Rev. Roum. Sci. Techn.– Électrotechn. et Énerg., 58 , Bucureşti, 2013.

The research was financed by the National Programme of Research, Development and Innovation - PNCDI II, contract no. 63/2014 (4312/2014).

Micro Electro-Mechanical Components and Systems (MEMS) developed by specific technologies with applications in medicine, micro fluidics and micro electrical machines and micro – actuators execution

ABSTRACT

Under the project continued research falling under the general theme of the project conducted in four phases during 2014. We have optimized systems with inertial reaction wheels, we conceived, designed and developed a linear electromagnetic generator type harvesting - electromagnetic damper, we performed measurements to characterize electrical transformer-planar ferrite core compared to the classical solution (transformer coils) and was sized prototype using innovative materials and processes. We performed experiments to achieve a flexible nanocomposite material (MNF) with piezoelectric for energy harvesting applications. We dimensioned, executed and tested a preliminary conversion harvesting microgenerators wind and hydroelectric conversion, based on piezoelectric and electrostrictive effects. We have set up a Center of Excellence in Scientific Research Initiation for Young Olympians, establishing centers of excellence management structure, admission criteria and evaluation at the center and the general methodology of initiation.

INTRODUCTION

Were continued research and have made contributions to be entered in the general theme of the project: development of microelectromechanical systems MEMS components and technologies with specific applications in medicine, microfluidic and electrical engineering. Multidisciplinary collective, based on detailed knowledge worldwide, through careful design, simulation and testing made a series of actuators, micro and complex microdevices.

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Dr. Eng. Cristinel Ilie

RESULTS AND DISCUSSIONS

Regarding micro inertial reaction wheels we proceeded to the optimization of micro reaction wheels to be used to guide satellites. Were designed, scaled and redesigned some reactive micro-rotor inertia.

Regarding ambient vibration energy conversion into electricity via electromagnetic induction generator/ converter was designed electromagnetic shock absorber used in regenerative automotive suspensions.

It was investigated the time evolution of electricity demand for MEMS applications supply using energy recovery ("energy harvesting") in the environment from one or more sources of energy (eg .: thermal, solar, wind, mechanical, chemical, etc.).

We presented the possibilities for energy recovery and a mechanical model with two degrees of freedom with self regenerative active suspension.

We analyzed three variants of electromagnetic suspensions: linear electromagnetic generator, ball screw, rack pinion. The linear electromagnetic generator construction is shown in fig. 1.

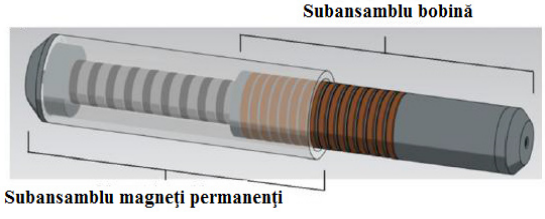

Fig. 1. Linear electromagnetic generator type harvesting

We designed and developed a functional model for linear electromagnetic generator type harvesting that converts energy ambient vibrations into electrical energy by electromagnetic induction.

Fig. 2 presents a linear electromagnetic generator coil type harvesting (electromagnetic damper).

Fig. 2. Coil - electromagnetic generator (electromagnetic damper)

Regarding planar transformers, given the specific application (running at high frequencies - up to 500kHz), in order to establish design parameters and constructive solutions to minimize losses, the issue was addressed in dynamic electrical characterization.

It was compared two types of windings (classic and planar) on the same ferrite core. The losses were determined, and the efficiency was 87.6% for planar transformer and 90.1% for wound -transformer. The two transformers have approximately the same efficiency, advantage planar transformer being reduced geometry with high applicability in printed circuits.

After performing complex electrical measurements made on the experimental model, defined criteria optimization parameter values focus of equivalent schema that defines the transformer.

Regarding the nanocomposite flexible piezoelectric properties of nanoparticle synthesis was performed barium titanate (BT) by co-precipitation method, route oxalate and lead zirconate titanate nanoparticles modified (PZT) solid state reactions and advanced grinding the mill atrittor.

To achieve flexible piezoelectric nanocomposite, we experimented 12 variants of composition.

Characterization of the dielectric constant of the nanocomposite flexible in the frequency range 0,4Hz - 500kHz, revealed that the relative dielectric permittivity values are <7.5 and the dielectric loss were $<7,6x10^{-3}$

We have determined electric hysteresis loop for all flexible composite samples. All samples showed ferroelectrics. Composite samples were flexible piezoelectric characterized by raising the impedance curve in the frequency domain, 0.4Hz 500kHz. Since the resonance frequency and antiresonance frequency was calculated electromechanical coupling coefficient Kp.

In the ICPE-CA was created a *Center of Initiation in Scientific Research*, based on the leading college students in the capital: Tudor Vianu College, Sfântul Sava College, Grigore Moisil College, Gh. Lazar College. In the center there are 4 teams base, with as many workshops, participating in prestigious national and international competitions: Workshop 1. The spider is changing the game in the industry adhesives, Workshop 2. The energy Harvesting, Workshop 3. The bionic research on applications with MEMS (Micro-Electromechanical Systems), Workshop 4. Hystory, Workshop 5. The biomedical research workshop (ESCULAP) *is under construction*.

Regarding the harvesting microgenerators based on direct piezoelectric effect and the directly electrostrictive effect was approached two types: with primary source wind and with primary source hydrodynamic energy (wave regime and drop drops). We proposed several general geometries unconventional structure: the structure plate, plate type structure with slides extensions recessed cylindrical structure, spherical structures. Experiments were performed for the 4 main structures under wind harvesting microgenerators. For tests on primary conversion wind was built open aerodynamic microtunnel.

Fig. 3. Micro wind tunnel with constant section

CONCLUSIONS

Activities leading to the achievement of objectives. Redesign, resize and optimize micro inertial reaction wheels driven by static switching consisted in moment of inertia and initial angular momentum and winding micromotor optimization.

We established formulas for electromagnetic parameters of a harvesting generator - electromagnetic damper and established a mathematical model to simulate its operation.

We have designed a functional model of linear electromagnetic harvesting generator with application in the automotive field (electromagnetic damper). He created a functional model of linear electromagnetic harvesting generator.

We have implemented a comprehensive characterization of ferrite core transformers at relatively high frequencies (100 kHz). He designed a small transformer, based on planar technology, using innovative materials and processes.

To achieve flexible nanocomposite was tested achieving a flexible nanocomposite material (MNF) with piezoelectric properties for energy harvesting application.

Flexible nanocomposite material was made by dispersing nanoparticles of barium titanate piezoelectric type (BT) or modified lead zirconate titanate (PZT) by the ultrasounds and magnetic stirring in a matrix of

a silicone rubber-like elastomer at room temperature with curing catalyst.

Creating a center of excellence in INCDIE ICPE-CA is the first time in Romania. Analysis was performed on some steps on the establishment of such centers, a structure of an introductory course in scientific research and study on the establishment of the themes, workshops on topical research and teams.

We conducted experimental models of micro wind generators conversion and experimental models of micro generators based on hydrodynamic conversion and electrostrictive piezoelectric effect. He developed a system for testing a test wind and hydrodynamic - for waves and a device for experiencing drops regime.

The results were disseminated in prestigious journals.

The research was financed by NUCLEU Programme, contract no. PN09350101 / 2009.

ENVIRONMENT

Environmental issues specific to the oil industry: waste management and recovery/recycling solutions

ABSTRACT

Two environment issues specific for oil industry were addressed in the project:

1. Waste management, according to the specific categories of activities: drilling, extraction and refining.

Besides the identification of industrial wastes treatment methods and of oil wastes recovery/recycling solutions, the project also contains a case study presenting how a representative entity for the oil industry performs the waste management (Petrotel Lukoil SA Ploieşti Refinery).

2. Physical and chemical depollution methods for water and soil, including a comparative analysis of the depollution methods and facilities.

INTRODUCTION

Taking into account the sustainable development and the long term ensuring of the appropriate living and working conditions, the environment issue is of major interest.

The environment issue is highly complex, including:

- analysis and evaluation of the environment factors;
- assessment and monitoring the residues/pollutants resulting from the human activities;
- actions for the emissions and pollutants treatment, such as:
  - retention;
  - neutralization;
  - treatment/extraction and recovery etc.

Worldwide, there is a trend to develop simple, rapid, cheap and efficient methods applicable in-situ, to block the pollutants migration from the oil discharge area to underground or surrounding areas, destroy the pollutants and restore the natural environment.

The overall objective of the project *„Device for CO2 detection and retention"* is an analysis of the environmental factors, industrial pollutants and innovative technical solutions to retain and treat anthropogenic emissions and wastes.

The general objective of the phase no. 1/2014 is an analysis of the oil industry specific waste management.

The general objective of the phase no. 2/2014 is to study the physical and chemical depollution methods for water and soil, applicable for the oil industry.

Research staff of the project

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Members:

Eng. Hermina Moscaliuc

PhD. Eng. Georgiana Marin

Eng. Aurelian Filip

RESULTS AND DISCUSSIONS

The project: "Device for CO_2 detection and retention" had the following phases in 2014:

Phase no. 1: "Study regarding the environmental issues specific for the oil industry: monitoring the quality indicators of the environmental factors and waste management";

Phase no. 2: "Physical and chemical depollution methods for water and soil, applicable for the oil industry".

The following activities were performed during the first phase:

- the analysis of the industrial waste treatment methods in order to neutralize their adverse effects;
- the identification of the treatment methods applicable for the oil industry specific wastes;
- recovery/recycling solutions for oil wastes, as appropriate;
- measures for controlled temporary and / or final storage.

The main waste treatment methods were presented, classified as follows:

- mechanical methods: size reduction, sorting, compacting;
- physico-chemical methods: stabilization/solidification, gravitational separation, centrifuging, filtration etc.;
- thermal methods incineration/ co-incineration, pyrolysis, thermal desorption, drying;
- biological methods: aerobic and anaerobic.

For all the treatment methods it was presented the operating principle and the types of waste the method is applicable for.

There were identified the treatment methods applicable for the wastes specific to the oil industry, categorized by activities: drilling, extraction and refining.

Much of the industrial wastes can be recovered / recycled in several ways.

The following recovery/recycling solutions for oil

wastes were identified:

- exploitation of acid tars as *energetic mixtures, hot coating and bitumen*, as *industrial liquid fuel* or as *road binding material* or *electrodes binders*;

- wastes recovery / recycling in refineries: heavy oil slops, spent catalysts, spent caustics, gases containing sulphur and sulphuric acid, sour waters and filter clays.

There were also presented measures for recovery/ recycling/re-using nonspecific wastes for the oil industry: metallic wastes, construction debris, storm waters and waste waters, waste oils, used tyres, paper, cardboard, glass etc.

A distinct chapter of the paper contains measures regarding intermediate/ final wastes storage. There are presented operational and technical requirements and measures to avoid or minimise the environmental and health impact.

The last chapter of the paper includes a case study presenting how a representative entity for the oil industry performs the waste management (Petrotel Lukoil SA Ploieşti Refinery):

The wastes generated by Petrotel Lukoil are managed as follows:

- *internal wastes recovery/recycling of:*

sludge from DAV3 unit, slops (inferior petroleum product), waste waters, used soda, spent catalysts, gases containing H_2S;

- *recycled / eliminated wastes by licenced firms:* tanks sludge, mineral oils, packing etc.

- *intermediate stored wastes:* ceramic catalysts supports, activated carbon, sieves for hydrogen plant etc.

The following activities were performed during the second phase:

- technical & economic analysis of the waste waters depollution methods;

- technical & economic analysis of the contaminated soils depollution methods;

- comparative analysis of the depollution methods and facilities in order to comply with the legal limits of the environment factors water-soil.

The paper addresses the main aspects regarding water-soil remediation. There are indicated:

- chemical and physico-chemical indicators used for ecological status assessment of the surface waters;

- admissible limits and standards related to the analysing methods of the surface waters, waste waters pollutants and soil pollutants.

There were identified depollution methods and processes for water and soil, as follows:

- for water [1,2]:

- ***physical processes***: settling, filtering, static or dynamic adsorption, distillation, flotation, centrifuging, membrane separation, pumping, air or vapour stripping procedure.

- ***chemical processes:*** oxidation, coalescence, flocculation, ion exchange, neutralisation, precipitation;

- ***microbiological processes***: natural & artificial biological treatment, biochemical waste water treatment with organic contamination using activated sludge process, in-situ bioremediation using water pumping, treatment and re-injection, bioreactors.

- for soil [1]:

- ***physical methods***:

- *physical immobilization:* sealing, hydraulic blocking, stabilisation or solidification;

- *physical extraction:* digging, particle-size sorting, washing, flotation, air extraction of the pollutants (venting, bioventing, double phase extraction, passive venting), pressurized air injection (sparging, hydro shock, geo shock), electro-kinetic extraction;

- ***chemical methods:*** chemical extraction (solvent extraction, sour or basic extraction), oxidation.

For all the treatment methods it was presented the operating principle, a representative scheme and the types of pollutants the method is applicable for.

The final part of the paper contains a comparative analysis of the depollution methods and facilities in order to meet the admissible limits of the environment factors –water and soil, specific for the oil industry. The depollution technique selection was realized based on specific technical and economic criteria.

There are tables indicating [1,2]:

- the analysis of the main technical criteria and basic technologies for soils and waste waters depollution in case of a known area;

- the statistic situation of the soils and waste waters depollution methods and processes for the main chemical indicators;

- the efficiency of the soil and underground water depollution methods and processes for the main indicators;

- an comparative analysis on the advantages and disadvantages of the soil and water depollution methods and processes depending on the depollution technical principles;

- specific costs estimated for the soil and water depollution using different methods.

CONCLUSIONS

Two environment issues specific for oil industry were addressed in the project:

- oil waste management;

- physical and chemical depollution methods for water and soil.

Concerning the waste management, there were identified the following:

- applicable treatment techniques for wastes specific to the oil industry;

- oil wastes recovery/recycling solutions, as appropriate;

- measures for controlled intermediate/ final storage.

It was also realized a case study on the waste management by a representative entity for the oil industry generating significant quantities of different wastes.

Studies show that wastes resulted from the oil industry are very different types (detritus, used drilling fluid, sludge, tars - acid tars included, waste waters

with high content of hydrocarbons, ceramic catalysts supports, spent metallic catalysts etc.)

It was also shown that several techniques more or less efficient were implemented, depending on the knowledge level at the time of their implementation.

The applicable methods selection is made taking into account technical & economic criteria, obviously for each waste or type of waste respectively.

Concerning the soil and water depollution methods and processes, they include the entire range of techniques intended to neutralize or block the pollutants stream and ensure the required efficiency and environment regulation application.

Depollution technique selection has to take account of the following factors:

- pollution and pollutants (their behaviour, characteristics, concentration in soil and ground water);
- polluted site surface and configuration and access paths;
- ground water, soil and underground type and characteristics (texture, structure, porosity, permeability and retention capacity).

It was also shown that the water and/or soil depollution is realized using complex processes assuming successive operations based on chemical, physical and microbiological processes and the technical, economic and psychosocial factors gathering is imposed in order to ensure an efficient depollution.

BIBLIOGRAPHY

[1] Valer Micle, Gheorghe Neag, *Procedee și echipamente de depoluare a solurilor și a apelor subterane,* U.T. Press, Cluj-Napoca, 2009;

[2] * * * http://www.floerger.ro/certificate/Potabilizarea%20apei.pdf

The research was financed by the Nucleus Programme, contract no. 0935-0303/2009.

Innovative aeration system of water used by hydraulic turbines, for preservation of the aquatic life

ABSTRACT

In this project is studied the optimisation of aeration process of water used by hydraulic turbines. The injection of a supplementary quantity of air in turbine hydraulic circuit can decrease its efficiency. For this reason, the process of air injection (the method of injection, the place, the quantity etc.) becomes very important for the balance between turbine efficiency and ecological factor. In order to design some aeration systems, the optimisation of water aeration process is proposed, emphasising the quality of aeration process (dimension and retention time of air bubbles, pressure loss on aeration devices, their geometry and dimensions etc.) and not only on the quantity of air used for aeration.

INTRODUCTION

It is well known that the hydroelectric sites influence directly or not the flora, fauna or even the microclimate of the area where are built. During the summer time the oxygen level in the water river downstream HPP can decrease under the minimum limit necessary for aquatic life, which affects the fish on a distance up to 5km. Low dissolved oxygen (DO) level happens when the reservoir has a depth greater than 15m, a volume bigger than $61 \cdot 10^6$ m^3 and the power output is more than 10MW [1]. The criteria established by the Environment Protection Agency of USA for water are: minimum 3 mg/l for fish survival, an average of 6.5 mg/l for 30 days to protect the reproduction of fish and minimum 4mg/l for invertebrate cold water sensitive. Now in the USA there is a strong concern to upgrade the turbines in order to correspond to environmental requirements [2], [3], [4]. The water resource agencies develop strategies and control systems to improve turbine operation. In Romania, the aeration in hydraulic turbines exists, but only in order to reduce the central vortex downstream the turbines runner, so to increase turbine efficiency and reduce pressure variations at part load operation.

The objective of the project is to identify and to put in operation a technical solution which will have an important contribution to improve and to assure the quantity of DO in water, essential for the existence of aquatic life.

The subject is recent and the researches in the literature don't have a general efficient solution for assuring the DO level downstream HPP.

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Techn. Tudorache Cornel

EXPERIMENTAL

For the experimental determination of the oxygen transfer in water, with respect the flow parameters through hydraulic machinery, it was proceeded to adapt and commissioning of an experimental set-up (fig. 1) designed for the study of the swirling flow, biphasic and with adverse pressure gradient.

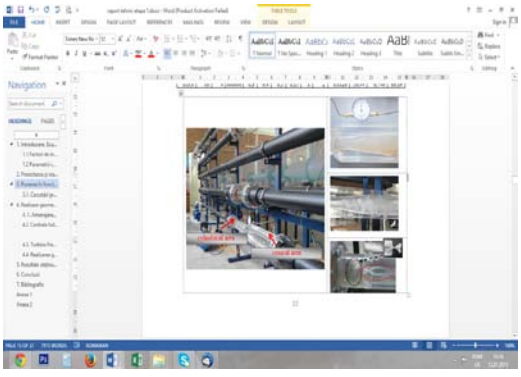

Fig. 1. Experimental set-up for swirling flow, biphasic, with adverse pressure gradient

The tests are carried out for a range of water flow rate between 5 and 17 l/s and water velocities between 2.5 and 8.6 m/s respectively. As the water velocity through the pipeline increases, the pressure decreases and the cavitation is developing in the swirling flow generated by the stator.

For detecting the cavitation vortex, a series of techniques are used, based on acoustic signals adapted to a particular hydraulic situation. The measurements purpose is to find a method that provides quantitative information on cavitation.

RESULTS AND DISCUSSIONS

Figure 2 shows that the bandwidth of received signals decreases as the cavitation vortex increases in size and strength. Starting with 3.3 m/s, the incipient cavitation occurs and the bandwidth decreases from 600 to 400 kHz. After cavitation becomes apparent, the bandwidth drops to 100 kHz, where becomes stable.

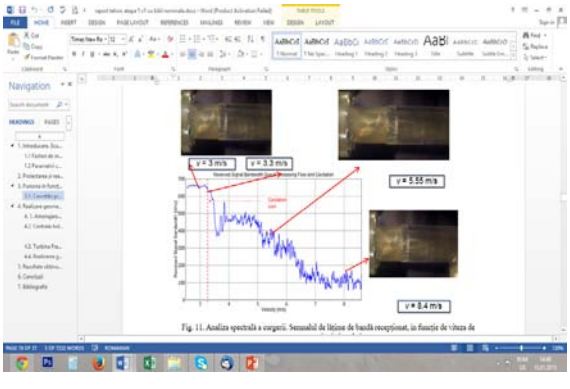

Fig. 2. Spectral analyses in the flow field. The bandwidth variation with the water flow velocity

The activity of numerical simulation of flow through a real Francis turbine aims to determine the maximum low pressure areas in the draft tube turbine.

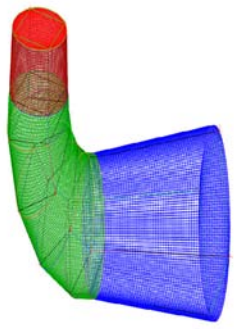

Fig. 3. Meshing draft-tube of F0 230/720 turbine

The 3D field is split into three volumes while the unstructured mesh has 245215 nodes and 237510 hexahedron elements.

Results achieved in project stage 1:

1. Candel I., Bunea F., Dunca G., Bucur D.M., Ioana C., Reeb B., Ciocan G.D., *Detection of cavitation vortex in hydraulic turbines using acoustic techniques*, IOP Publishing, Conf. Series: Earth and Environmental Science, vol. 22 (Sustainable Hydropower), Iss.5, 2014 052007, E-ISSN 1755-1315, DOI 10.1088/1755-1315/22/5/052007

and

Candel I., Bunea F., Dunca G., Bucur D.M., Ioana C., Reeb B., Ciocan G.D., *Detection of cavitation vortex in hydraulic turbines using acoustic techniques,* Proceeding of 27th IAHR Symposium on Hydraulic Machinery and Systems (CD), session 5.3, paper 5.3.3, 22-26 september 2014, Montreal, Canada.

2. Bunea F., Ciocan G.D., Bucur D.M., Dunca G., *Aeration solution of water used by hydraulic turbines to respect the environmental policies*, International Conference and Exposition on Electrical and Power Engineering, EPE 2014, October 16-18, Iasi, ISSN: 978-1-4799-5848-1, Catalog No. CFP1447S-USB, conference record #33577

and

Bunea F., Ciocan G.D., Bucur D.M., Dunca G., *Aeration solution of water used by hydraulic turbines to respect the environmental policies*, published in: Electrical and Power Engineering, 2014 International Conference and Exposition on, publisher IEEE, p. 1015-1020, DOI 10.1109/ICEPE.2014.6970062, ISSN 978-1-4799-5849-8.

CONCLUSIONS

The air quantity injected in the turbine affects their efficiency in two ways:

Firstly, due to the flow perturbation which is caused by the invasive air injection and secondly due to the energy consumption caused by the air injection. To design aeration systems should be consider the following parameters:

- Increasing the air-water contact time.

Therefore was commissioned an experimental set-up for swirling flow, biphasic, with adverse pressure gradient, *which* respect the main flow parameters through a real turbine.

- Using the vacuum level from the draft-tube turbine to get a pressure gradient and thus to reduce energy consumption for air injection.

Therefore using numerical simulation activity, already started, the low pressure areas will be identified. Knowledge of these areas will be useful for the implementation of the air injection device on the turbine.

- Increasing the air-water interfacial area;

Therefore plates with holes of different sizes were carried out; so that air will be injected as disperse.

- Injecting air in the hydraulic system, without prejudice the flow.

Therefore the experimental set-up is provided with a non-invasive device for air injection.

REFERENCES

[1] *Evaluarea micropotențialului hidroenergetic românesc, sursă regenerabilă de energie, în vederea identificării de amplasamente pentru dezvoltarea investițiilor în acest sector*, contract 24/2006, Ministerul Roman al Economiei, Comerțului și de Afaceri

[2] Harshbarger E.D., Herrold B., Robbins G., Carter J. 1999, *Turbine Venting for Dissolved Oxygen Improvements at Bull Shoals, Norfork and Table Rock Dams*, Waterpower '99 - Hydro's Future: Technology, Markets, and Policy, CD-ROM

[3] Papillon B., Sabourin M., Couston M., Deschenes C., 2002, *Methods for Air Admission in Hydroturbines*, Proc.of the XXIst IAHR Symp. on Hydraulic Machinery and Systems, Lausanne,

[4] Boring S., 2005, *Lower Saluda Site Specific DO Standard, Joint Meeting with Fish & Wildlife RCG*, Presentation, Kleinschmidt, http://www.saludahydrorelicense.com

The research was financed by the National Programme of Research, Development and Innovation PNCDI II - Partnerships in priority areas, contract no. 88 / 2014 (4314/2014).

APPLICATIONS IN ELECTRICAL ENGINEERING

Installation and technology for recycling wastes through selective disassembly using high voltage pulses

ABSTRACT

This project refers to the method of recovering metals from electric/electronic wastes or from domestic waste clay through high voltage discharge using pulse generators of high voltage and high power.

In this regard, the starting point is the idea of using a new principle relative to this application, namely the synthetic scheme of replacing the Marx generator with two generators working in synchronized regime, one as voltage pulse generator for the breakdown of the semiconductor portion, and the other one as current pulse generator for creating the plasma channel which causes the fragmentation of solid material.

INTRODUCTION

Several equipments for the fragmentation of solid materials are known from the scientific literature, under development or produced by few companies, but the researches in this domain are far from being finished and are still the subject of intense efforts [1].

The studied documentation revealed that fact that in Europe there is a single company that produces and commercially exploits this type of installation initially dedicated to selective fragmentation of rocks. The same company (*SELFRAG A. G.* – Switzerland) conducted tests in order to demonstrate the possibility of recycling wastes from electric and electronic equipments (WEEE).

At national level there are no documented technical concerns in this domain. The fact that in the western countries there is a permanent concern for theoretical developments, related to these methods, in order to elaborate some new types of pulse generators and to improve the technology, also results from the dynamics of the topics addressed by the articles in scientific literature [2], [3], [4].

The purpose and, in the same time, the main objective of this project consists in building an efficient generator able to supply high power pulses at high voltage that to assure the development of plasma channels in the mass of solid material and consequently the selective fragmentation of wastes from electric an electronic equipments.

General objectives:

1. Elaboration of an efficient/successful electro-technology that to assure the selective disassembly of wastes, eliminating the obsolete stages (shredding, manual separation of fractions, etc.) and susceptible to contamination (of the environment and/or personnel).

2. Building of an experimental model to validate and promote this technology.

Project's research staff

Work team INCDIE ICPE-CA:

Project director: Dr. Eng. Mihai BADIC

Members: Dr. Eng. Phys. Jana Pintea

PhDs. Eng. Cristian Morari

Techn. Mihai Brezeanu

EXPERIMENTS

Preliminary experiments were made in order to verify the possibility of obtaining current pulses with times-to-peak respectively front times under 500 ns. Another aim was the validation of theoretical calculations through actual measurements in a RLC circuit.

Fig. 1 shows the series-parallel configuration corresponding to high voltage ceramic capacitors used during tests. The configuration was meant to deliver an increased working voltage (30 kV) while maintaining a relatively high capacity value.

Fig. 1. Ceramic capacitors in series-parallel configuration

The oscillograms in fig. 2 show the obtaining of the repetitive current pulses, respectively a discharge corresponding to one pulse and the evaluation of the time-to-peak and front time. There is a very good agreement between theoretical calculations which give a time-to-peak of 80.869 ns and the time-to-peak value of the damped harmonic regime obtained in the experiment (approx. 80 ns). The peak value of the voltage measured with the high voltage probe is about 7 kV over a non-inductive resistance of 5 ohms.

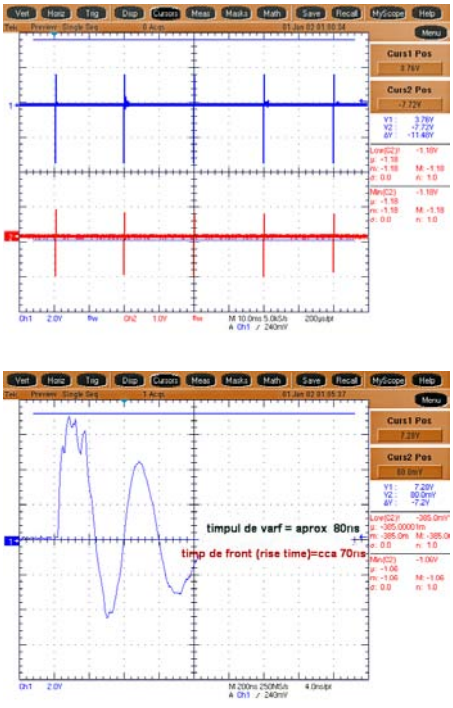

Fig. 2. Oscillograms obtained using the configuration in fig. 1

A second set of experiments was also performed with a pulse generator with switching elements (tiratron) and the oscillograms in fig. 3 were obtained.

It is observed that the times-to-peak satisfy the project conditions in this case too (approx. 89.6 ns).

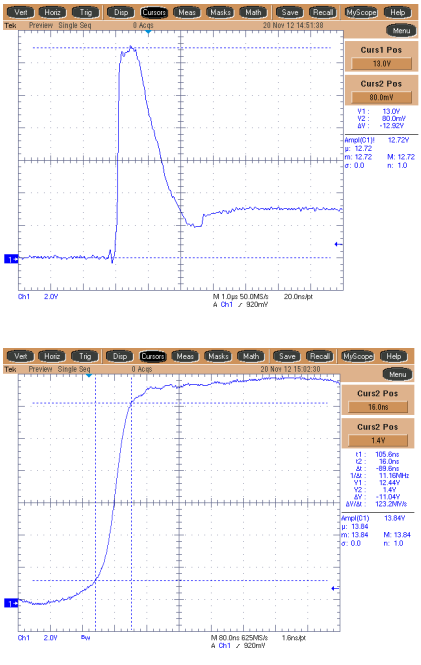

Fig.3. – Demonstration of obtaining the shortest rise time (89.6ns) – pulse shape, respectively rise time measurement (R = 17Ω, non-inductive)

RESULTS AND DISCUTIONS

The results obtained in the first phase are:

1. Documentary study on elaboration and technical-scientific substantiation of a new solution regarding the selective disassembling of wastes;
2. Studies and critical analysis of current solutions regarding the selective disassembling of wastes by means of high voltage pulses;
3. Numerical modelling, on simplified models, of destructive processes in compound materials;
4. Preliminary experimental results, and
5. The main parameters of the experimental model (EM).

CONCLUSIONS

The first phase of the project (2014) *Installation and technology for recycling wastes through selective disassembly by means of high voltage pulses – ITESEDEZ* aimed, besides the general presentation of the topic, to investigate the means/methods of analytical and technical calculus in order to design the EM. Thus, premises were created for tests concerning the constructive versions of the repetitive pulse generator, for designing and for execution.

REFERENCES

[1]. Markus J. Loeffler, *Commercial Pulsed Power Applications in Germany*, University of Applied Sciences Gelsenkirchen, 2005;

[2]. Rim G.H., Cho C.H., Lee H.S., Pavlov E. P., *An electric-blast system for rock fragmentation*, IEEE Pulsed power Conference, pp. 165-168, 1999;

[3]. S.H. Cho, B. Mohanty, M. Ito, Y. Nakamiya, S. Owada, S. Kubota, Y. Ogata, A. Tsubayama, M. Yokota, K. Kaneko, *Dynamic fragmentation of rock by high voltage pulses*, 41st U.S. Symposium on Rock Mechanics (USRM), American Rock Mechanics Association, 2006;

[4]. B. M. Kovalchuk, A. V. Kharlov, V. A. Vizir, V. V. Kumpyak, V. B. Zorin, and V. N. Kiselev, *High-Voltage pulsed generator for dynamic fragmentation of rocks*, Rev. Sci. Instrum. Vol. 81, 103506, 2010;

The research was funded through the National R&D&I Programme PNCDI II –Partnership PCCA, contract no. 84(4307) /2014.

Electro-insulating environmental friendly oil for electric equipments - UPMEE

ABSTRACT

The main aim *of the project is the obtaining, the characterization and the demonstration of the functionality of an electro insulating oil, for electrical equipment. This oil is environmental-friendly, biodegradable and it can be obtained from renewable sources (plant extract).*

Phase abstract:

Aiming the obtaining of an environmental friendly oil for electric equipment, in order to achieve the first phase of the project UPMEE it was followed and realized the following activities:

I. analysis and documentary research, sustained by 52 bibliographic references, aiming the establishing of the required performances for the environmental friendly oil (based on natural esters, vegetal origin) for electro technic use;

II. experimental model concept of **UPMEE** environmental friendly oil;

III. preliminary experimental tests aiming*:*

- the miscibility of the mineral oils based on esters (synthetic and natural, vegetal origin);
- the behavior of the viscosity of different types of oils with the temperature;
- chemical analysis of the vegetal oils;
- the evaluation of the content in fat acids (by GC-FID method) of some vegetal oils;
- chemical stability (thermo-oxidative behavior) in a comparative way of different types of oils for electro technic use;
- the bio-degradability in a comparative way of different types of oils for electro technic use;

IV. *Dissemination / exploitation of results*

Exploitation of results up to the present stage of the project it was achieved by:

a) scientific paper presentation to the *15th International Conference on energetic-electrical engineering,* ENELKO 2014, 9-12 October, Odorheiul Secuiesc – RO;

b) paper publishing in an international scientific prestigious event volume (with program committee): *J. Lingvay, L. Tudosie, I. Szatmári, "Environmentally friendly products for replacement of insulating mineral oils"*, în 15th International Conference on energetic-electrical engineering, ENELKO 2014, 9-12 October, Odorheiul Secuiesc – Romania, ISSN 1842-4546, pp. 58-63.

c) Preparing a paper to be published into an international database indexed revue (Scopus etc., CNCSIS B+ etc.): I. Lingvay, A. Pica, M. Marinescu, D. Popa, V. Stănoi, *„Esterii vegetali – alternativă ecologică pentru înlocuirea uleiurilor minerale de uz electrotehnic"* (*Vegetal esters - an alternative for replacing the mineral oils for electro technic use*) , EEA – Electronică, Electrotehnică, Automatizări – to be published.

Also, the preliminary results were exploited trough the PhD thesis chapter of JOIA (TUDOSIE) Liana-Mihaiela *"Contribuţii la studiul degradării izolaţiei cablurilor electrice sub acţiunea unor factori de mediu"* (*Contributions to the degradability of insulator cables under the environmental condition*) (PhD thesis– Universitatea Politehnica Bucureşti 2014 (chapter 6.2. *"Studiul stabilităţii termice a unor uleiuri electroizolante"* (*Thermal stability of some electroinsulating oils*)).

INTRODUCTION

Aiming the obtaining of an environmental friendly oil for electric equipment, in order to achieve the first phase of the project UPMEE it was followed and realized the following activities: analysis and documentary research, sustained of 52 bibliographic references, aiming the establishing of the required performances for the environmental friendly oil (based on natural esters, vegetal origin) for electro technic use.

I. experimental model concept of UPMEE environmental friendly oil;

II. preliminary experimental tests aiming:

- the miscibility of the mineral oils based on esters (synthetic and natural, vegetal origin);
- the behavior of the viscosity of different types of oils with the temperature;
- chemical analysis of the vegetal oils;
- the evaluation of the content in fat acids (by GC-FID method) of some vegetal oils;
- chemical stability (thermo-oxidative behavior) in a comparative way of different types of oils for electro technic use;
- the bio-degradability in a comparative way of different types of oils for electro technic use;

From the bibliographic study it was concluded that the UPMEE oil that will be prepared, it must have the following minimal properties, in order to achieve the required performances of functionality:

- Easy biodegradability–minimum 97%, in 21 days – in conformity with CEC-L-33;
- Specific heat over 1700 J/kg·K;

- Conductivity over 0,126 W/m·K;
- Freezing point up to –20°C;
- Fire point over 200°C;
- Fire protection – minimum class K2 or K3 – in conformity with IEC 61100 [1];
- miscibility and compatibility with traditional electro technic use oils;
- high chemical stability – it should not develop aging processes by thermos oxidation in air environment, up to 200°C;
- breakdown voltage over 70kV (measured in conformity with CEI 60156 [2]);
- relative permittivity less than 3,5 (measured in conformity with CEI 60247 [3];
- dielectric loss factor *tg* δ (at 90°C) less than 0,009;
- compatibility with used materials for the electro-energetic equipment – it should not interact with insulating materials (lacquers, paper, cotton, etc.), should not be corrosive agent for Cu, Al and/or steel etc.

Research personnel of the project:

Project manager: Dr. Eng. Lingvay Iosif, Scientific Manager

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Eng. Marinescu Mariana M d lina, IDT II

PhD. Eng. Cucoş Andrei, CS III

Eng. Chiose Ileana Laura

EXPERIMENTAL

Preliminary experimental work envisaged the following determinations:

- the miscibility of the mineral oils based on esters (synthetic and natural, vegetal origin);
- the behavior of the viscosity of different types of oils with the temperature;
- chemical analysis of the vegetal oils;
- the evaluation of the content in fat acids (by GC-FID method) of some vegetal oils;
- chemical stability (thermo-oxidative behavior) in a comparative way of different types of oils for electro technic use;
- the bio-degradability in a comparative way of different types of oils for electro technic use;

RESULTS AND DISCUSSIONS

The experimental model of UPMEEE oil is based on vegetal oil extracted from sunflower seeds. For this it was developed an extractive, purifying and conditioning/ addition flux.

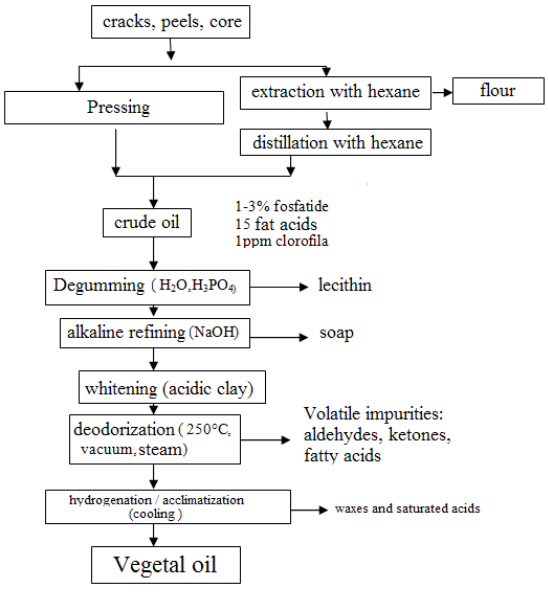

Fig. 1. The production flux for the electro insulating oil – proposed experimental model

In order to establish of the requirements/ performances of the proposed reference model, it were performed comparative evaluations in what concerns the dielectric behavior, the miscibility, the thermo-oxidative behavior (stability), the acidity, the unsaturation degree, the density, the fire point, etc. of several type of oils.

By thermal analysis methods, simultaneous TG/ DTG + DTA analysis, it were investigated several type of oils, LUMINOL (synthetic ester) [4], NYNAS (mineral oil) [5], sunflower edible oil and BIOTEMP oil (natural ester oil for electro technical use). The analyzed samples were: oil sample 1 – sunflower (edible oil), BIOTEMP oil in initial state, BIOTEMP oil aged at 135°C, for 1600 h, synthetic ester LUMINOL, and mineral oil NYNAS.

TG, DTG and DTA curves for the sample "sample 1 –sunflower oil (edible oil)" are presented in Fig. 2. We can conclude that when increasing the temperature and heating the oil sample, are developping four successively processes: one initial process – exothermal oxidative process with the development of some liquid products and three consecutive thermo-oxidative processes with the development of volatile products. At the end of these processes, practicaly all the quantity of the oil was transformed in gaseous products. The non-isothermal parameters were presented in Table 1.

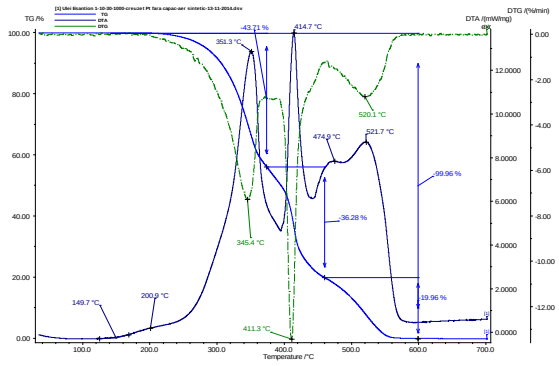

Fig. 2. TG, DTG și DTA curves for "sample sample 1 –sunflower oil (edible oil)"

Table 1. Characteristic parameters of the processes developed when heating the "sample 1 –sunflower oil (edible oil)"

Process	ΔT [°C]	%Δm [%]	T (DTG) [°C]	DTA Peak [°C]	ΔH
1.	149,7 – 226,0	0	-	200,9	exo
2	226,0 – 371,0	43,71	345,4	351,3	exo
3	371,0 – 460,0	36,28	411,3	414,7	exo
4	460,0 – 600,0	19,96	520,1	474,9; 521,7	exo

ΔT = temperature range where is developing the process; %Δm = mass variation in the process development (%Δm>0for the loss of the mass; T(DTG) = the temperature corresponding to the minimum DTG; DTA peak = the temperature corresponding to the maximum DTA; ΔH = endotherm effect (endo) / exothermal effect (exo)

In Fig. 3 there are presented in a comarative way the TG and DTG curves corresponding to the oxidative processes with development of gaseous products for the oil samples "BIO oil in initial state" and "BIO oil aged at 135^{0}C, for 1600 h". These curves are similar one each other, but for "BIO oil aged at 135^{0}C, for 1600 h" the degradation it is happening at higher temperature than "BIO oil in initial state"

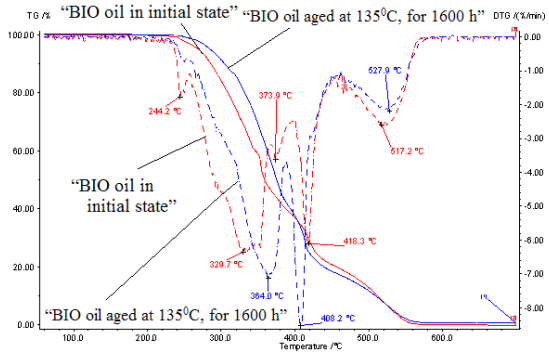

Fig. 3.TG and DTG curves corresponding to the oxidation process with liquid product formation of "initial BIO oil"and old BIO oil at 135^{0}C for1600 hours"

Specifically micro-logical determinations according to SR EN 60068-2-10/2006 were made for the biodegradation evaluation of the mineral oil NYNAS, synthetic esthetic oil LUMINOL and vegetal oil BIOTEMP.

Microbiological observations results are synthetically presented in the Table 2.

Table 2. Microbiological determinations results

Sample	**Testing method**	**Periodical microscopically observation**					
		24h	48h	72h	7zile	14 days	21 days
Mineral oil *NYNAS*	1	**0**	**0**	**0**	**0**	**0**	**0**
	2	**0**	**0**	**0 –1** *A.niger*	**1 - 2** *A.niger* + *Penicillium* + *Trichoderma*	**2** *Predomina* + *Aspergillus niger*	**3**
BIOTEMP (vegetal oil)	1	**0**	**0**	0	**0**	**0 – 1** A.terreus	**2**
	2	**0**	**0**	**0 – 1** Trace of *Paecilomyces variotii* (nude)	**2** *A.niger, Paecilomyces variotii, Mucor sp* . spontaneous flora	**3** *A.niger, Penicillium Trichoderma*	**5**
LUMINOL (synthetic ester)	1	**0**	**0**	**0**	**0 – 1** Two species of *Aspergillus*	**1** *Aspergillus;Penicillium; Stachybotrys astra*	**2**
	2	**0**	**0**	**1** *A.niger Trichoderma*	**2** *Aspergillus* (two species) + *Trichoderma*	**3 – 4** 2 species of *Aspergillus, Penicillium, Stachibotrys*	**5**

Covering degree– Note: 0 – without visible growing at microscope: 1 – fungal growth microscopic visible; 2- fungal growth naked eye visible – covering up 25% of the surface; 3 fungal growth naked eye visible – covering up 26÷50% of the surface 4 - fungal growth naked eye visible covering up 51÷75% of the surface; 5 - fungal growth naked eye visible – covering over 75% of the surface.

As result of the microbiologic tests , we can conclude that, in order to obtain the **UPMEE** type oil (experimental and demonstrating models), it will be mandatory to select the additives taking in account both them bio- degradability and xeno biotic effects

CONCLUSIONS

Based on some sudies and documentary analyses supported by 52 bibliographic references, they were achieved:

a) establishing of the requirements/ performances of the reference model of environmental friendly oil (based on natural esters, vegetal origin) for electro technique use and the concept of an experimental model (ME) of UPMEE oil;

b) preliminary experimental tests – including the biodegradability,

c) Dissemination of the achieved results.

From those proposed at point a) it was concluded that the UPMEE oil it must have the following minimal properties:

- Easy biodegradability–minimum 97%, in 21 days – in conformity with CEC-L-33;
- Specific heat over 1700 J/kg·K;
- Conductivity over 0,126 W/m·K;
- Freezing point up to –20^{0}C;
- Fire point over 200^{0}C;
- Fire protection – minimum class K2 or K3 – in conformity with IEC 61100 [1];
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- high chemical stability – it should not develop aging processes by thermos oxidation in air environment, up to 200^{0}C;
- breakdown voltage over 70kV (measured in conformity with CEI 60156 [2]);
- relative permittivity less than 3,5 (measured in conformity with CEI 60247 [3];
- dielectric loss factor *tg* δ (at 90^{0}C) less than 0,009;

On the strength of the speciality literature data, these performance are possible to achieve simultaneously, with an oil obtained from the seeds of sun flower ((*Helianthus annuus)* – with a suitable selection of the variety, the mining technique (content in oleic acid – minimum 75%) and the additives - first of all the antioxidants and the corrosion inhibitors.

From preliminary experimental determination – b) all major conclusions are:

- LUMINOL oil based on synthetic ester has humidity content significantly bigger than mineral oil NYNAS;
- Mineral oil NYNAS and synthetic ester oil are perfect miscible and form an homogeneous mixture;
- increase the humidity into the oil it has the effect of increasing losses into dielectric tg δ and the relative permittivity ε_r ;
- the viscosities of the mineral oil mixture and the etheric oil evolving linear with the added synthetic ester percentage;
- the tack of a sun flower oil (natural ester – edible sun flower oil) present values considerable bigger than the tack of NYNAS mineral oil and the tack of LUMINOL synthetic ester – the ascertainment suggested that, on assumption of sun flower oil variety, for experimental model accomplishment, it must be investigated extraction methods which can favour fraction extraction with a smaller tack. (higher content of oleic acid);
- on the sun flower oil specimen there are remarkable difference at the recorded values – especially for the acidity, alkalinity and iodine index, so that, for the achievement of experimental model it must select extraction methods appropriate with the goal;
- the initial BIOTEMP oil is thermical stable up to 233,8^{0}C – with the thermic aging in air, at 135^{0}C, for 1600 hours, it became stable up to 236^{0}C – so, there is the possibility that the thermic stability of vegetal oil is improved by proper thermic treatment;
- NYNAS mineral oil is thermic stable up to only 100^{0}C;
- LUMINOL oil, based on synthetic ester is thermic stable up to 170^{0}C;
- NYNAS Mineral oil is not biodegradable – it doesn't represent carbon source (nutrition source) for the investigated microscopic fungus – it present a low xenobiotic effect;

LUMINOL etheric oils (synthetic ester) and BIOTEMP (vegetal oil) is easy biodegradable - nevertheless, contrary to exception, synthetic ester has a higher biodegradability than BIOTEMP (vegetal oil), and this fact is explained by the eventual additives (antioxidants, corrosion inhibitors) that are added to vegetal oil. Taking into account these remarks, is noticed that, for the purpose of obtaining the **UPMEE** oil (experimental and demonstrative model), it will be mandatory to select the additives taking into account both them bio-degradability and xenobiotic effects

BIBLIOGRAPHY

[1] **** IEC 61100 Classification of insulating liquids according to fire-point and net calorific value.

[2] **** CEI 60156 - Method for the determination of the electric strength of insulating oils.

[3] **** CEI 60247 Insulating liquids - Measurement of relative permittivity, dielectric dissipation factor (*tg* δ) and d.c. resistivity.

[4] ***** LUMINOL, *"Electrical Insulating Fluids"*, *in* PETRO Canada TechBulletin.

[5] ***** Nynas Naphthenics AB "Transformatorenöl Handbuch" www.nynas.com/naphthenics.

The research was financed by PCCA Programme, contract no. 100/2014 (4313/2014).

Flammable and toxic gas detector based on MOS sensor array on silicon carbide (SIC GAS)

ABSTRACT

The gas sensor within projet 204 / 2012 is based on catalytic metal gate MOS structure. Experiments were made in order to achieve oxide layers of SiO_2, TiO_2 on SiC substrate. Thin layers of Ni and Pd, and multi-layers M/O: Ni/SiO_2/SiC, Pd/SiO_2/SiC were made for the MOS capacitor experimental model in the form of dots with Φ = 18, 24, 36 and 68 μm and areas with metal dots Φ = 200, 300 and 400 μm. MOS gas sensors were characterized for air and an environment of 0.5% H_2 in Ar. C-V curves of the Ni/SiO_2/SiC, Pd/SiO_2/SiC structures are characteristic to a MOS capacitor.

INTRODUCTION

The gas sensor studied in SIC-GAS project is based on a structure of metal / oxide / semiconductor (MOS), structure in which the semiconductor is silicon carbide (SiC) [1]. This type of sensor has a high sensitivity in the detection of hydrogen and hydrocarbons to a temperature of 1000°C [2]. Baranzahi studied the hydrogen sensitivity of Pt / TaSix / SiO_2 / 6H-SiC capacitors at temperatures higher than 650°C, while Tobias studied the same domain of Pt / TaSix / SiO_2 / 4H-SiC structures [3,4]. On the other hand, Ghosh analyzed Pt / SiO_2 / SiC capacitors at a temperature of 527°C in environments with oxygen or hydrogen [5]. Two structures with metal electrode of Pt, SiC semiconductor and TiO_x, respectively CeO_2, oxides showed an increased sensitivity to hydrogen [6, 7]. A Pd / TiO_2 / SiO_2 / SiC structure with layer thicknesses of 50 nm (Pd), 75 nm (TiO_2), 25 nm (SiO_2) showed high sensitivity to H_2, H_2S and O_2. In Step 3 of the project were performed: experiments on nanometric oxide layers, sensitive elements with metal / oxide / SiC structure, and experiments on nanometric multilayered metal / oxide structures for the experimental metal/ oxide / SiC model. In order to study the depositions of dielectric and metal thin films on silicon carbide substrate, "INTERNATIONAL AJA equipment ATC 2200" was used. There have been achieved nanometer thick films of Ni and Pd for the experimental model of gas sensor and C-V determinations have been made on the encapsulated sensors in air and under an atmosphere of hydrogen (5000 ppm H_2: Ar).

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EXPERIMENTAL

The oxide used as insulator in MOS structure, in this stage of the project, is silicon oxide or titanium oxide. In order to achieve the MOS structures sensitive to small amounts of toxic gases, oxide thicknesses under 50 nm are used. Thus, the main problem of this stage is to achieve different thicknesses of these oxides in a controlled and reproducible way. The investigations were made on silicon carbide (SiC).

The growth of SiO_2 on SiC wafers is much slower due to the strong links between Si and C. Therefore, in order to break these bonds, a higher oxidation temperature and a long oxidation time is required. Thus, in order to obtain a thickness of about 30 nm, SiC wafers were oxidized in dry oxygen atmosphere at a temperature of 1100°C for 6 hours.

This process of oxide growth on SiC was used for the fabrication of MOS capacitor structures with gate electrodes of nickel and palladium. In order to obtain titanium oxide (TiO_2), was used a sputter deposition process at radio-frequency with ATC2200 AJA INT. in a vacuum of 5 mTorr, without substrate heating, and heating the substrate to 225°C.

RESULTS AND DISCUSSIONS

The metal in the MOS sensor structure is a catalytic metal; at this stage, experiments were carried out to obtain thin films of nickel and palladium, and multilayer MOS structures on silicon carbide substrate. When a sensor, MOS capacitor, is exposed to gas (hydrogen), the gas molecules dissociate in contact with the electrode metal at temperatures below 150°C.

Some of the hydrogen atoms remain on the surface of the metal, others diffuses into metal and touch the metal-oxide interface. There is a balance between the number of hydrogen molecules adsorbed on the surface of the metal and the number of molecules adsorbed to the metal oxide interface. The bipolar layer from the metal-oxide interface decreases the work function of the metal strip and reduces the flat band voltage of MOS capacitor. The flat band voltage change causes a shift of the C-V characteristic of the capacitor, proportional to the gas concentration. For experiments regarding the achievement of Ni/SiO_2/SiC, Pd/SiO_2/ SiC structures for the experimental model, the DC

Sputtering equipment ATC2200 AJA INTERNATIONAL was used.

The deposition of catalytic metal in MOS capacitor is part of the process of obtaining the structure by photolithography and etching. As catalytic metal were used both Ni and Pd. This was detained in the capacitor area through a new photolithographic process. The deposition of Ni or Pd was carried out over the oxide layer (SiO2) previously deposited on the SiC substrate. At this stage, two types of MOS capacitors areas were developed for the experimental model:

- areas with dots of Φ = 18 μm; 24 μm; 36 μm; 68 μm;
- areas with dots of Φ = 200 μm; 300 μm; 400 μm.

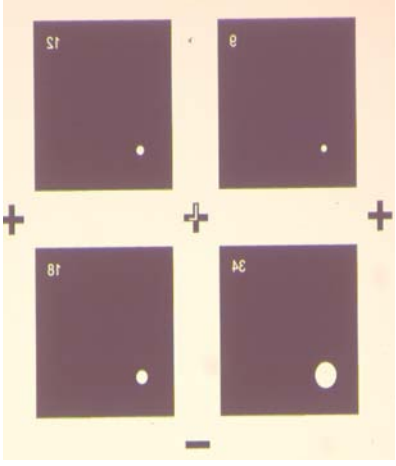

Fig. 1. Areas with dots of Φ = 18 µm; 24 µm; 36 µm; 68 µm for the experimental model (mask)

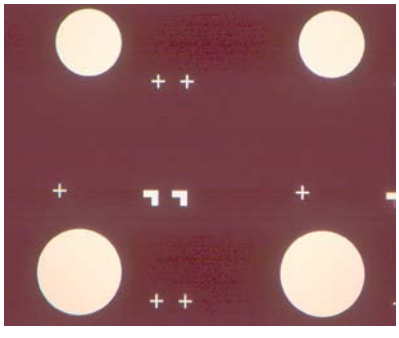

Fig. 2. Areas with dots of Φ = 200 µm; 300 µm; 400µm for the experimental model

The performed experiments showed that the catalytic effect is stronger for MOS sensor structures made with the thin layer of palladium deposited by DC sputtering. Fig. 3 presents a detail of a MOSiC sensor: Pd / SiO2 / SiC designed with Φ = 36 μm. In Fig. 4 the gas sensors Pd / SiO_2/SiC with Φ = 68 μm mounted on the type TO 39 capsules are showed.

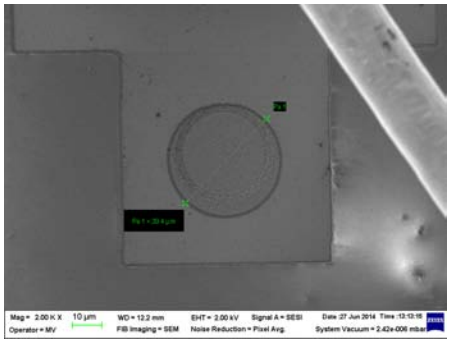

Fig. 3. Detail of M / O / SiC sensor (2000 x)

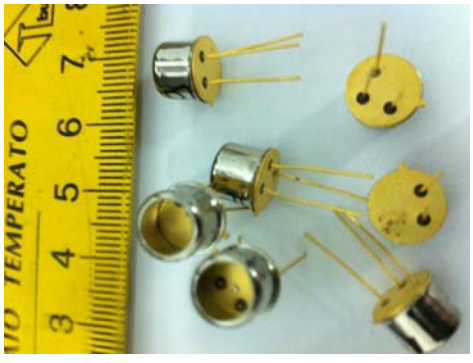

Fig. 4. Gas sensors Pd/ SiO_2/SiC, Φ = 68 µm, capsules TO 39

The gas sensor with Pd and Ni as catalytic metals with Φ = 68 μm encapsulated in TO39, were electrically characterized by C-V, both in the air and under an atmosphere of hydrogen (5000 ppmH_2: Ar) using the stand for measuring the electrical properties made by ICPE-CA.

This stand includes the mixer-dispenser of hydrogen in argon, the sealed measurement enclosure provided with sensor heating from room temperature to 300^{0}C, and an Agilent E4980A programmable RLC bridge.

The following presents electrical characterization of MOSiC capacitive sensors, in air and in 5000 ppm H_2 in Ar. Fig. 5 shows the stand of C-V electrical characterization, realized by ICPE-CA.

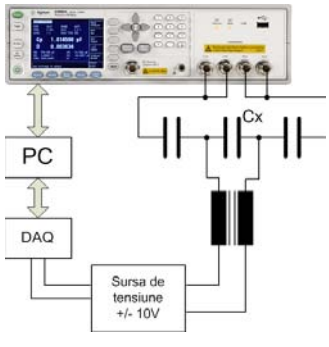

Fig.5. Stand for C-V electrical characterizations of MOSiC sensors

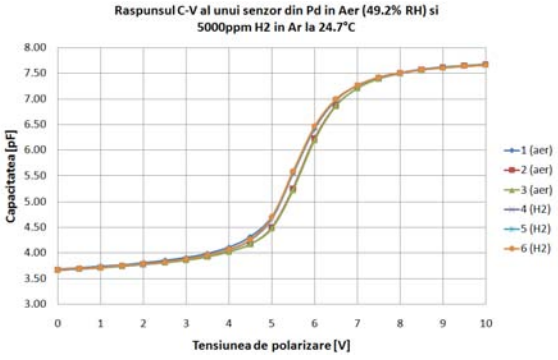

Fig.6. C-V characteristic of the sensor with Pd, with Φ = 68 μm in air and in (5000 ppm H_2: Ar)

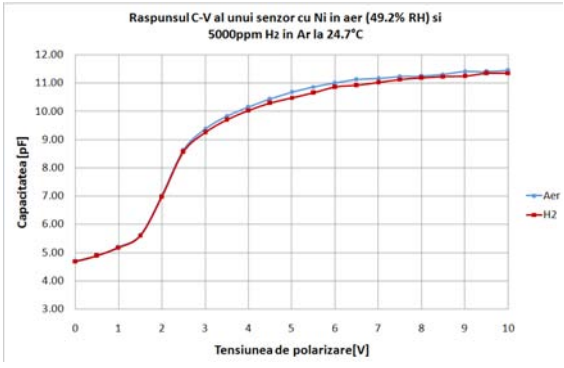

Fig.7. C-V characteristic of the sensor with Ni, with Φ= 68 μm, in air and in (5000 ppm H_2: Ar)

CONCLUSIONS

- Experiments on achieving oxide thin films of SiO_2 and TiO_2 for the formation of the dielectric layer in the experimental model of MOS sensor in two ways:
  - SiO_2 layers were achieved by oxidation of the SiC wafers at 1100°C for 6 hours;
  - layers of TiO_2 were made by RF sputtering;
- Thin metallic films of Ni and Pd, and Ni / SiO_2 / SiC, Pd / SiO_2 / SiC multi-layers for the MOS sensor experimental model were achieved in the form of areas of dots of Φ = 18 μm; 24 μm; 36 μm; 68 μm, and, after masks optimization, new sensors with areas of = 200 μm; 300 μm; 400μm.
- To obtain higher capacities, active areas with D = 200, 300, 400 μm were designed and made. Sensor arrays of 3x3 areas have been designed in that way. The active area of MOS capacitors can be defined in a silicon oxide layer with a thickness of about 1 μm deposited on the surface of the silicon carbide wafer. The deposition is made by CVD technique.
- Experimental models of Ni/SiO_2/SiC, Pd/SiO_2/SiC MOSiC gas sensors were achieved by encapsulating the chips in TO39 and DIL 16 packages.
- Experimental models of MOSiC sensors have been characterized by raising the C-V curves at the frequency of 100 kHz in the air and in an atmosphere of hydrogen (5000 ppmH2: Ar). C-V curves of MOS capacitors: Ni / SiO_2 / SiC, Pd / SiO_2 / SiC show the displacement characteristic to hydrogen exposure as against the air curve, on voltage axis.

REFERENCES

[1] N.I. Sax, *Dangerous Properties of Industrial Materials*, 4th ed., New York, USA, 1975, pp21-25; Choyke, W. J., and G. Pensl, *"Physical Properties of SiC,"* MRS Bulletin, March, 1997, pp. 25–29.

[2] A.Trinchi, S. Kandasamy, *High temperature field effect hydrogen and hydrocarbon gas sensors based on SiC MOS devices,* Sensors and Actuators B 133, 2008, pp. 705–716, Elsevier.

[3] A. Spetz, A. Arbab, I. Lundström, *Gas sensors for high-temperature operation based on metal oxide silicon carbide (MOSiC) devices*, Sensors and Actuators B 15 (1993) 19–23.

[4] A. Baranzahi, A.L. Spetz, I. Lundström, *Reversible hydrogen annealing of metal oxide silicon carbide devices at high temperatures,* Applied Physics Letters, 67,1995, p. 3203.

[5] P. Tobias, A. Baranchi, I. Lundström, A. Schöner, K. Rottner, S. Karlsson, P. Mărtersson, A.L. Spetz, *Studies of the ambient dependent inversion capacitance of catalytic metal-oxide-silicon carbide devices based on 6H- and 4H-SiC material*, Materials Science Forum , 264–268,1998 pp. 1097–1100.

[6] G.W. Hunter, P.G. Neudeck, M. Gray, D. Androjna, L.Y. Chen, R.W. Hoffman Jr., C.C. Liu, Q.H. Wu, *SiC-based gas sensor development*, Materials Science Forum 338–342, 2000, pp. 1439–1442.

[7] R. N. Ghosh, P. Tobias, S. G. Ejakov, B. Golding, *Interface States in High Temperature* SiC *Gas Sensing*, Proceedings of IEEE Sensors,2, vol. 2, 2002 , pp. 1120-1125.

The research was financed by the National Programme of Research, Development and Innovation - PNCDI II, contract no. 204/2012 (4284/2012).

Polymeric insulations of high performance for rotating electrical machines. Technology and modelling methods

ABSTRACT

The paper presents a study about:

- Problem formulation about the effects and processes in insulation systems and hypothesis on the destructive action of several chemical and electrical stress factors in insulation scheme;

- Types contaminats and their influences on equivalent scheme;

- Modelling about the mixed influence of temperature and contaminants in insulation scheme and lifetime of polymeric insulations.

INTRODUCTION

Insulation scheme of electrical machines includes a system which contains insulation materials in order to separate the coils (windings or even other conducting elements) by magnetic circuits of electrical machine or even a separation between windings. Insulation scheme includes the following important elements [1,2]:

A. the coil wires insulation;

B. slot insulation;

C. varnish impregnation and coil consolidation;

D. Insulation separators between winding sections.

The paper presents the studies for following aspects about the rotative electrical machines insulations:

- hypothesis formulation on destructive action of several chemical and electrical stress factors in insulation scheme of electrical machines;

- modelling about the mixed influence of temperature and contaminants in insulation scheme;

- thermal equivalent scheme

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STUDIES

Electrical machines are important components in conventional and unconventional drives with uses as electrical generators, by c.c. asynchronous and synchronous [1, 3, 4, 5].

A. Problem formulation on effects and processes in insulation systems and hypothesis about distructive action of chemical and electric stress factors in insulation scheme.

Have been formulated 2 important aspects on insulation system, about theoretical protocol:

- A. a formulation about the effects and processes from insulation systems;
- B. a formulation about the quality determination of insulation system and implicitly at parameters which characterize the insulation system.

To be an electrical machine a domain Ω and magnetic circuit M, winding or coil, K, I, insulation, subdomains inclused so that (Figure 1):

$$M \bigcup K \bigcup I = \Omega \quad (1)$$

Subdomaines are characterized by microsources systems. To note that all tree types of sources: electrical, thermal, mechanical, can be described unitary from the analogies theory cause I. The principal comments need to focus in that the domain Ω, is headquarters in separate effects and micromechanicals.

In detail, the insulation can be considered as a separation domain between magnetic circuit subdomains (rotor or stator) M and subdomain KK, which represents the electrical winding or coil. So, the effects produced in one of the two subdomain listed can be the place of effects which can

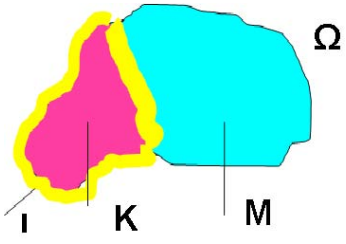

Fig. 1. About of problem formulation. The principal subdomains

propagate in the crossing subdomain, named electrical insulation I, without to eliminate the posibility as one from the three types to appear in insulation subdomain. (For example, the electrochemical effects caused to varnish impregnation or mechanical effects caused by elements expansion which compose the insulation: slot insulation or varnish impregnation.)

Hypothesis formulation:

1. The system represented by the electrical

machines insulation is affected by the stress or stresses factors mechanical, electrical, thermal and chemicals;

2. This stresses can be exterior or interior of electrical machine;

3. The stresses can operate alone or coupled;

4. The effect of this stresses changes local or total the insulation resistance (impedance) with all known consequences [6]:

- The decreases of breakdown voltage;
- The decreases of polarisation level;
- The decreases of creeping voltage;
- The decreases pf reliability and explicitly of lifetime.

B. Modelling about the mixed influence and the contaminants in insulation scheme

The contaminants from environment on insulation of rotative machines and electrical and chemical stress factors by inside insulation, leading to insulation degradation by polymer chain scission and the decrease molecular mass of polymer. The contaminants factors include:

- biological degradation;
- chemical pollutants: SO_2, O_2, O_3, NO_x;
- Environmental contaminants: heat, light, dust, powders, precipitations, UV radiation [7, 8].

The environmental stress effects on insulations are presented in Figure 2.

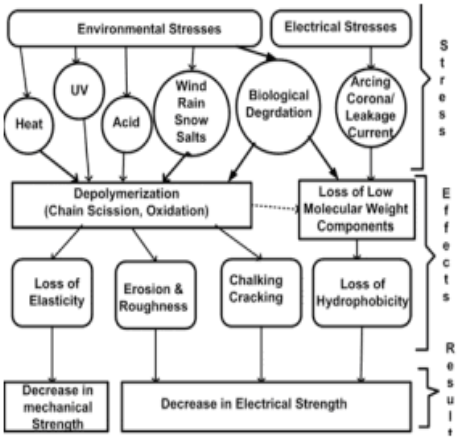

Fig. 2. Environmental effect factor on electrical insulations

C. The contaminants influence on equivalent scheme for surface insulation

A model of equivalent scheme for wet and dry surface insulation is shown in Figure 3. The dry surface insulation is represented by a chain of n capacitors where the electric field is equal distributed.

The wet contamined surface insulation is represented by a chain of n capacitors and n resistors in parallel.

This representation presents a simple model which not take into account the shape and distribution of drops on insulation surface, however the model presents a first approximation of wet surface insulation. The drops and/or contaminat conducting particles located on the surface insulation, lead a variable distribution of electric field and the local overstressing in the droplets area which leads at partial discharge (PD) in insulation layer. Local PD leads to chemical by-products and deterioration of the surface which becomes rough with loss of hydrophobicity. The insulator surface absorbs more water increasing their thickness and conductivity by the products presence like nitrates. This in turn leads to an increased leakage current.

The tangential electric field on the surface of the insulator creates a force on the surface of the droplet which causes its deformation and the electric field distribution can cause micro-discharges

between the droplets. Electrochemical deterioration of the surface may ensue and leads to partial loss of polymer hydrophobicity [9, 10].

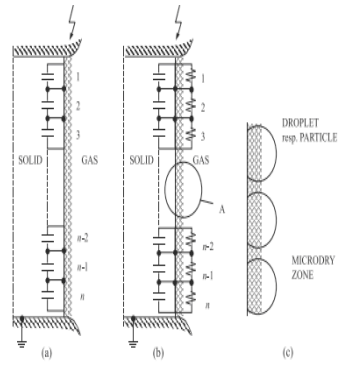

Fig. 3. Modelling of an insulating surface: (a) dry and clean conditions, (b) wet and/or contaminated conditions, (c) details of a wet hydrophobic and/ or contaminated surface (droplets, respective. conducting particles)

D. Lifetime modelling of polymeric insulations. Postulate Toop

Toop was established a relation between activation energy and estimated lifetime of insulation described by relation:

$$\ln t_f = \frac{E}{RT_f} + \ln[\frac{E}{RT} P(X_f)] \qquad (2)$$

where: t_f is estimated time to failure (min);

E is activation energy (J/mol);

T_f is failure temperature (K);

R is gas constant (J/molK);

$P(X_f)$ is a function whose values depend on E at the failure temperature;

T_c is the corresponding temperature of specific loss mass (conversion) at $\beta(T)$;

β is heating rate (°C/min).

Rearrangement of equation 2 yields a form which may be used to calculate the maximum use temperature (T_f) for a given

lifetime (t_f) [11].

$$T_f = \frac{E/R}{\ln t_f - \ln[\frac{E}{\beta R} P(X_f)]} \quad (3)$$

E. Equivalent thermal scheme

Considering that in coils area (K), but and in magnetic circuit domain of electrical machines we have the heating sources due increased current density and of the loss in rotors and stators packages, a simple thermal equivalent scheme is presented In Figure 4.

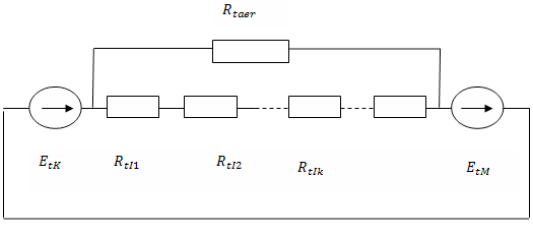

Fig. 4. Thermal equivalent scheme for electrical machine with more insulation layers (subdomaines)

In this scheme: E_{tK} – thermal source from coil, E_{tM} – thermal source from magnetic circuit, R_{tI1} – thermal resistance of the first subdomain of insulation, R_{tI2} – thermal resistance for a second subdomain of insulation, R_{tk} - thermal resistance for k subdomain, R_{tIN} – thermal resistance for n subdomain, R_{taer} - thermal resistance by air which bypasses the resistances of insulation subdomaines (insulation layers).

To note that thermal sources represent superheating due the loss of windings or coil E_{tK} – the loss in magnetic circuit E_{tM} – [4].

Results dissemination

1. M. Ignat, D. Lipcinschi, G. Telipan, B. Varaticeanu, I. Dulama, *"Aspecte privind metode convenționale și neconvenționale de evaluare a izolației mașinilor electrice"*, Simpozion Actualităţi şi perspective în domeniul maşinilor electrice SME 2014, 10th edition, 3 oct. 2014, UPB, Bucharest.

2. I.V. Popescu, C.Radulescu, C. Stihi, G. Telipan, I.D.Dulama, I. Ionita, I.R. Bunghez, *„The influence of heavy metals composition of soil on the polimeric insulators materials of power cables"*, TIM14 Physics Conference - Physics without frontiers, 20-22 Nov., Timișoara, Romania.

CONCLUSIONS

The studies effected on insulation systems include:

- Problems formulation about the effects and processes in insulation systems and the hypothesis on the destructive action of several chemical and electrical stress factors in insulation scheme like:

1. The system represented by the electrical machines insulation is affected by stresses or stress factors, mechanical, thermal, electrical and chemical;

2. The stresses can be outdoor or indoor of electrical machines;

3. The stresses can operate together or coupled;

4. The stress effect local or total the resistance (impedance) insulation with all known consequences.

- The influence of biological, chemical, electrical and environmental contaminants on equivalent scheme of surface insulations.

- Modelling of insulation lifetime by Toop postulate;

- Equivalent thermal scheme for an electrical machine with more insulation layers.

REFERENCES

[1]. Bala C., *"Lucrari de laborator. Masini electrice"*, Ed.IPB, 1972.

[2]. Gheorghiu I.S., Fransua Al., *"Tratat de masini electrice"*, vol. I, II, III, IV, Ed. Academiei, 1971.

[3]. Buzdugan Gh., *"Rezistenta materialelor"*, Ed. Tehnica, 1970.

[4]. Chapman S.J., *"Electric Machinery Fundamentals"*, Mc.Graw Hill, Fourth Edition, Boston, New York, 2005.

[5]. Denisov Evgeny T., Afanasev Igor B., *„Oxidation and Antioxidants in Organic Chemistry and Biology"*, CRC Press Taylor & Francis Group, 2005.

[6]. Hortopan Gh., *"Aparate electrice"*, Ed.Tehnica, 1980.

[7]. Muhammad Amin, Salman Amin, *Aging of polymeric insulator. (An overview)*, Rev. Adv. Mater. Sci., 13 (2006), 93-116.

[8]. Greg C. Stone, Edward A. Boulter, Ian Culbert, Hussein Dhirani, *"Electrical Insulation for Rotating Machines"*, IEEE Press Series on Power Engineering, John&Sons Inc. Publication, Chapter 8, 2004.

[9]. IEEE Std 1434-2000, *„IEEE Trial - Use Guide to the Measurement of Partial Discharges in Rotating Machinery"*.

[10]. Kyung-Bum Lim, Duck-Chool Lee, *„Study of the Surface Degradation Mechanism of an Epoxy Insulator Exposed to Water"*, Journal of the Korean Physical Society, Vol. 37, No. 1, July 2000, pp. 49-54.

[11]. Sergey Vyazovkin, Alan K. Burnham, José M. Criado, Luis A. Pérez-Maqueda, Crisan Popescu, Nicolas Sbirrazzuoli, *„ICTAC Kinetics Committee recommendations for performing kinetic computations on thermal analysis data"*, Thermochimica Acta 520 (2011) 1–19.

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ESD fabrics realized from fibres with conductive core knitted bilayer

ABSTRACT

Evaluation of electromagnetic shielding effectiveness (SE) for fabric samples with carbon conductive thread was effected in accord with standard IEEE SRD 299, a modified variant which utilizes a shielding enclosure with an window on one side and involves the transmittance an electromagnetic wave by the fabric sample mounted on the window. The measurements of shielding effectiveness were realized in anechoic chamber in conditions: distance between antennas emission and reception was 0.6 m, frequency range 0.9-18 GHz and temperature 22°C.

INTRODUCTION

The method used for shielding effectiveness determination is based on standard MIL-STD-285 replaced by standard IEEE –STD-299, which refers to electromagnetic shielding effectiveness measurement of shielding enclosures.

Range measure for these methods splits in 3 subgroups:

- Small range: from 9 kHz (50Hz) at 20 MHz for magnetic component (H);
- Resonant range: from 20 MHz at 300 MHz for electric component (E);
- High range: from 300 MHz at 18 GHz (100 GHz) for plane wave power (P) [1, 2, 3, 4, 5].

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EXPERIMENTAL

For SE determination of materials is used a modified version of method standard IEEE STD 299. This modified method uses a shielding enclosure with a window on one side and involves the electromagnetic wave transmittance by material sample for testing on the window. The electromagnetic wave emitted by the emission antennas is transmitted by the window of shielding enclosure and then is received by an antenna placed inside of enclosure. For SE determination is measured the electromagnetic field level transmitted by the enclosure window by two situations:

a) with test sample mounted on the window (measurement in charge);

b) without sample mounted on window (reference measurement).

During measurements the antennas position remains unchanged. SE is given by the ratio between the signal level transmitted by cell without sample, P_i and the signal level transmitted by sample tested P_t. So, SE, in dB is given by relation:

$$SE_{dB} = 10 \cdot \log\left(\frac{P_i}{P_t}\right) \quad (1)$$

The electromagnetic field level was measured in 2 situations - Figure 1:

1. with antennas placed face-to-face without sample mounted on shielding enclosure window;
2. with antennas placed face-to-face with sample mounted on shielding enclosure window.

Between antennas keeps the same distance. The distance between antennas is 0.6 m.

Measurement conditions: frequency range:

0.9-18 GHz, temperature 22°C.

Apparatus used for measurements:

1. Signal generator HP 8614B, Frequency range: 0.8 GHz – 2.4 GHz;

Output power: 15 mW, controlled by attenuator.

2. Amplifier Bonn Electronik BSA 0104-15/10D, Frequency range: 9 kHz – 4.2 GHz; Maximum power: 15 W,
3. Amplifier Research 20T4G18, Frequency range: 4.2 GHz – 18 GHz; Maximum power: 20 W,
4. Spectre Analyser Agilent 7405, Frequency range: 100 kHz - 26.7 GHz.
5. Antennas horn ETS Lindgren 3115, Frequency range: 1GHz – 18 GHz;

Gain: between 5.5 and 16 dB; VSWR: < 1.5:1.

6. Anechoic chamber –Figure 2

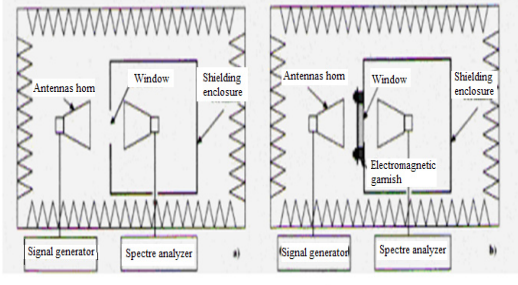

Fig. 1. Experimental test setup used to determine shielding effectiveness. (a) Reference measurement (without sample) and (b) load measurement (with sample)

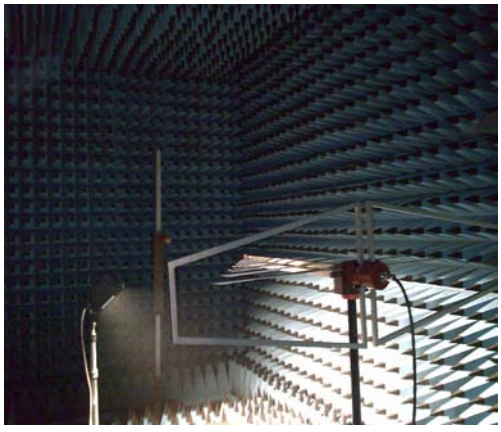

Fig. 2. Anechoic chamber INCDIE ICPE-CA

Fabric samples

Conductive fabric samples were provided by Research and Development national Institute for Textiles and Leather. This structure fabric is presented in Tables 1 and 2. The conductive threads were constituted by carbon.

Table 1. The structure of fabric samples 1-9

Sample	Structure	Face threads	Back threads	Percent onductive thread (%)
1	Glad vanished	1 thread b b c + 1 thread 2	1 thread bbc +3 threads 4	6%
2	P a t e n t vanished	1 thread b b c + 1 thread 2	1 thread bbc +2 threads 3	5%
3	Glad vanished	1 thread b b c + 1 thread 2	1 thread bbc +2 threads 3	5%
4	P a t e n t vanished	1 thread b b c + 1 thread 2	1 thread b b c + 3 threads 3	6%
5	Glad vanished	1 thread b b c + 1 thread 2	1 thread b b c + 1 threads 3	4%
6	Glad vanished	1 thread b b c + 1 thread 2	1 thread bbc +2 threads 4	6%
7	Glad vanished	1 thread b b c + 1 thread 2	1 thread bbc +1 threads 4	5%
8	P a t e n t vanished	1 thread b b c + 1 thread 2	1 thread bbc +1 threads 4	4.5%
9	P a t e n t vanished	1 thread b b c + 1 thread 2	1 thread bbc +2 4	6%

Legend:

Thread type 2 Cotton fibers (75%) + epitropic fibers (25% - polyester covered with carbon)

Thread type 3 Nega-Stat P210, polyester filament with outer carbon trilobal core

Thread type 4 Nega-Stat P190, polyester filament cu inside carbon trilobal core.

Table 2. The structure of fabric samples 10-20

Sample	Structure	Face threads	B a c k threads	P e r c e n t conductive thread (%)
10	Glad vanished	1 thread type 2+1 thread cotton	1 thread type 5+1 t h r e a d cotton	4.5
11	Glad vanished	1 thread type 2+1 thread cotton	2 thread type 5+1 thread cotton	6
12	Glad vanished	1 thread type 2+1 thread cotton	3 thread type 5+1 thread cotton	7.5
13	P a t e n t vanished	1 thread type 2+1 thread cotton	3 thread type 5 + 1 thread cotton	7.5
14	P a t e n t vanished	1 thread type 2+1 thread cotton	2 thread type 5 + 1 thread cotton	6
17	P a t e n t vanished	1 thread type 2 + 1 thread wool	2 threads type 5 + 1 thread wool	6
18	P a t e n t vanished	1 thread type 2 + 1 thread wool	3 threads type 5 + 1 thread wool	7.5
19	G l a d vanished	1 thread type 2 + 1 thread wool	3 threads type 5 + 1 thread wool	7.5
20	G l a d vanished	1 thread type 2 + 1 thread wool	2 threads type 5 + 1 thread wool	6

Legend:

Fiber type 2 Cotton fibers (75%) + epitropic fibers (25% - polyester covered with carbon.

Fiber type 5. has filament of nylon saturated at surface with carbon particles.

RESULTS AND DISCUSSIONS

The shielding effectiveness-frequency graphics were presented in Figures 3 and 4.

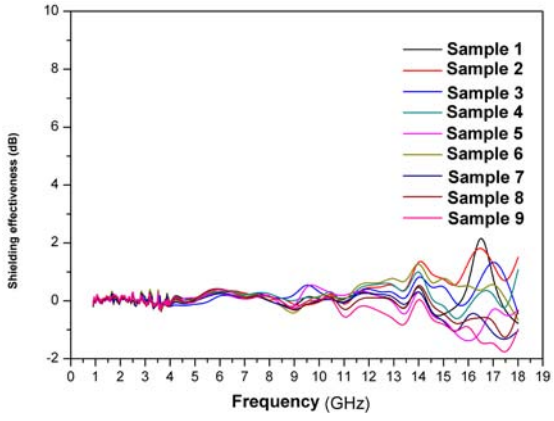

Fig. 3. Electromagnetic shielding effectiveness versus frequency for fabric samples 1-9

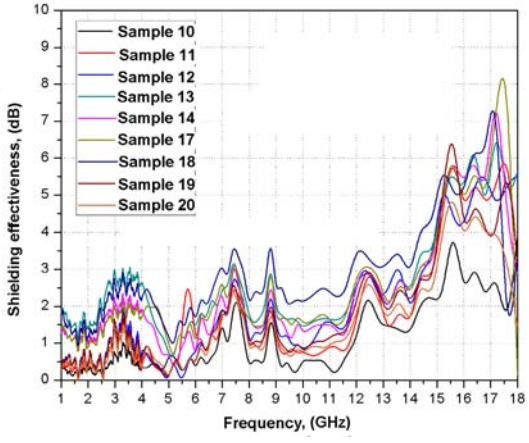

Fig. 4. Electromagnetic shielding effectiveness versus frequency for fabric samples 10-20

Sample 1 presents a shielding effectiveness very small by 3.03 dB at frequency of 16.5 GHz.

Sample 2 presents o very small electromagnetic shielding effectiveness with value of 2.04 dB at a frequency of 16.5 GHz.

Samples 3,4,5,6,7,8,9, do not present electromagnetic shielding effectiveness.

Sample 10 do not presents electromagnetic shielding effectiveness on the range frequency 0.9-4 GHz, for the range frequency 4-18 GHz presents the small values of shielding effectiveness of 2-4.59 dB.

Sample 11 do not presents electromagnetic shielding effectiveness **on**

the range frequency 0.9-4 GHz. For the range frequency 4-18 GHz, the shielding effectiveness is 3.17-6.51 dB.

Sample 12 do not presents electromagnetic shielding effectiveness on

the range frequency 0.9-4. On the range frequency 4-18 GHz the shielding effectiveness is 4.02-5.68 dB.

Sample 13 on the range frequency 0.9-4 GHz the shielding effectiveness is 2-3 dB a weak SE , on the range frequency 14.4-18 GHz, the shielding effectiveness is 3.77-7.46 dB.

Sample 14. on the range frequency 2.7-4 GHz, the shielding effectiveness is 1.8-2.0 dB, (weak SE), on the range frequency 15.2-17.2 GHz, the shielding effectiveness is 3.77-7.46 dB.

Sample 17. on the range frequency 2.7-4 GHz, the shielding effectiveness is 1.58-2.12 dB (weak SE). On the range frequency 15.2-17.6 GHz the shielding effectiveness is 4.48-9.35 dB.

Sample 18 on the range frequency 0.9-4 GHz the electromagnetic shielding effectiveness is 1.2-2.9 dB (weak SE). On range frequency 4.22-18 GHz, the shielding effectiveness is 0.8-8.9 dB.

Sample 19 on the range frequency 0.9-4 GHz do not presents shielding effectiveness. On the range frequency 4-18 GHz on register higher values of shielding effectiveness by 3.21-7.39 dB.

Sample 20 do not presents electromagnetic shielding effectiveness on range frequency of 0.9-4 GHz. On the range frequency 4-18 GHz, presents the small values of shielding effectiveness of 0-5.27 dB.

Results dissemination

[1]. Beatrice Moașa, Elena Helerea, Mircea Ignat, Gabriela Telipan, "*Experimental Research on Dissipative Textile Structures*", 2014 International Conference on Optimization of Electrical and Electronic Equipment IEEE Proceedings OPTIM 2014, 155-160.

[2]. G. Telipan, C. Morari, "*Electromagnetic shielding characterization of several conductive textiles*", Al 9-lea Workshop International de Compatibilitate Electromagnetica CEM, Timisoara, 3-5 sept. 2014.

[3]. G. Telipan, M. Ignat, L. Catanescu, B. Moasa, "*Electrostatic Discharge Testing of Several ESD Protective Textiles Used in Electronic Industry*", IEEE Proceedings of the 2014 International Conference and Exposition on Electrical and Power Engineering , 2014, paper ID 855, 602-605.

CONCLUSIONS

Were carried out electromagnetic shielding effectiveness measurements on the basis of standard IEEE STD 299 method on several structures of fabrics samples with carbon conductive threads in 4.5-7.5% percent. The measurements conditions were:

the distance between emission and reception antennas is 0.6 m, the range frequency 0.9-18 GHz and temperature 22°C. The fabric samples 3,4,5,6,7,8,9 do not present electromagnetic shielding. For other samples the electromagnetic shielding effectiveness was in the range of 2-7.39 dB, which represents a relative small electromagnetic shielding effectiveness.

REFERENCES

[1]. Tadeusz W. Wi ckowski, Jaros aw M. Janukiewicz, "*Methods for Evaluating the Shielding Effectiveness of Textiles*", FIBRES & TEXTILES in Eastern Europe January / December 2006, Vol. 14, No. 5 (59).

[2]. IEEE Std 299-1997, *IEEE Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures*.

[3]. Katalin Németh-Erd di, Tibor Gregász, *„Development of Measurement Method for Testing the Shielding Properties of Textiles and Analysis*

of Avialibity of the Measurement System". Óbuda University Bulletin, Vol. 2, No. 1, 2011, 201-215.

[4]. Renata Redondo Bonaldi, Elias Siores, Tahir Shah, *„Electromagnetic Shielding Characterisation of Several Conductive Fabrics for Medical Applications"*, Journal of Fiber Bioengineering and Informatics, Vol. 2 No. 4 2010 237-245.

[5]. Jagdev Singh Rana, *„Measurement of electromagnetic interference shielding„* International Journal of Advances in Engineering Research, Vol. No. 3, Issue No. III, March, 2012, http://www.ijaer.com/

[6]. C. Morari, I. Balan, J. Pintea, E. Chitanu, I. Iordache, "*Electrical conductivity and electromagnetic shielding effectiveness of silicone rubber filled with ferrite and graphite powders"*, Progress In Electromagnetics Research M, Vol. 21, 93-104, 2011.

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Magnetic nanofluids and fluids magnetizable nano-micro composites with high magnetization. Applications for high pressure rotary seals and heavy duty operation, respectively magnetorheological control devices

SUMMARY

Magnetic colloidal systems have been subjected to gamma irradiation and then the samples were subject to investigations by the non-isothermal chemiluminescence. The results underpin the selection of these products in order to seal high pressure circuits related to nuclear power plants, made by Rose Székelyudvarhely, partner of this project. In this respect, differences in levels oxidisability evaluated by varying the non-isothermal chemiluminescence emission intensities by changing the temperature of initiation of oxidative degradation, have been highlighted by CL spectra for different compositions radiative treated alike.

INTRODUCTION

In this phase were made following objectives:

- artificial aging testing by gamma irradiation of a set of samples for testing experimental NFM sealing systems for nuclear equipment turning MF;
- identifying and assigning the results of industrial property rights;
- dissemination of results through articles, participation in scientific meetings; web site of the project; visits between partners.

Research staff of the project

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PhDs Eng. Madalina Marinescu
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Eng. Alina Dumitru
Dr. Phys. Beatrice Sbârcea
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EXPERIMENTS, RESULTS AND DISCUSSION

Samples containing primary components and synthesized magnetic fluids were available from Timisoara Branch of the Romanian Academy (Table 1) [1, 8]. They were characterized as such or after irradiation 0, 50, 100 and 150 kGy at a 137Cs source, dose rate of which is 0.4 kGy/h. The irradiation was performed in air at ambient temperature of 20 ± 2°C. This dose range was chosen as equivalent to actual conditions corresponding endurance limit imposed by the use of organic compounds outside the active area of a nuclear reactor.

Characterization of the resistance to oxidation of the 3 magnetic fluid samples was carried out by

chemiluminescence non-isothermal, between 25 and 250°C, heating rate = 5°C/min, and the samples weights being in the range 200-300 mg.

Table 1. The samples provided by the Romanian Academy, Timisoara Branch

Nr.	sample	Surfactant	code type nanoparticles
1	141029-1	MF/ Cyclohexan	Fe_3O_4. oleic acid
2	141029-2	MF/ Cyclohexan	Fe_3O_4. Miristic acid
3	141029-3	MF/Pentanol	Fe_3O_4.acid 2-dodecylben-zensulfonic

The molecular structure of the surfactants are shown in Fig.1.

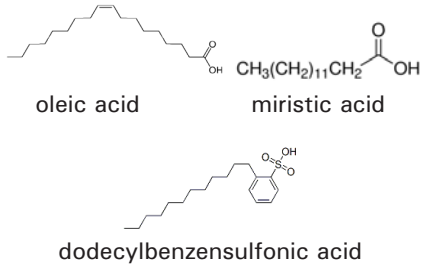
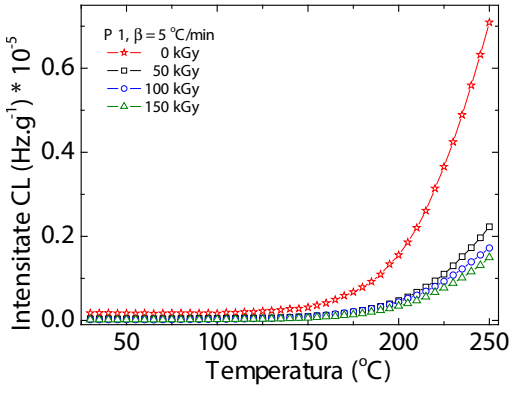


Fig. 1. Structure of surfactants used in the preparation of magnetic fluids tested

THE INVESTIGATION RESULTS CHEMILUMINESCENCE

Non-isothermal chemiluminescence investigations have revealed evidence of liquid magnetic susceptibility to the action of radiation. In this respect, it presents non-isothermal chemiluminescence spectra recorded for all doses applied. Chemiluminescence intensity dependencies of temperature for all the samples investigated are shown in Fig. 2. Note that the base fluids have low vapour pressures and the evaporation of these solvents is fast. Therefore, we chose to investigate the same amount of sample to avoid errors contribution solvent emission intensity normalization relative to the amount of magnetite particles.



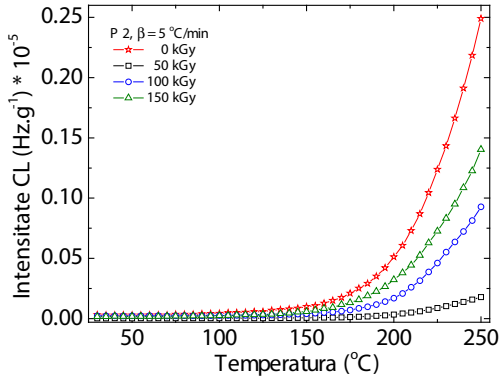


Fig. 2. The non-isothermal chemiluminescence spectra for samples 141029-1 and 141029-2 magnetic fluid

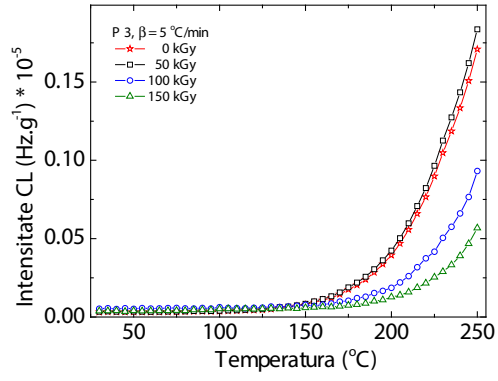


Fig. 2 (continued). Non-isothermal chemiluminescence spectra for the samples of magnetic fluids 141029-3

Comparative analysis of two basic liquid cyclohexane (141029-1 and 141029-2 prob) and pentanol (141029-3 samples) could highlight the difference in polarity of the molecules. But, in terms of radiochemical stability is lower cyclo-hexane pentanol, due to the tension in the cycle of carbon atoms. In this respect, it is compared to the spectra of non-irradiated samples, in all three cases, faster than the irradiated oxidized. The explanation for this behavior is related to the intervention of their radiolysis products resulting from the process of breaking hydrocarbon chains and different stability of surface-coatings. Since the oleic acid has a lower speed than myristic acid (Fig. 1), corresponding to the thermal degradation of the sample 1 is slower than that measured on the sample 2. In addition, exposure of these two types of magnetic fluid, the dispersion of recorded spectra increasing irradiation dose is increased in the system, myristic acid coated particles. This wrapping of the turns, in the case of magnetite particles coated with oleic acid, and may also be explained by the behavior of the double bond in the molecule of the acid. This structure is very vulnerable to the action of ionizing radiation, the easily fragmentation. On the other hand, it can take part in a polymerization process involving radicals formed during the radiolysis which may be a

factor in the stability of the surface to the action of released oxygen, maintaining the accelerated aging process.

For samples of type 3, in which the mother liquor is dodecylbenzenesulfonic acid, the existence of benzene nuclei leads to localization of the incident energy dissipated by radiation and, therefore, will achieve increased stability as compared to other types of compositions. Consequently, magnetic fluid sample type 3 141 029 the most favorable composition in terms of thermal and oxidative degradation of the radio.

In fig.3 are presented for comparison the chemiluminescence curves recorded by irradiating the samples at a dose of 100kGy.

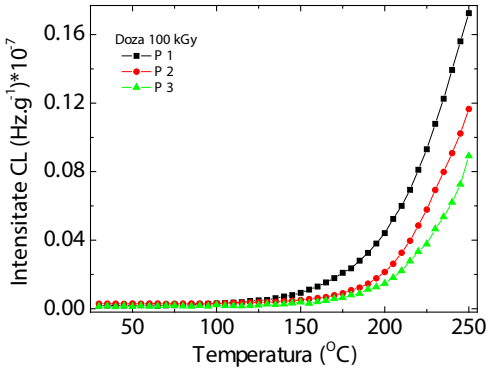


Fig. 3. Non-isothermal chemiluminescence spectra for samples of magnetic liquids type 141029 undergo radiolysis at a dose of 100kGy

It can be seen clearly in order of increasing stability: 141029-3> 141029-2> 141029-1. It should however be noted acceptable radiochemical stability for all three types of magnetic liquid compositions tested, which expressed high quality of the prepared systems. Two aspects should be considered essential conditions of use:

- Magnetic radiation doses of liquid fluid pressure circuits will not touch any time during normal operation of nuclear power plants, test doses applied. These are coverings for severe emergency conditions, conditions that far exceed the doses of damage;

- Providing a seal created by the coupling of the various pipeline segments or rotary systems, diffusion of oxygen is limited to the screw joints, which are dictated by the margins of error accepted in the manufacture thereof. In these situations, the amount of oxygen in the liquid film magnetic broadcast is insufficient to maintain oxidative degradation.

- Nanometric magnetite particles coated with a double layer, oleic acid / dodecylbenzenesulfonic acid confers high radiochemical stability, so that the penetration of oxygen is more difficult, and the existence of the benzene nuclei of the energy storage units derived from incident radiation.

IDENTIFICATION AND AWARD OF INDUSTRIAL PROPERTY RIGHTS OF THE RESULTS

In the scientific collaboration between project partners, during a meeting which took place at the coordinator, each group has outlined the importance of realizing their results in scientific papers or papers at international conferences. It was agreed that the results obtained by each partner owned consortium partner and the share that is dictated by the actual contribution to the achievement of business. In addition, for the same paper, the authors order must comply share content contribution to the completion of each job.

ARTICLES dissemination of results, participation in scientific

MAKING WEBSITE OF THE PROJECT, working visits between partners

At this stage of the project participated in the drafting and publication of a scientific article:

- Zaharescu T., L. Vekas, I. Borbath, *Radiation effects in polyisobutylene succinic anhydride modified with silica and magnetite nanoparticles*, Radiat. Phys. Chem., 105, 22-25 (2014).

This article deals with behavior compared nanaoparticles magnetite and silica (reference material) covered with PIBSA.

Likewise, the International Conference Irradiation of Polymers IRAP 2014 held in Jeju - South Korea has presented the communication 2P-8:

- EM Lungulescu, T. Zaharescu, M. Marinescu, *Influence of ferromagnetic fluids on γ-irradiation Behavior of Some polymeric materials*

who presented a study on the influence of magnetic fluids in the presence of polymeric components work in cases of accidents in nuclear power plants.

P3 partner contributed to the drafting of specific tasks related to experimental part updating the project web page. On days 20 and 21 November 2014, the delegation partner, dr. Traian Zaharescu and dr. Marius Lungulescu, attended the meeting coordinator working at the headquarters of Timisoara.

CONCLUSIONS

Testing 141029 series magnetic liquids provided useful information so the manufacturer, the project coordinator and research beneficiary partner P2. The radiochemical aging produced during exposure range shown that such systems are stable in terms of oxidation at ambient temperature and at high temperature, the irradiated samples showed low speed oxidation. In contrast, the three magnetic liquids tested were ordered, depending on the components used in the following sequence: 141029-3> 141029-2> 141029-1. In this regard, it was observed that the double layer applied magnetite nanoparticles consisting of dodecylbenzene sulfonic acid and oleic acid provides effective protection in terms of oxidative degradation. The other two structures surfactants, oleic acid, myristic acid, the effective protection, characterized by the degradation of intermediates adsorption on the surface of the magnetite particles. By blocking the reaction with oxygen, the aging is slowed down, and

the sealing action is maintained over a long period of time, comparable to the steps of the technical servicing nuclear power circuits.

It should be noted that the beginning of the oxidation takes place at high temperatures over 150°C.

If we analyze the requirements of stability to oxidative degradation test of the series of magnetic liquid at this stage, it can be concluded that it stands up very well at very low doses of radiation doses in which they are exposed, actually, the magnetic fluid of the power nuclear.

Test results radiochemical and thermal stability of polymer technology which may come into contact with irradiated magnetic fluids were presented at an international conference aimed at promoting new information in exploarării safe nuclear power plants.

REFERENCES

[1] L. Vekas, *Ferrofluids. Synthesis, Properties and Applications*, European Summer School "European Summer School on Magnetism, Magnetic Materials and Their New Applications", 9 to 18 September 2007, Cluj-Napoca (Romania).

[2] Vekas L., D. Bica and MV Avdeev, *Magnetic nanoparticles and concentrated magnetic nanofluids: synthesis, properties and some applications*, China Particuology 2007

[3] JL Bolland and Gee G., *Radiation degradation of organic material,* Trans. Faraday Soc., 42, 236-264 (1946)

[4] Chapiro A., *Radiation chemistry of polymeric compounds*, Interscience Pub., 1962

[5] T. Zaharescu, Setnescu R., Borbath I., *Thermal oxidation of irradiated magnetic component fluids and Their surfactants and dispersing oils*, Cent. Eur. J. Chem., 12, 782-787 (2014)

[6] KT Gillen and RL Clough, *Quantitative Confirmation of Simple Theoretical Models for Diffusion-Limited Oxidation*, editors RL Clough and SW Shalaby, ACS Symp Series 475, ACS, Washington DC, Chapter 28, 1991

[7] Zaharescu T., Borbath I. and Vekas L., *Radiation effects in polyisobutylene succinic anhydride modified with silica and magnetite nanoparticles*, Radiat. Phys. Chem. 105: 22-25, 2014.

The research was financed by National Programme of Research, Development and Innovation PNCDI II, contract no. 157 (7087/2012)

Electrical machines with increased efficiency, by using advanced technical solutions, based on the predetermination of the magnetic properties of sheets

ABSTRACT

Currently, the efficiency of the engine by reducing power loss has become a necessity in Romania and in Europe. Reducing energy costs have significant effects on both final users, especially by reducing emissions from the combustion of primary fuel for power generation in power plants. Increased efficiency of AC motors can be achieved in particular by reducing energy losses in their magnetic core.

Considering these requirements is obvious and necessary for the production and research in Romania electric motors with class IE3. Strong growth in the demand for electric motors, predicted for the near future, must find the Romanian industry able to provide new series of energy efficient motors.

This project is a real basis for the realization of a complex product, produced in Romania, which can be exported in terms of international technical and economic competitiveness.

INTRODUCTION

In line with EU standards is mandatory since 2017 selling only electric motors of efficiency class IE3. In the case of a 4-pole motor, 0.75 kW, 50 Hz this involves an increase in energy efficiency from 79.6% (IE2 standard) to 82.5% (standard IE3). For engines with power of 18.5 kW efficiency will increase from 91.2% to 92.6%. This project will provide to manufacturers and users of e NO electrical steel and electric engines real way of obtaining improved functional performance engines, based on efficient use of magnetic material properties resulting from a physical and mathematical model suitable for modeling the magnetic properties of the sheets used. This model takes into account the composition of the material, methods for the preparation of the alloy, geometry and thermal treatment, to which the sheets will be subjected.

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EXPERIMENTAL

The results presented in the scientific report of Phase I proved that, for reasons equally functional and economic nature, the technology for cutting of sheets of electric motors developed in the project is recommended for mechanical punching or electroerosion. Take into consideration that achieving engines that use the sheet-type M400-65A allowed obtaining electric engines which fall in class IE3 (increased efficiency), which is the major objective of the project, was passed to attempt to see if using the sheet type M800-65A (lower magnetic characteristics as a result of measurements taken in previous phases, but taken into consideration as possibly solution in the project proposal) electric motors can be made to fit into the same IE3 class.

We opted for cutting sheets by punching, technological process preferred by the beneficiary and, moreover, most frequently used in current production.

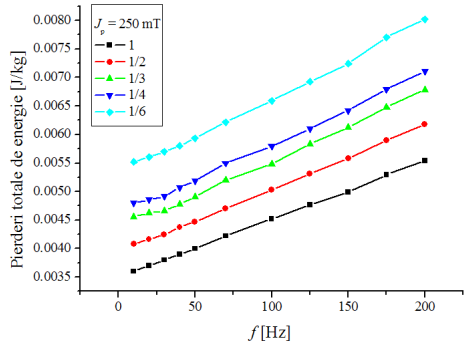
In order to analyse the influence of the process of punching on the heat loss, has been chosen, as in the case of the M400-65A sheet to increase the length of the perimeter of the punching by the application of successive cuts along the length of the sample at different widths. To this end, sheet 300 × 30 mm^2 was cut as follows:

- Two samples of size 300 × 15 mm^2;
- Three samples of size 300 × 10 mm^2;
- Four samples of size 300 × 7,5 mm^2;
- Six samples of size 300 × 5 mm^2.

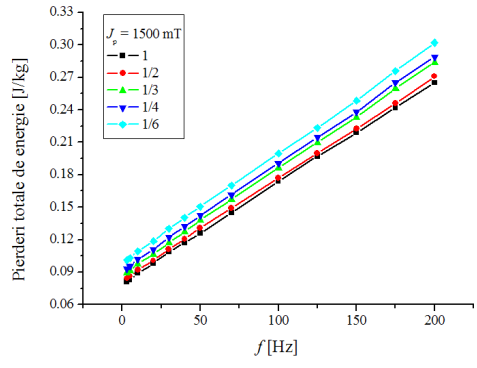
Samples were cut parallel to the rolling direction (RD) measurements were performed with a single-Sheet tester samples by joining the same width to restore the standard sample width 30 mm.

RESULTS AND DISCUSSIONS

Frequency analysis of energy losses was performed on a sample of 300 × 30 × 0,65 mm^3. The test which has been subjected to metallic sheet was the variation of magnetic polarization $J \in \{250, 500, 1000, 1500\}$ mT, measured in the case of frequency $f \in \{3, 5, 10, 20, 30, 40, 50, 75, 100, 125, 150, 175, 200\}$ Hz.



a.



b.

Fig. 1. Variation of total energy losses for sheets at different widths punched for the magnetic polarization. a. 250 mT and b. 1500 mT

The analysis of frequency consisted in variation of magnetic polarization $J \in \{50, 100, 200, 250, 500, 800, 1000, 1200, 1500\}$ mT, at frequency f = 50 Hz.

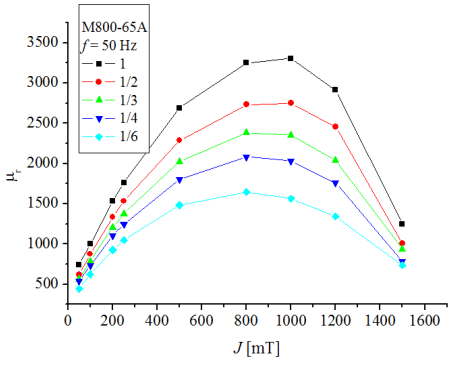


Fig. 2. Variation of relative magnetic permeability depending on magnetic polarization at frequency of 50Hz

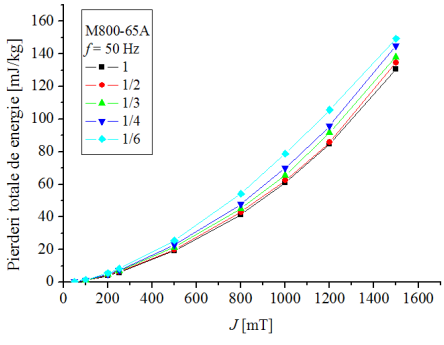


Fig. 3. Variation of total loss depending on magnetic polarization at frequency of 50Hz

The results were integrated to the design of the magnetic circuit of the electric machine components using the sheets M800. The losses were specific for induction of nine values between 50 and 1500 mT. Design calculation was performed for three phase asynchronous motor (11 kW, 1000 rev / min).

In accordance with the project plan were executed by Electroprecizia (P2), two engines from magnetic tape with non-oriented electrical steel cold rolled M800-65, according to EN 10106: 7.5kW-1000 rot / min and 11kW- 1000 rot / min.

Fig. 3. Engine MAL160M-IE3-42-6A

Our institute has been involved in testing the two engines. Main data regarding efficiency for the two electric motors which are subject of this contract, the magnetic circuit is made with sheet M400-65A, are summarized in the table below.

Table 1

Engine Type	η calculated	η measured	η IE3: recommended/ tolerate
7,5 kW MAL 160M 42 6A	89,4	88,2	89,1/87,46
10 kW MAL 160L 42 6B	89,4	89,4	90,3/88,84

Those facts confirms that the use of electrical sheet M400 allows engines that comply with the class IE3 efficiency.

CONCLUSIONS

It is noted that in the case of low magnetic polarization (Jp = 250 mT and 500 mT = Jp) total energy losses are significantly influenced by the technological process of punching, which increased along with increasing the length of the perimeter punched. In the process of punching large magnetic polarization does not significantly influence energy losses.

It is found that the total energy losses increase and the magnetic permeability decreases with increasing punching perimeter. It is noted that the engines made of M800 sheet the higher iron loss decreased the yield, so they do not fall in efficiency class IE3 or even tolerated efficiency values. It was thus demonstrated, theoretically and practically, that to obtain an appropriate return IE3 efficiency class must be used sheet M400 with superior magnetic qualities!

The research was financed by the National Programme of Research, Development and Innovation PNCDI II – Partnership, contract no. 32 / 2012 (7093/2012).

Mortar systems composite microspheres based for bricklaying, plastering and protection

ABSTRACT

An important role in sustainable development and energy efficiency of buildings have building materials. The use and development of new construction materials aims to improve the energy efficiency of buildings. Building insulation is very important in reducing energy losses in noise reduction and at the same time to achieve a thermal comfort. In the project, it is proposed the development of mortar systems based composite microspheres (inorganic, fly ash) used in masonry and development of composite materials with microspheres (plaster).

Composite materials systems will have the following properties: low thermal conductivity, a high resistance to ultraviolet and infrared radiations.

INTRODUCTION

European directives related strategies include building energy efficiency, durability and functionality of the materials used in residential and industrial buildings.

Multiple studies have focused on the use of ash from burning wood waste in cement mortars and others have investigated the use of wood chips as a matrix of concrete/mortar or cement matrix and clay [1-5].

At national level mortars are obtained such special characteristics that, besides current materials (cement, lime, and aggregates) using expanded perlite [6].

At international level, to achieve thermal and acoustic insulation mortar besides the usual materials (cement, lime, aggregates) are also used generally of plant materials (wood, cob ash, reeds, etc.).

Multiple studies have focused on the use of ash from burning wood waste in cement mortars and others have investigated the use of wood chips as a matrix of concrete/mortar or cement matrix and clay [7].

Rehabilitation is the solution based composite microspheres mortars for bricklaying, plastering and protection.

The main objective of the project consists in the achievement a "mortar systems based composite microspheres - SMCM" to be applied in masonry work and plaster used in enveloping and protecting buildings to increase energy efficiency and building sustainability.

The objectives of the first phase consisted in developing the concept of microspheres inorganic materials, the characterization of materials for the achievement the SMCM concept and preliminary experiments processing ash.

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EXPERIMENTAL

In the first stage of the project the following activities were carried:

1. Elaboration the design concept inorganic microspheres, the established and defining design theme, the structure of inorganic microspheres, the microspheres types, their chemical composition and characteristics of the inorganic microspheres

2. The characterization physico - chemical on two varieties of ash from thermal plants Turceni and Govora.

Physical characterization by two ash types are: determination of moisture, particle size distribution and loss on ignition. The particle size distribution was performed by dry sieving powder on the site of 150 μm, 125 μm, 70 μm, 50 μm. The volatile content of ash was determined by loss on ignition at 800^{0}C. The P.C. is one of the important properties for the use of the ash; it must be less than 7% in order to be used as an additive in cement or mortar. The chemical composition of ash varies depending on the chemical composition of coal burned, the most important are those of silicon oxide, alumina, iron, calcium and carbon. The determination of main oxides of the samples was performed by XRF analysis.

3. Preliminary experiments of processing of two fly ash by chemical and thermal method and the characterization of the ash by chemical analysis, structural and microstructural.

RESULTS AND DISCUSSIONS

1. It was developed the concept of hollow inorganic microspheres;

2. The physical characteristics of ash from CET Turceni (T) and Govora (G) are shown in Table 1.

Table 1. The physical characteristics of ash from CET Turceni and Govora

Type	The physical characteristics					
	U (%)	D (kg/m^3)	R_{70} (%)	R_{50} (%)	P.C. (%)	Coulor
T	0,12	676	10,5	36,6	1,89	Dark gray
G	0,08	418	9,85	71,5	2,31	Light gray

U = moisture; d = density; R = residue on the sieve of 50 and 70 μm; P.C. = loss on ignition.

Table 2 presents the main results of the chemical composition of the ash analyzed.

Table 2. Chemical characteristics of ash from CET Turceni and Govora

Type	The oxides composition					
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3
T	45,70	19,43	11,18	11,33	4,27	4,26
G	52,00	22,58	10,80	6,25	3,13	1,02

According to SR EN197-1/2011 principal amount of fly ash compounds must be less than 70%, as confirmed by the results:

$\Sigma = SiO_2 + Al_2O_3 + Fe_2O_3 = 76,31$ %

$\Sigma = SiO_2 + Al_2O_3 + Fe_2O_3 = 85,38$ %.

The ashes are materials with predominant aluminum silicate composition, in this case the two varieties of ash fulfill the condition imposed by the current standards.

3. The ashes were processed by chemical and thermal activation. The results show that after thermal and chemical activation, the ash is by Class V siliceous nature. According to EN 197-1 / 2011, the amount of $SiO_2 + Al_2O_3 + Fe_2O_3$ oxides is greater than 70%. It is noted that thermal and chemical treated samples have a higher content of SiO_2.

The samples of the both varieties of ash densities ranging from 135.2 to 169.2 kg/m^3, and the chemical treated samples and the thermal at 600°C have the lowest densities. The Turceni ash has the grain size of <50 μm and the density 137.4 kg/m^3 and the Govora ash has the grain size <50 μm and 135.2kg/m^3 the density. the low densities of these ashes obtained from thermal and chemical activation of we show the presence of the micro and nanospheres. The chemical composition of ash was determined by XRF measurements. Table 3 presents the results obtained for the main oxides.

Table 3. The chemical properties of the activated ash thermal and chemical

Type	Activated	The chemical composition (%)			
		SiO_2	Al_2O_3	Fe_2O_3	CaO
TT-4	600°C	41,15	14,33	19,62	15,19
TAT -4	600°C + HCl	65,71	16,95	7,14	3,38
TAT - 2	1000°C + HCl	55,19	14,74	13,54	8,19
GI3	-	49,49	21,18	11,78	8,37
GI3 -T	600°C	43,66	15,42	19,78	11,88
GI3 -AT	600°C + HCl	67,84	14,85	7,61	3,07
GI3 -AT	1000°C + HCl	49,14	17,82	12,66	11,32

The activated ashes was characterization by XRD for determination the chemical composition.

The ash from Turceni the heat activated at 600°C, shows that the predominant crystalline phases, major compounds are: SiO_2 in various forms, hexagonal and tetragonal α quartz, or combinations of SiO_2 with Al_2O_3, CaO:

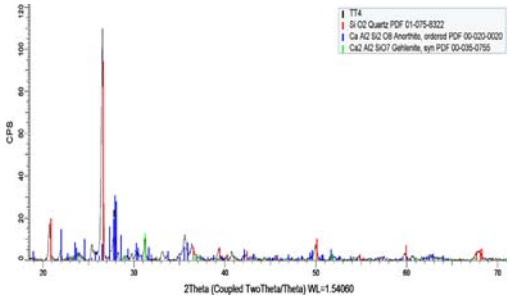

Fig.1. Diffractograms of activated fly ash sapmle TT -4 (< 50 µm)

In Figure 2 is shown the diffractogram of the sample thermally and chemically activated (600°C) it observed majority phase quartz with traces of calcium silicate (anorthite) and hematite.

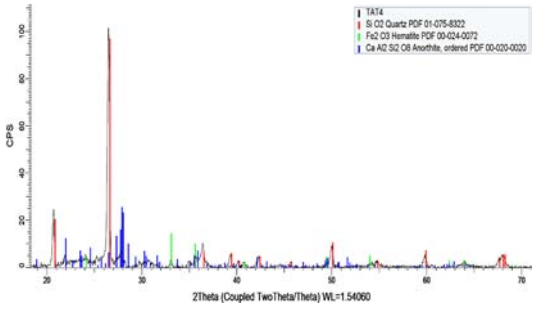

Fig.2. The diffractogram of the sample TAT -4 (< 50 µm)

From the diffractograms performed on samples of the ashes Govora resulting chemical composition similar to that of the ashes Turceni.

The XRD patterns of the Figures 3 and 4 show that with thermal and chemical activation of the samples were observed the presence of crystal phases, mostly of quartz SiO_2 in combination with SiO_2 Al_2O_3, CaO in the form of anorthite.

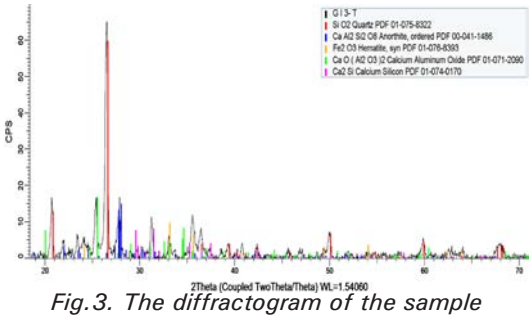

Fig.3. The diffractogram of the sample GI3-T (< 50 μm)

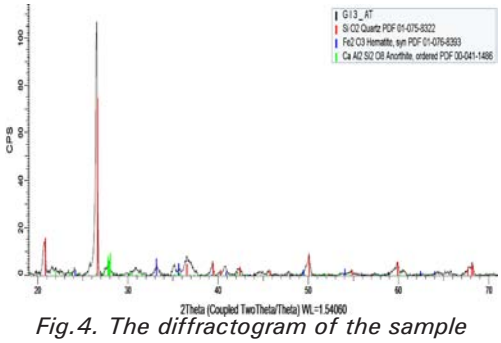

Fig.4. The diffractogram of the sample GI3-AT (< 50 μm)

Electron micrograph of the powder TT-4 (heat-treated at 600°C, particle size less than <50 μm) shown in Figure 5 shows a varied morphology with spherical hollow microspheres. The microspheres diameter ranges between 13.5 and 91.5μm.

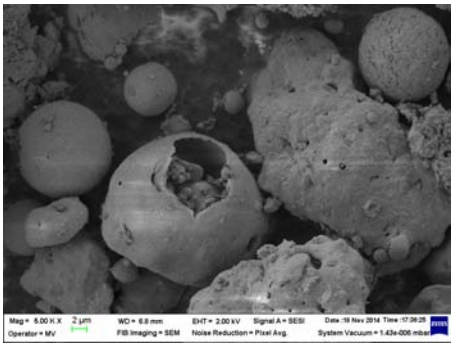

Fig.5. Electron micrograph of the sample TT-4

The micografia of the sample TAT-4 (the heat activated and chemically at 600°C with grained size <50 μm) the Figure 6 presents a majority powder microspheres with sizes between 8.6 and 28. 6 μm.

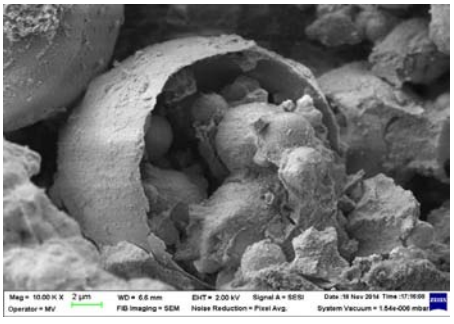

Fig.6. Electron micrograph of the sample TAT-4

The microstructure of the surface of the microspheres and the size of the crystallites depends on the temperature and duration of the burning of coal, as well as the precise combination of minerals, the contents of silicate compounds, iron compounds and other minerals within the structure of the coal.

CONCLUSIONS

The main conclusions achieved are:

- the concept of inorganic microspheres, involves making the inorganic hollow microspheres, obtained either by chemical synthesis or by activation of the fly ashes;
- the experiments processing of the ashes were performed by chemical and thermal activation method on two varieties of ash, from CET Turceni (T) and the Govora (G);
- the results show that both chemically and thermally activated ash are the siliceous ashes and fall within the class V in the conforming to EN 197-1 / 2011;
- the samples ashes of chemically treated and thermally at 600°C have the lowest densities. The ashes sample T with grain size <50 μm has the density of 137.4 kg/m^3, and the ashes G with grain size <50 μm has 135,2kg / m^3 density;
- this highlights the presence of micro and nanospheres, which was confirmed by analysis of microstructure.

In view of these considerations, it is proposed that:

- two varieties of ashes Govora and Turceni with grain size <50 μm to be used as additives in achievement of the composite mortar systems SMCM;
- we will continue further experiments with other types of ash and ceramic microspheres synthesis.

REFERENCES

[1]. Krammer Anna, Velciu Georgeta, Lingvay Carmen†, *Acrylic and polivinilic based protective layers with ceramic aggregates*, VEKOR Corrosion Conference, Balatonfüred (HU), April 16-18, 2013, CD Proceedings

[2]. Arvind K. Suryavanshi, R. Naraxan Swamy, *"Development of lightweight mixes using ceramic microspheres as fillers"*, Cement and Concrete Research 32, 2002, pg. 1783-1789

[3]. Vikrant Tiwari, Arun Shukla, Arijit Bose,

"Acoustic properties of cenosphere reinforced cement and asphalt concrete", Applied Acoustics 65 (2004) 263–275, pg.263-275

[4]. Vipasri Kanchanason, Manasit Sarigaphuti, *"Effect of Types of Cellular Material on Thermal Conductivity of Cement Composite"*, Journal of the Microscopy Society of Thailand, 24, 1, 2010, pg. 29-33

[5]. J. Berling, J. Blomer, R. Kummel, *"Hollow Microspheres"*, Chem. Eng. Technol., no. 8, 27, 2004, pg. 829-837

[6]. SR EN 197-1:2011, *Ciment, Partea 1: Compoziție, specificație și criterii de conformitate uzuale SR EN 450-1:2006, Cenușă zburătoare pentru beton. Partea 1: Definiții, condiții și criterii de conformitate*

[7]. SR EN 450-1:2006, *Cenușă zburătoare pentru beton. Partea 1: Definiții, condiții și criterii de conformitate*.

The research was financed by the National Programme of Research, Development and Innovation - PNCDI II, contract no. 40/2014 (7104/2014).

New types of actuators specific to space applications

ABSTRACT

A new concept of sonic motor with electronic module magnetostrictive actuator that can be used in outer space is proposed. Magnetization magnetic field is produced by an auxiliary coil with two permanent magnets, which replaces the classic cylindrical permanent magnet. Activation voltage of premagnetization coil and activation coil is PWM having amplitude peak to peak correlated with the amplitude provided by solar panels of satellites. In space, in absence of terrestrial gravitational field, cooling assembly of the two coils and magnetostrictive active material is made of three Peltier elements, activated by a PWM modulator.

INTRODUCTION

"New types of actuators specific space applications" aims to achieve a functional model in Phase 1, called linear magnetostrictive motor with electric drive specified. Target application is the manufacture of electrical drives specific in the field of space technology. Although similar devices have been developed worldwide, the emergence of new active materials [1-3], as well as new electronic components generated new concepts that can be used in the design of these engines with significant technological improvements. In order to establish criteria for choosing the optimal form factor of magnetostrictive core physic-mathematical modeling and numerical modeling of linear magnetostrictive motor is required. This form factor is useful in the design stage for initial dimensioning of magnetostrictive motor for a given application. Optimal dimensioning of the volume of the magnetostrictive material (Terfenol-D), [4], and the permanent magnet volume contributes to reducing production cost.

An idea of achieving fuel injection modulation at rocket fuel based on very good operation frequency of linear magnetostrictive motor is proposed [5]. Thus, two successive injections can occur in a time which is determined by a system of automatic control and pilot injection may contain a large number of secondary injections.

Research staff of the project

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EXPERIMENTAL

Linear magnetostrictive micro motor was sent for testing in the Laboratory of Institute for theoretical & experimental analysis of aeronautical structures SC STRAERO SA. The test method consisted in generating and measuring the force developed by linear magnetostrictive micromotor. Motor supply was made from a variable DC source (0 - 32 Vcc). Also, microdisplacements measurements were performed with Agilent 5529B interferometer with linear measurement kit 55280A, at INCDIE ICPE-CA.

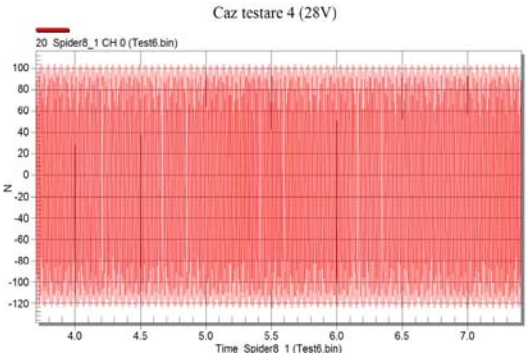

Fig. 1. Sequences of the signal representing the forces of linear magnetostrictive motor for supply voltage 28 V.

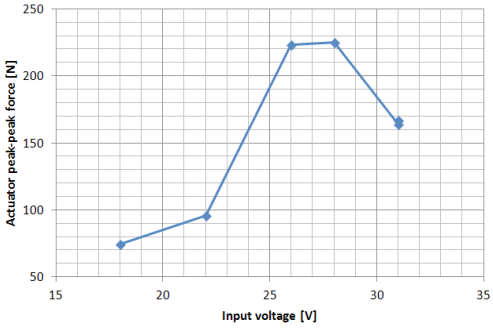

Fig. 2. Force variation relatively to supply voltage of linear magnetostrictive motor

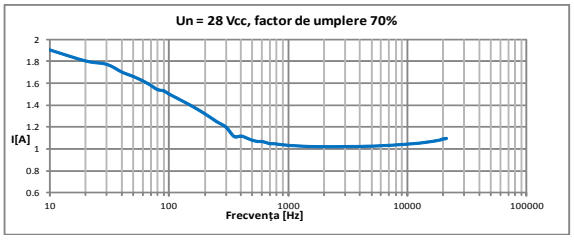

Fig. 3. The variation of the current over to terminals by linear magnetostrictive motor, for a voltage with the characteristics: f = 10Hz - 21kHz, A = 28 V_{vv} si k = 70 %, applied to activation coil and a DC voltage U2 = 28V_{cc}, applied to bias magnetic coil

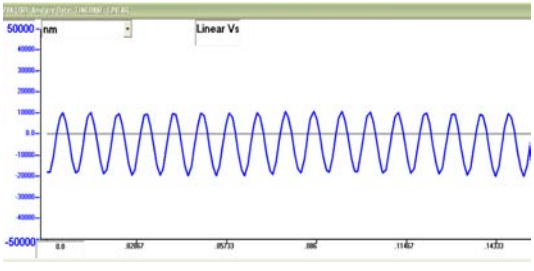

Fig. 4. Displacement diagram versus time of magnetostrictive core, for a voltage U1, PWM1 form, with characteristics: f = 100 Hz, A = 32 V_{vv} and k = 70 %, applied to activation coil and a voltage U2, PWM2 form, with characteristics: f = 100 Hz, A = 32 V_{vv} si k = 40 %, applied to bias magnetic coil.

Fig. 5. Agilent 5529B interferometer measurement system with 55280A linear measurement kit, used for determining the mechanical oscillation amplitude variation made by magnetostrictive core, depending on the time.

RESULTS AND DISCUSSIONS

The project generates in the first phase a linear magnetostrictive motor product family. Thus, a variety of applications in aerospace technology can be covered. In the case of linear displacement magnetostrictive motor driving is consistent with the required specifications. For instance, within 0,5Hz - 100Hz forces up to 300N and amplitudes up to 30μm can be obtained. Within 4kHz – 16kHz forces up to 100N and amplitudes up to 3μm can be obtained.

Project for electronic diagram of electronic specific driver for linear magnetostrictive motor drive is based on a study done. Mechanic project of linear magnetostrictive motor contains sketches of all mechanical assemblies. A functional model of electric drive: linear magnetostrictive motor- electronic specific driver is realized. A testing report of the electric drive: linear magnetostrictive motor - electronic specific driver completes scientific/technical report.

For the functional model realized following technological improvements was obtained:

- an extended interval of voltage PWM frequency that activate coils (drive and bias): 0,5Hz-21kHz,
- an extended interval for voltage PWM duty cycle that activate coils: 20%-90%,
- a supply current for rated voltage 28Vcc between 1A-1,9A for the entire frequency range.

A national patent application entitled *„linear magnetostrictive motor"* registered at OSIM under the number A/00879/17.11.2014 has been elaborated.

The project has been presented as poster at Farnborough Airshow, U.K., 14-20 July 2014.

CONCLUSIONS

Physic-mathematical modeling and numerical modeling highlighted:

- the existence of optimal volume and form factors for magnetostrictive material characteristic for given applications;
- the displacement of the drive rod, [6-7];
- mechanical load (load to the drive rod), [8].

A project of electronic driver circuit diagram specific

for linear magnetostrictive motor drive has been made. Electronic scheme project was made after a "design theme", which is consistent with the operating conditions imposed to linear magnetostrictive motor.

A project of linear magnetostrictive motor has been made. Linear magnetostrictive motor modeling allow predetermination magnetic and mechanical stresses to which it is exposed during operation at various PWM frequency for different duty cycles of excitation voltages and bias. The project of linear magnetostrictive motor was made after a "design theme", which is consistent with the operating conditions imposed. Mechanic project contains sketches of all mechanical assemblies.

A functional model of electric drive: linear magnetostrictive motor- electronic specific driver is realized.

REFERENCES

[1] Claeyssen F., Lhermet N., Maillard T., "*Magnetostrictive Actuators Compared to Piezoelectric Actuators"*, Cedrat Technologies ASSET 2002,

[2] Atulasimha J., Flatau A.B., "*A review of magnetostrictive iron-gallium alloys"*, Smart Materials and Structures, 20, 2011.

[3] ETREMA Products, Inc., Terfenol-D data sheet.

[4] Popa M., Morega A.M., Morega M., "*Optimizarea unui actuator magnetostrictiv", Simpozionul de Maşini Electrice SME'14, a X-a ediție* – Bucureşti, 3 Octombrie, 2014.

[5] Pîslaru-Dănescu L., Morega A.M., Morega M., "*A Novel Magnetostrictive Injection Actuator Based on New Giant Magnetostrictive Materials"*, ATEE 2013.

[6] COMSOL Multiphysics User's Guide, 3.5a, COMSOL A.B. Sewden, 2010.

[7] *** *Terfenol-D Data sheet*, Etrema Products Inc., www.etrema-usa.com

[8] Tomescu A., Tomescu I.B.I, Tomescu F.M.G., *Direct energy conversion* Ed. MatrixRom, 2008.

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Hybrid vertical axis wind turbine acronym HYWINDT

ABSTRACT

The project aims to study, design, experimental development and monitoring of a hybrid wind generator functional model (GEH) with total power output of 3kW, equipped with electricity and heat management system, for Hybrid Wind Turbines with vertical axis (TEH). In the first phase of the project surveys were made regarding feasible constructive solutions of the components for hybrid vertical axis wind turbines which have determined the constructive solution for the hybrid wind generator. The necessary documentation was drawn up in order to protect intellectual property rights regarding the innovative elements and submitted to OSIM;

INTRODUCTION

The generators commonly used in wind turbine systems can be: synchronous with electromagnetic or permanent magnet excitation, respectively asynchronous squirrel cage or wound rotor. Integrated synchronous generators for wind systems are generally connected to the network but can work also if not connected to the grid. Current solutions regard wind systems equipped with:

a) Asynchronous generator with squirrel cage, speed multiplier and soft-starter;

b) dual power asynchronous generator and speed multiplier;

c) Permanent magnet synchronous

generator with or without speed multiplier; d) Permanent magnet synchronous generator without speed multiplier with battery charging system [1].

In the case of high power winds systems, the most widely used electronic converter solution is based on two voltage converters with two levels in a back-to-back configuration [2]. At lower power, other solutions are possible, such as a diode bridge connected in cascade with a dc-dc boost converter. For high power applications, the use of multilevel voltage converters presents in recent years a strong interest [3]. Vertical axis wind hybrid systems addressed in the project HYWINDT allow, unlike conventional ones, simultaneously converting of wind energy into electricity and heat via a Hybrid Wind Generator (GEH) supplying not only electricity just like a conventional electric generator but also heat.

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EXPERIMENTATION

Vertical axis turbines are more efficient under turbulent winds. These turbines further provides advantages in terms of maintenance costs as the electric generator and the electronics are close to the ground and are easier to maintain. In addition, vertical axis wind turbines do not require guidance system. Classical vertical axis wind turbines consist of three main elements: rotor, tower and nacelle that support the wind system components. The most used types of vertical axis wind rotors are Savonius or Darrieus type Fig.1. Operating principle of a wind system involves in the first phase the conversion of kinetic energy of the wind into mechanical energy, followed by its conversion into electricity by adapting to the requirements of specific parameters. Wind systems can operate at variable speed or constant speed electronically controlled.

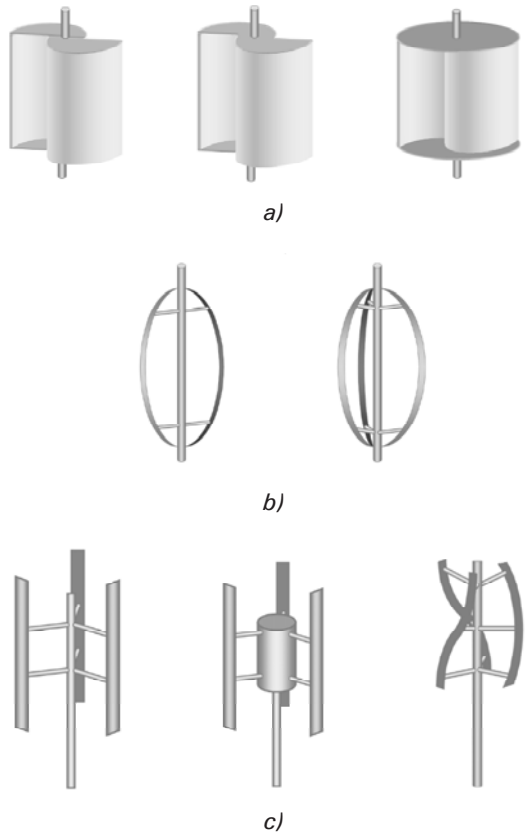

Fig. 1. Examples of constructive solutions: a) Savonius Turbine; b) Darrieus Turbines; c) Darrieus turbine type and helical rotor type H

The functional hybrid wind generator to be realized and tested in the project consists of two main components, a permanent magnet generator and a permanent magnet Heating System, which together form a wind energy conversion device in compact construction characterized by high energy efficiency.

RESULTS

Research undertaken in the first phase is materialized in three patent applications submitted to OSIM:

- CBI A / 00838 / 11.10.2014: *Hybrid wind generator with radially magnetic flux and outer rotor;*
- CBI A / 00839 / 11.10.2014: *Hybrid wind generator with radially magnetic flux and inner rotor*;
- CBI A / 00840 / 11.10.2014: Hybrid wind generator with axial magnetic flux

CONCLUSIONS

Within the stage of execution no. I / 2014 were three technical and scientific activities were undertaken, all fully achieved. The research carried out by the project partners in the current stage of constructive solutions aimed at analyzing the components feasible hybrid vertical axis turbine, preparing documentation for certification of innovative concepts or constructive analysis on choosing the electric generator. The research staff from ICPE-CA focused in this first stage

on the analysis of constructive solutions of components that can be used for hybrid vertical axis wind turbine. Research has allowed the identification of several possible constructive solutions vertical axis turbines. The technical solution that best meets the required criteria (reliability, simplicity, minimal constructive cost, robustness).

REFERENCES

[1]. A. J. Pujante, E. Gómez, A. Molina, J. A. Fuentes and S. Martín: "*State of the Art of Wind Turbines Modelling with Induction Generator*", European Wind Energy Conference and Exhibition (EWEC).20-23.04. 2010, Warsaw, Poland;

[2] M. Liserre, R. Cardenas, M. Molinas, and J. Rodriguez, "*Overview of multi-MW wind turbines and wind parks*", IEEE Trans. Ind. Electron.,vol. 58, no.4, pp. 1081–1095, Apr. 2011.

[3] F. Blaabjerg, M. Liserre, and K. Ma, "*Power electronics converters for wind turbine systems*", IEEE Trans. Ind. Appl., vol. 48, no. 2, pp. 708–719, Mar./Apr. 2012.

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Compact spectrometer in infrared domain (COSPIR)

STAGE No. 1

Theoretical and experimental preliminary studies for realization of spectrometer

ABSTRACT

The realization of pyro-detectors involve the realization of PZT thin films by RF sputtering deposition. For this goal it is necessary the realization of PZT targets. The lead-zirconium-titanate $Pb(Zr_{1-x})Ti_xO_3$ (PZT) shows the good ferroelectric properties for different ratio Zr/Ti, for this reason PZT is used for detector realization. The objective of this stage is the realization of $Pb(Zr_{1-x})Ti_xO_3$ target with good ferroelectric properties for sputtering PZT thin films. By dopants addition the PZT properties are improved. The PbO excess lead to the growth of electromecanic planar coefficient kp = 0.45.

INTRODUCTION

For the realization of pyro-detectors it is necessary the realization of PZT thin films by RF sputtering deposition, with the electrical and structural properties similar to electrical and structural properties of PZT target. The lead-zirconium-titanate $Pb(Zr_{1-x})Ti_xO_3$ (PZT) shows the good ferroelectric properties for different ratio Zr/Ti, for this reason PZT is used for detector realization. The properties of polycrystalline PZT ceramic can be modified by donors and acceptors ions to obtain "soft" or "hard" materials [1-3]. The PZT has general formula structure ABO_3 (were A – mono–trivalent ion and B is tri–hexavalent ion).

The project objectives are:

1. The realization of functional model of compact IR spectometer;
2. The obtaining of thin films for active components;
3. Design of active components and passive components with specialized software;
4. The fabrication of passive and active components using micro-fabrication techniques;
5. Design and fabrication of command and control circuits.

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Techn. Filofteia Fotea

EXPERIMENTAL

The PZT composition with ratio Zr/Ti = 52/48 shows good electro-mecanic properties at room temperature. For experimental work we used the general composition: $Pb(Zr_{1-x})Ti_xO_3$ codified: (PZTc).

For fabrication of new composition codified PZTc we used high purity oxide powders: PbO (Aldrich PbO >99%), ZrO_2 (Alfa Aesar ZrO_2>99%), TiO_2 (Aldrich TiO_2>99%). We used PbO in excess for compensation the loss of lead during the sintering process. For inhibiting the growth of grains we used MnO (Merck with MnO >99%).

The density for the sintered samples have been calculated from the measured volume and weight. The phase composition of sintered samples has been determinate by X-ray diffraction with *BRUKER AXS D8 Advance diffractometer.* The microstructure development after the sintering have been determinate using the scanning electron microscopy (SEM).

From XRD analysis we determine the size of grains for the samples sintered at temperatures: 1150°C, 1200°C, 1250°C. Average sizes are: 40.85-50.91 nm.

From SEM we observe the differences between the grains determinate from sintering temperature and process.

All sintered samples have been covered with Ag paste to obtain the electrodes.The dielectric properties have been measured with a RLC bridge tipe HAMEG to 1kHz.

Piezoelectric properties of the sample were measured with the impedance annalizer 4294A Agilent.

The complex dielectric permittivity and the dielectric loss (tg δ) were measured by the impedance annalizer 4294A Agilent between 40Hz-500KHz, for all samples.

RESULTS AND DISCUSSIONS

Figure 1 show XRD patterns for the composition PZTc, with sintering temperatures of 1150°C, 1200°C, 1250° C.

Table 1 shows average sizes for the se PZTc crystallites, with sintering temperatures of 1150°C, 1200°C, 1250° C.

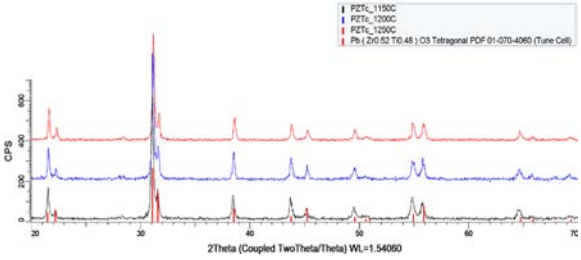

Fig. 1. XRD patterns for the composition PZTc, with sintering temperatures of 1150°C, 1200°C, 1250° C

Table 1 Average sizes for the crystallites

Sample_T[°C]	D[101] (nm)
PZTc _1150°C	42.98
PZTc- 1200°C	48.23
PZTc 1250°C	50.91

Figure 2 shows SEM image for PZTc sample sintered at 1250°C / 2h.

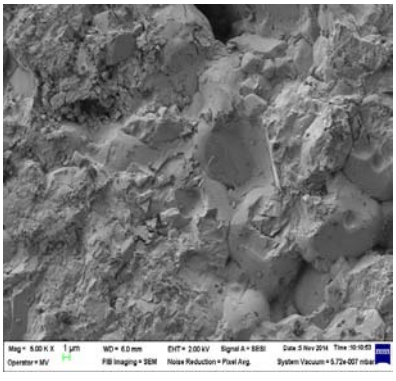

Fig. 2. SEM image for PZTc sample sintered at 1250°C / 2h

Figure 3 shows the relative dielectric permittivity for the sample PZTc_PbO sintered at 1250°C.

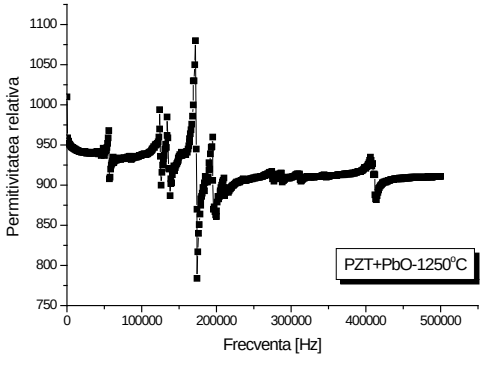

Fig. 3. Relative dielectric permittivity for the sample PZTc_PbO

CONCLUSIONS

1. The PZT targets for thin films by RF sputtering deposition must have a crystalline structure with only perovskite phase, high density (95-98% from theoretical density) and a reduced porosity. The target is a disk with a diameter of 20-60 mm and thickness of 1 - 3 mm.

2. The sintered PZT for target has general formula: $Pb(Zr_{1-x})Ti_xO_3$ (PZT). We achieved 3 compositions, all described by the ratio Zr/Ti = 52/48.

3. From XRD we calculated average sizes for the PZTc crystallites for 3 sintered compositions with sintering temperatures of 1150°C, 1200°C, 1250°C.

From SEM we observe the differences between the size of grains determinate from sintering temperature and process.

4. The PZT_c without addition has the little electro-mecanic coefficient, only 0.3 at 1250°C. By addition of dopants, the electro-mecanic properties increase. For the excess of PbO, the electro-mecanic coefficient kp = 0.45 at 1250°C sintered temperature.

5. By our technology we obtained 3 perovskite compositions ABO_3, with the ratio Zr^{4+}/Ti^{4+} = 52/48. Those 3 compositions: PZTc, PZTc_PbO, PZTc_MnO, will use for the targets fabrication in Stage II of Project.

REFERENCES

[1] B. Jaffe, R. W. Cook, and H. Jaffe, *Piezoelectric Ceramics,* Academic Press, New York, 197.

[2] G.H.Haertiling, J.Am.Ceramic.Soc.82 (1999) 797.

[3] S.Takahashi, Ferroelectrics 41 (1982) 143.

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High temperature intelligent Sensor with silicon carbide (SiC) diodes for industrial applications in harsh environments (SiC SET)

ABSTRACT

In Phase III of the project, ICPE-CA partner realized two activities:

Study of dielectric and metal thin films depositions on SiC and study of the required heat treatment. The methods used in this project for obtaining thin dielectric and metal layers on silicon carbide (SiC) substrate are:

- *deposition by thermal evaporation in vacuum;*
- *RF sputtering, DC sputtering.*

Structural and morphological characterizations of Ni thin films samples have been made by XRD and SEM.

Studies and experiments on the conductive adhesive materials resistant to high temperature technology for mounting the high temperature diode in the capsule.

Electrical and morphological (SEM) characterizations of conductive adhesive samples (type nano-sized silver paste) have been made.

INTRODUCTION

The main SiC-SET project's objectives are the design, development, and implementation of a temperature sensor with SiC diodes for monitoring the temperature in cement factory furnaces.

The temperature sensors studied in this project are based on a Ni/4H-SiC Schottky contact [2-9].

In phase III of the project were made:

- Ni thin layers structures for the Schottky and ohmic contacts;
- Characterization of crystalline structure (XRD) and microstructure (SEM) of the prepared thin film samples;
- Studies on electrically conductive adhesives (ECAs) (Conductive Fillers Electrically for electrically conductive adhesives);
- Experiments on manufacturing electrically conductive adhesive of type nano-sized silver paste;
- Microstructural (SEM) characterization of AgNPs;

• Electrical characterization of conductive adhesive samples.

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Technician Adrian Militaru
Technician Filoftea Fotea

EXPERIMENTAL

During Phase III, for manufacturing SiC Schottky diodes and ohmic contacts, structures of thin layers of Ni and Ni/SiO_2 on SiC were achieved. Experiments were made by depositing thin layers of Ni and Ni/SiO_2 on SiC though DC Sputtering and by in situ and ex-situ thermal treatments.

In advance a silicon oxide layer, with a thickness of 650 nm, was thermally grown and on this structure was deposited a thin layer of nickel. The deposited Ni structures were processed at different temperatures, in an argon atmosphere of 99,999%, in situ and ex-situ. (Table 1) [1].

Table 1. Conditions of structures manufacturing

Sample	Layer or multilayer	Thermal treatment/ Temperature /time	Speed to reach the level	Atmosphere heat treatment
1	Ni	-	-	Ar 99,999% x10^{-3}at
2	Ni/SiO_2	In situu 200^{0}C	-	Ar 99,999% x10^{-3}at
3	Ni/SiO_2	In situu 400^{0}C	-	Ar 99,999% x10^{-3}at

After the investigation of the materials and the technologies for mounting a diode in the capsule followed high-temperature experiments for achieving the conductive adhesive of type nano-sized silver paste.

Nano silver paste was made of nano-sized silver powder synthesized at this stage by using other organics (dispersant, solvent) [10-14].

RESULTS AND DISCUSSIONS

The microphysical information obtained from the study of Ni/SiO_2 metal -oxide bilayers are important in determining the technology for the temperature sensor on the silicon carbide Schottky diode (SiC); it has been found that the deposition on the substrate heated to 200°C and 400° C is not causing changes in the Ni/SiO_2 structure (Fig.1 , Fig.2 , Fig.3). Ni is crystalline (face centered cubic) (2Θ = 44.7° and 52.2°). After treatment, the nickel crystallite size increases and the intensity peaks are much larger (Fig.1, Fig. 2, Fig. 3) which shows the crystal structure

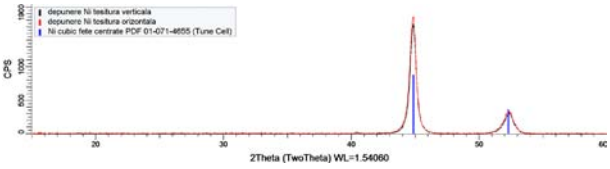

Fig 1. X-ray diffraction pattern (XRD) for nickel thin layer (sample 1) deposition on unheated substrate

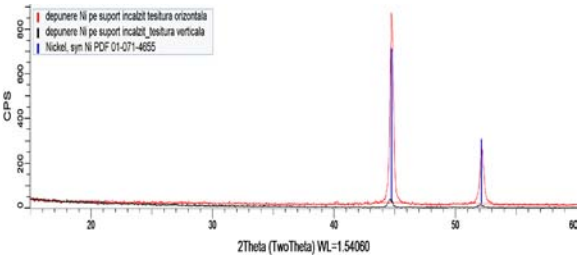

Fig. 2. X-ray diffraction pattern (XRD) for nickel thin layer (sample 2) deposition on heated substrate to 200^{0}C

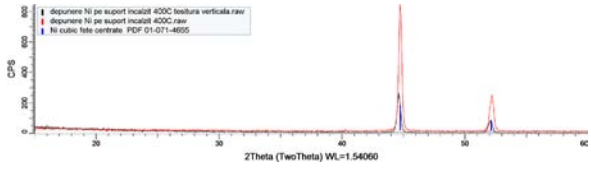

Fig. 3. X-ray diffraction pattern (XRD) for nickel thin layer (sample 3) deposition on heated substrate to 400^{0}C

Nano silver particles synthesized for achieving conductive adhesive were morphologically analyzed (SEM) (Fig.4).

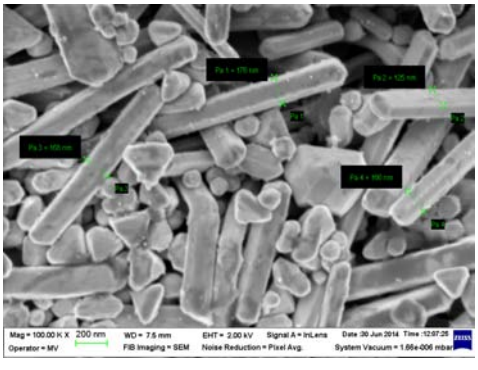

Fig. 4. SEM image of Ag NPs obtained by polyol method

SEM image showed Ag spherical nanoparticles and Ag nanorods with sizes between 125-176 nm.

The obtained conductive adhesives were tested in terms of electrical conductivity by electrical resistivity determination.

Table 2. The results obtained on electrical resistivity determination for the obtained adhesive sample

Adhesive type	Resistance (Ω)	Resistivity (Ω ·m)
1.	40,48	18,07

The results obtained on electrical resistivity determination showed conductive properties for the obtained adhesives samples.

CONCLUSIONS

In the first phase, the ICPE-CA partner accomplished the following:

- Developed the thin layers structures for Schottky diodes able to work in high-temperature environment (up to 450^{0}C) and that can be encapsulated;
- Experimental depositions by DC Sputtering of the Ni and Ni/SiO_2 thin layers and thermal treatments in-situ and ex-situ;
- Structural (XRD) and morphological (SEM) characterizations of the deposited thin layers;
- Studies on electrically conductive materials resistant at high-temperatures and on the technologies *for mounting the high temperature diode in the capsule*;
- Experiments on manufacturing the electrically conductive adhesive of type nano-sized silver paste with high temperature performance;
- Morphological characterization (SEM) and structural (XRD) for the synthesized nano-sized silver powder;
- The results obtained on electrical resistivity determination showed conductive properties for the obtained adhesives samples.

The results of the researches on conductive adhesive materials were disseminated by making an application for patent filed at OSIM under no. A/00857/13.11.2014, with the title "Process for the preparation of the adhesive composition based on conductive nanostructured Ag", authors: Mălăeru Teodora, Neamţu Jenica, Georgescu Gabriela, Marinescu Virgil, Pătroi Delia.

REFERENCES

[1] T. Kimoto, Q. Wahab, A. Ellison, U. Forsberg, M. Tuominen, R.Yakimova, A. Henry, and E. Janz´en, *"High-voltage (>2.5 kV) 4H–SiC Schottky rectifiers processed on hot-wall CVD and high-temperature CVD layers"* in Silicon Carbide, III–Nitrides and Related Materials VII–Stockholm 1997, G. Pensl, H. Morkoc, B. Monemar, and E. Janz´en, Eds., Materials Science Forum, vols. 264–268, pp. 921–924, 1998.

[2] Q. Wahab, A. Kimoto, Ellison, C. Hallin, M. Tuominen, R. Yakimova, A. Henry, J. P. Bergman, and E. Janz´en, „A 3 kV Schottky barrier diode in 4H–SiC", Appl. Phys. Lett., vol. 72, pp. 445–447, 1998.

[3],[4] P.Godignon, Inst. de Microelectron. de Barcelona-Centro Nac. de Microelectron., Univ. Autonoma de Barcelona, Barcelona, Spain, X. Jorda; M. Vellvehi, X. Perpina, V. Banu, D. Lopez, J. Barbero, P. Brosselard, S. Massetti, *„SiC Schottky Diodes for Harsh Environment Space Applications"*, Industrial Electronics, IEEE Transactions on, July 2011, Volume: 58, Issue: 7, pp 2582 –2587; 2588- 2593.

[5] W.M. Tang, C.H. Leung, P.T. Lai, *„A Study on Hydrogen Reaction Kinetics of Pt/HfO2/SiC Schottky-Diode Hydrogen Sensors"*, în cartea: Stoichiometry and Materials Science - When numbers matter", 04/2012; ISBN: 978-953-5-0512-1.

[6] V. Saxena, Jian Nong Su, A.J. Steckl, Lucent Technol., FL. Orlando, *„High-voltage Ni- and Pt-SiC Schottky diodes utilizing metal field plate termination"*, IEEE Transactions on Electron Devices (impact factor: 2.32).04/1999; DOI:10.1109/16.748862.

[7] Jovan M. Hadži-Vuković, Milan M. Jevtić, Institute of Physics, Beograd, 11080 Zemun, Pregrevica 118, Serbia and Montenegro, *„The voltage pulse degraded Ti/4H–SiC Schottky diodes studied with I–V and low frequency noise measurements"*, Diamond and Related Materials; DOI:10.1016/j.diamond.2006.03.016.

[8] Yen-Ting Chiang, Yean-Kuen Fang, Tse-Heng Chou, Cheng-I Lin, Feng-Renn Juang, Kung-Cheng Lin, Dept. of Electr. Eng., Nat. Cheng Kung Univ.Tainan, Taiwan, *„The Impact of Interface Layer on a Pd/n-LTPS Schottky Diode Hydrogen Detecting Performances"*, IEEE Transactions on Electron Devices, 09/2010; DOI:10.1109/TED.2010.2051364.

[9] R. Pascu, F. Craciunoiu, M. Kusko, F. Draghici, A. Dinescu, M. Danila, *"The Effect of the Post-Metallization Annealing of Ni/n-type 4H-SiC Schottky Contact"*, in Proc. of the 35th International Semiconductor Conference, 15-17 Oct. 2012, Sinaia, Romania, vol. 2, IEEE Catalog Number: CFP12CAS-PRT, ISBN: 978-1-4673-0736-9, ISSN: 1545-827X, pp. 457-460.

[10] Murray C.T., Rudman R.L., Sabade M.B., and Pocius A.V., *„Conductive adhesives for electronic assemblies"*, Mater. Res. Bull. 2003, 28, 2003, pp.449–454.

[11] S. Kottaus, B. H. Guenther, R. Haug, and H. Schafer, *„Study of Isotropically Conductive Bondings Filled with Aggregates of Nano-Sized Ag-Particles"*, IEEE Transactions on Components, Packaging, and Manufacturing Technology, Part A, 20 (1), 1997, pp. 15-20.

[12] Wu H., Wu X., Liu J., Zhang G., Wang Y., Zeng Y., and Jing J., *„Development of a novelisotropic conductive adhesive filled with silver nanowires"* , J. Compos. Mater., 40(21), 2006, pp.1961–1968.

[13] Chen C., Wang L., Li R., Jiang G., Yu H., and Chen T., *„Effect of silver nanowires on electrical conductance of system composed of silver particles",* J. Mater. Sci., 42(9), 2007, pp. 3172.

[14] Lee H.S., Chou K.S., and Shih Z.W., *„Effect of nano-sized silver particles on the resistivityof polymeric conductive adhesives"* , Int. J. Adhes. Adhes., 25, 2005, pp. 437–441.

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HTS Superconductive magnet for nuclear magnetic moments measurement

SUMMARY

Within the research project, more objectives of the project were fulfilled. The technical theme has been elaborated with the geometrical and magnetic parameters of the HTS superconductive magnet. The main characteristics: magnetic field < 3 T; nonuniformity ~ 10^{-3}; access possibility to the field zone in three orthogonal directions. Also, the conceptual model of HTS superconducting magnet had been elaborated and numerical 2D and 3D simulations of the field were made considering three constructive variants and of the temperature distribution in the magnet, as well as of the Lorentz forces within the superconductive coil winding considering the three variants by using COMSOL MULTIPHYSICS.

INTRODUCTION

Conventional electromagnets (made with cooper winding) can usually generate magnetic fields with maximum values 1,5-1,8 T. Thus, this type of electromagnets have limited performances and high energy consumption because of Joule losses. Discovery of the High Temperature Superconductors (HTS) like YBCO (YBaCuO) or BSCCO (BaSrCaCuO), with critical temperatures below 92K, in the usable industrial scale, allowed their use for obtaining electromagnets for particles accelerators and other applications in the field of nuclear physics. The advantage of those consist in the fact that the necessity of eliminating the usage of liquid Helium for cooling the coils (4,2K) and the liquid Nitrogen (77K) may be used which is economical.

The proposed electromagnet for this project will operate at a temperature around 30K, obtained using a Gifford-McMahon (GM) cryocooler, having two cooling steps: 50 K and 4.2 K, and the superconducting wire will be made of HTS YBCO superconducting tape.

In this research project, through this highly competent partnership in this field, the prerequisites to achieve an innovative product and application of high complexity and next-generation technologies are created. The overall objective of the project is to produce a superconducting dipole magnet prototype for making measurements of nuclear magnetic moments. This prototype will produce a 2T magnetic field with 10^{-3} – 10^{-4} homogeneity along the active area of the magnet and in the hot channel area. By using HTS superconducting materials instead of the conventional ones as NbTi, a dimensional and economical optimization is achieved.

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ELABORATING THE CONCEPTUAL MODEL OF HTS SUPERCONDUCTING MAGNET

Since the superconducting winding requires assuring some suitable operating conditions, especially the temperature (20-30K), this must be inserted into a suitable thermal protection system (cryostat).

It must also be ensured the superconductive winding (solenoid) cooling system, which consists of a device called cryocooler having a heat pump role. Cooling shall be effected by heat conduction. In order to produce the magnetic field, the coils will be supplied from a DC power supply, programmable power supply, which allows supplying the solenoids, with different increase speeds from 0-300 A. The conceptual mode is described in FIG. 1.

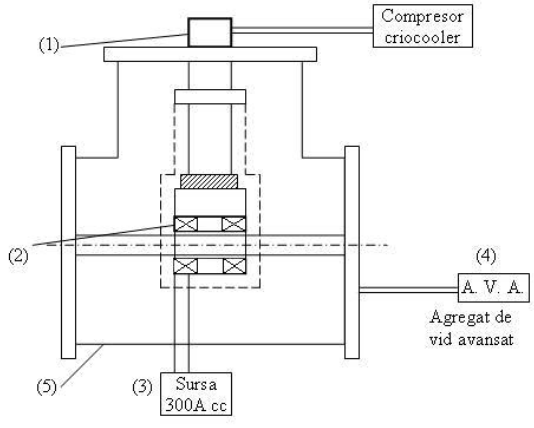

Fig. 1. HTS superconductive magnet conceptual model

The system is made of the following sub assemblies:

1. Cryocooler (1)
2. HTS coil (2)
3. DC programmable power supply (3)
4. Advanced vacuum aggregate (4)
5. Coil cryostat (5)

NUMERICAL MODELING OF THE MAGNETIC FIELD

Coils assembly known as Helmholtz coils consists of two identical coaxial coils.

Such a device creates under certain circumstances a uniform magnetic field in a given volume, midway between the coils, [1]. For simplicity we assume that the coils are actually parallel coaxial turns, traveled by equal currents in the same direction.

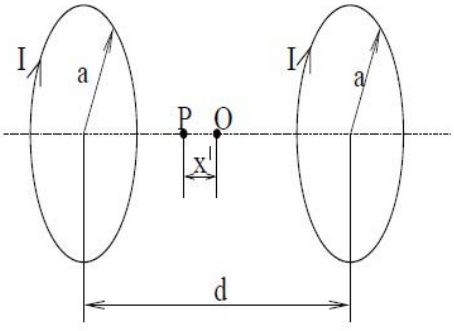

Fig. 2. Bobinele Helmholtz

After the geometrical, physical and mathematical modeling the numeric modeling of the magnetic field has been done. Three working variants will be analyzed: the coil with iron yoke fed with 170 A and 300 A, respectively, and the no iron yoke variant.

For the optimal variant with iron yoke, I = 170 A, N= 692 turns, the modeling results are displayed in Fig. 3.

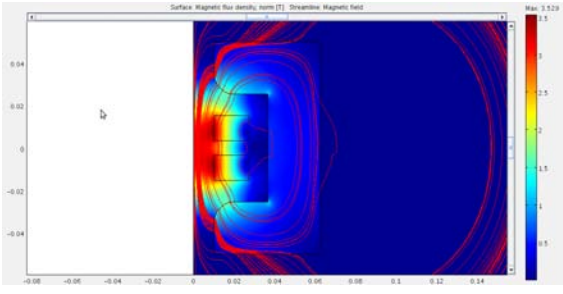

Fig. 3. Magnetic field streamline

Magnetic induction in the center of the coil can be seen in Fig. 4.

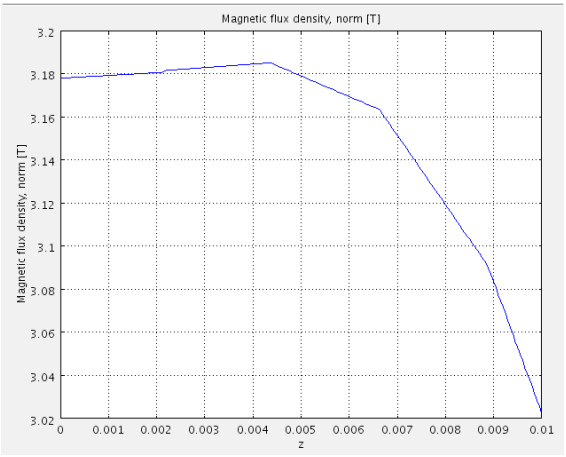

Fig. 4. B(x) magnetic induction in the center of the coil

Following the 3D modeling, the field lines in Fig. 5 resulted:

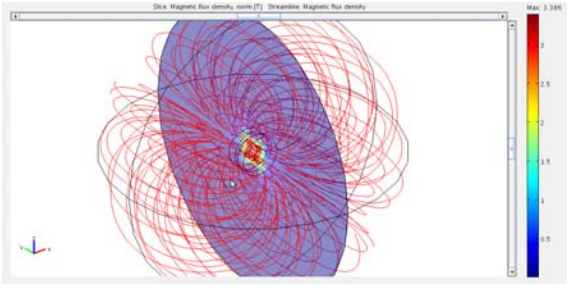

Fig. 5. Magnetic field lines

The 3D modeling shows an extended distribution of the magnetic field lines, much outside the interest area (central system area). Avoiding this situation can be achieved only by using a screen (yoke) of iron to limit the protection zone and the surrounding areas of the electromagnet field.

Table 1. Comparison between HTS superconducting magnets versions

	Iron yoke	B [T]	I [A]	N_{turns}	B/B [%]	Lorentz Force [N]
Ver. 1	Yes	3.18	170	692	0.22	30
Ver. 2	No	2.76	170	692	0.31	25
Ver. 3	Yes	4.85	300	692	0.15	90

CONCLUSIONS

Within this project stage, the following objectives were achieved:

- Elaboration of the HTS superconducting magnet concept model.
- Based on the technical theme, elaborated together with partner IFIN-HH, the HTS superconducting magnet concept model was elaborated to determine nuclear magnetic moments.
- The HTS superconducting magnet concept model consists mainly in the following components:

1. Cryocooler
2. Coil cryostat
3. HTS winding
4. DC programmable power supply (300 A)
5. Advanced vacuum aggregate

- Numerical simulations of the generated magnetic field, of the magnet thermal field and of the Lorentz forces in the winding. Establishing the design optimal parameters.
- Elaboration of the technical theme with setting the parameters necessary to be obtained by the superconducting magnet (field intensity, uniformity, main dimensions, etc.).
- Elaboration of the magnetic field measurement system concept model.

REFERENCES

[1] B.Montgomery, *„Solenoid magnet design"*, Wiley – Interscience, New York, 1969.

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Dipolar superconducting electromagnet for high and uniform magnetic field generation

ABSTRACT

In the project several objectives were achieved. An EMSD concept model was elaborated including numerical modeling and model optimization. The technical theme for the elaboration of the EMSD concept model was elaborated. Also, the concept model of the measurement system and 3D mapping of the magnetic field generated by EMSD was elaborated. 3D numerical evaluations of the magnetic field and of the temperature distribution of EMSD were performed, as well as the mechanical tensions in the superconducting winding by using the software COMSOL MULTIPHYSICS. The concept and the design of a realization system of the planar HTS superconducting coils were performed.

INTRODUCTION

The project proposes the realization of a prototype of a dipolar superconducting electromagnet which generates a high (~3T) and uniform magnetic field in an extended and well defined area, the so called "warm channel" of the electromagnet, throughout its length. Through this warm channel pass the electric charged and accelerated at high energies (~ GeV-TeV) particles flux, to be deviated from the initial direction and maintained on a curved trajectory. This deviation is made by passing the electric charged particles through high and uniform magnetic field.

This type of superconducting electromagnet is intended for use in the high energy [1], modern particle accelerators, without which the current physics progress cannot be conceived or for various industrial applications. Within the theme, for dimensioning the electromagnet, the ultimate realizations in the software intended for 3D numerical modeling (Comsol Multiphysics) [2] of the magnetic field and of the electromagnet functioning simulation will be used. Also, the ultimate technology for obtaining the low temperatures (cryocoolers) will be used, which eliminates the use of the cryogenic agents and the last type of superconducting materials will be used, the so called HTS superconductors (High Temperature Superconductors).

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ELABORATION OF DIPOLAR SUPERCONDUCTING MAGNET CONCEPTUAL MODEL

For the realization of the conditions necessary to perform the function of deflector magnet for the electric charged and accelerated particles [3], the electromagnet will fulfill the requirements stated below:

- superconducting magnet must produce a high magnetic field (2-3T) in its center, with a uniformity of $\sim 10^{-3}$, with the following features:
  - a "warm" channel for access to the accelerated particles;
  - diameter of the interior access channel: 20 mm;
  - field useful area dimension: approx. 15 cm^3;
  - cooling without cryogenic agents (use of cryocooler) by thermal conduction;
  - use of the HTS superconducting materials;
  - closing the system in an austenitic stainless steel cryostat;
  - vacuuming the cryogenic chamber at a level of de 10^{-3}-10^{-5} torr.

Taking into account the constraints and requirements imposed by the design theme, the superconducting dipole magnet conceptual model was developed. This is schematically represented in fig.1 and 2.

The dipolar magnet concept model has a complex structure, being composed mainly of the following subassemblies:

a. The actual electromagnet;
b. The electromagnet cryogenic cooling system;
c. The superconducting electromagnet cryostat;
d. The magnet power supply conductors.

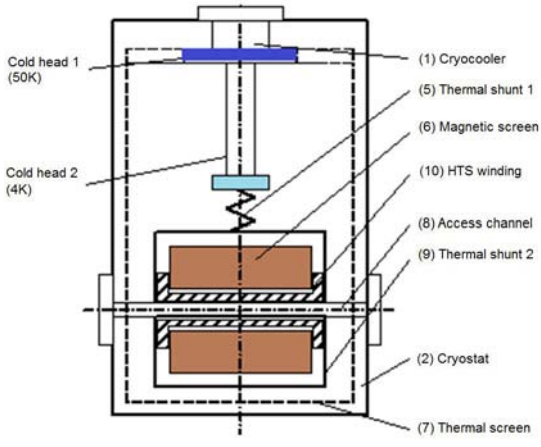

Fig. 1. Longitudinal cross-section

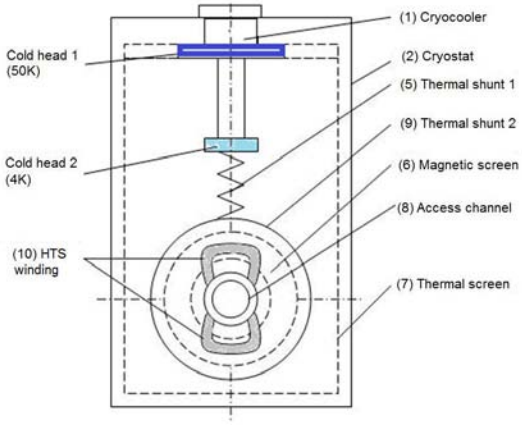

Fig. 2. Axial cross section

This structure resulted following the necessity of the realization of the functioning conditions of the superconducting electromagnet: achieving and maintaining low temperatures (min. 77K) in the superconducting coils, so the use of cryogenics and a cryostat to thermally isolate the coils from the environment.

NUMERICAL MODELING

Magnetic field distribution at cos dipole electromagnets

Starting from the Biot –Savart law [4], for the computation of the magnetic induction from a current line, the equations were deducted for the harmonics of the magnetic field generated by N conductors placed in four quadrants.

In the process of optimization of the magnetic dipole $\cos\theta$, there were taken into account:

- value of the magnetic field in the aperture for which there is desired a value of approx. 2.5T;
- magnetic induction in the iron yoke which must have a value under the saturation one (2T) ;
- reduction of the iron used for manufacturing the magnetic yoke;
- The maximum value of the current I = 300A;
- uniformity of the magnetic field in the aperture.

The 2D modeling of a characterized $\cos\theta$ dipole was realized by geometrical parameters in Table 1.

Table 1. Dipole geometrical parameters

Parameter	Value
Aperture radius	15 mm
Air gap	5 mm
Iron yoke thickness	30 mm
Wire diameter	0,2 mm
Total number of turns	265
Current	290 A
Current density	7,25e^{09} A/m^2
$\theta_0,\theta_1,\theta_2,\theta_3$	$59.4°, 49.6°, 26.6°, 10°$

Results

The main purpose of the modeling consisted in the determination of the magnetic field distribution at dipole type electromagnets to identify the input parameters of the system to be characterized.

The total number of turns in the optimized model is N = 265, divided into sectors according to Fig. 3.

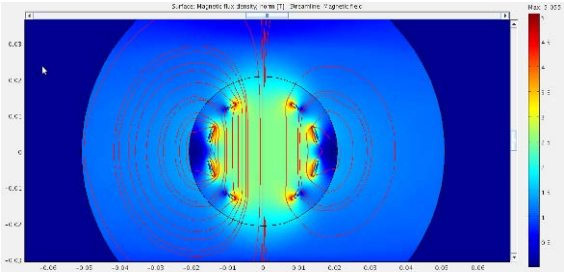

Fig. 3. Magnetic field distribution and the field lines for the cos θ dipole

The f_{om} inhomogeneity of the magnetic field in the aperture, in percentage, is determined using the formula:

$$\frac{B_{\max} - B_{\min}}{B_{\max}} \cdot 100 = f_{om}\,\% \qquad (1)$$

For the modeled case, considering two thirds in the aperture, the inhomogeneity of the magnetic field is: f_{om} = 0.96 % for a variation of the magnetic field according to Fig. 4.

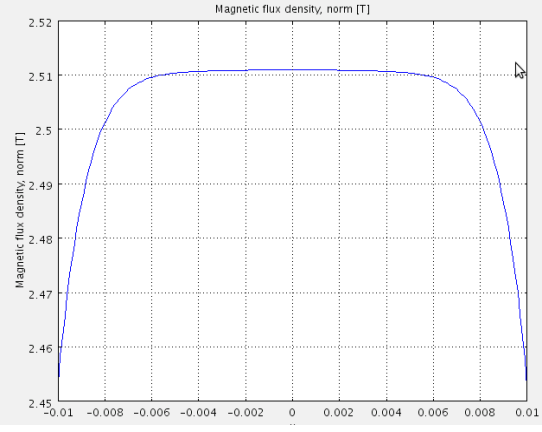

Fig. 4. Magnetic induction variation B [T] depending on the coordinate x[m] on 2/3 of the aperture

Dipolar electromagnets without iron yoke and tilted coils

Physical model

This version is realized for a 30 mm diameter and a magnetic field in the center of 3 T, current I = 300A. The YBCO conductor used has a width of 6 mm. There was considered that the coils are made by tilting the tape at 45° against the winding direction. Table 2 contains the data used for the construction of the model.

Table 2. Coils data

Coil	Angle [°]	Turns	Dimensions [mm]
1	−66.815	50	8.5
2	−37.7	101	17.17
3	−17.84	121	20.57
4	0	128	21.76
5	0	128	21.76
6	17.84	121	20.57
7	37.79	101	17.17
8	66.815	50	8.5

Results

The results can be observed in Fig. 5, which contain the field lines and the color map of the magnetic induction module, as well as in Fig. 6 in which is given the $|\overline{B}|$ variation in the center, marked with a red line in Fig. 5.

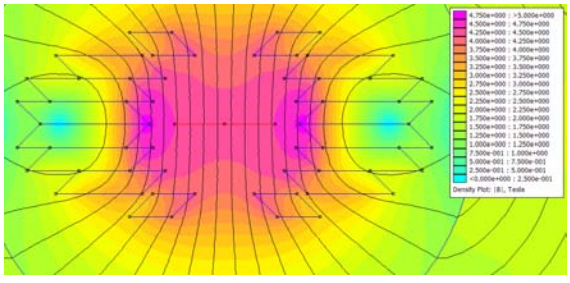

Fig. 5. Distribution of magnetic field and field lines

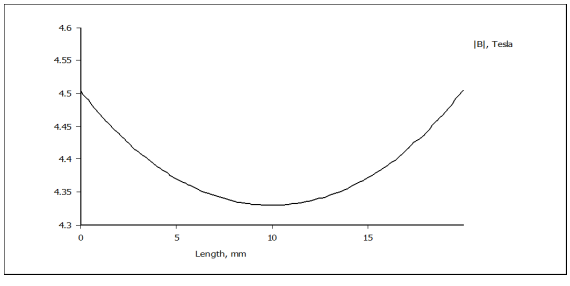

Fig. 6. Curve $|\overline{B}| = f(x)_{y=0}$, *x ∈ [-10, 10]*

For the modeled case, considering two thirds from the aperture, the inhomogeneity of the magnetic field is: f_{om} = 11.74 %, for B_0 = 4.33 T.

Dipolar electromagnet with parallel planar coils

A physical model made of two coils, double pancake, placed in parallel planes to each other was studied, at a distance of 30 mm.

Modeling

The AC/DC 2D module was used for modeling, environment "Perpendicular Induction Currents, Vector Potential" of the software COMSOL Multiphysics.

Results

The particular situation with the following specifications was considered (Fig.7):

- distance between the coils 30[mm];

- interior curvature radius of the coils 15[mm];
- electric current intensity 170[A];
- winding width 60[mm].

In this case the nonuniformity of the field is 3.3%.

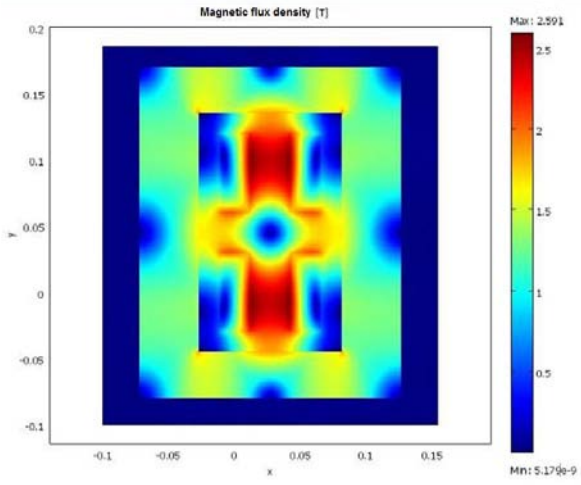

Fig. 7. Distribution of the magnetic flux density in the considered assembly

CONCLUSIONS

The proposed objectives of the project were achieved. Thus, the conceptual model of the HTS superconductor electromagnet (EMSD) was elaborated, with the following structure:

a. The actual electromagnet;

b. The cryogenic cooling system of the electromagnet;

c. The cryostat of the superconducting electromagnet;

d. The magnet power supply conductors.

Its main features are:

- generated magnetic field: 2-3T;
- field nonuniformity: 10^{-3};
- good field zone volume: 15cm^3;
- central access channel: 20mm diameter.

Also, a numerical modeling of the magnetic field generated by the analyzed windings models (cos winding, tilted turns winding and planar winding) was made. The most advantageous version was found for a cos configuration:

- obtained magnetic field: 2,51T;
- nonuniformity: 0,96%;
- number of turns: 265;
- used current: 290A.

For the execution of the superconducting coils the concept and the realization of an adequate device execution of these coils is necessary. In this stage the execution project of its mechanical components was conceived and realized.

REFERENCES

[1] Keita Takahashi et al., *„Magnetic Field Design of Coil-Dominated Magnets Wound With Coated Conductors"*, IEEE Transactions on Applied Superconductivity, vol. 22, nr. 3, 2012.

[2] *"COMSOL Multiphysics Software"* http://www.comsol.com/.

[3] S. Russenschuck, *Field Computation for Accelerator Magnets*, Wiley-VCH, 2010.

[4] C.I. Mocanu, *Teoria câmpului electromagnetic*, EDP, Bucureşti, 1982.

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Fabrication of dipolar superferric electromagnets and magnets and field sources for FAIR particle accelerators

SUMMARY

Within the research project, in year 2014 all the objectives of the project were fulfilled. In the first phase, the cryogenic cooling system of the HTS coils was made. In the second phase, the working drawings of the multipolar superconducting coils with cylindrical geometry were made. Also, the working drawings of the superconducting coils montage devices were made. In the third phase, two devices were made: a device to fabricate the multipolar NbTi superconducting coils, in planar geometry and a multipolar NbTi superconducting coils assembling device with cylindrical geometry. In the fourth phase, dipolar and sextupolar planar coils were made, which were used to form a cylindrical assembly.

INTRODUCTION

The superconducting HTS (High Temperature Superconductor) coils due to their high performances, obtained from HTS, BSCCO and YBCO materials, are more frequently used in order to obtain high magnetic fields necessary for performant electromagnets for the particles accelerators [1]. These kind of superconducting coils are used to design complex measurement systems of the materials properties in high magnetic fields. Replacing the NbTi or Nb_3Sn classic superconducting winding with HTS, this has the advantage of higher working temperature: 77K (liquid nitrogen) instead of 4,2K the working temperature of the LTS (low temperature superconductors) materials. Under these circumstances, instead of liquid helium, the liquid nitrogen or a cyocooler can be used, which is economical. More, the HTS coils have the advantage of being compact, these having smaller dimensions for the same values of the obtained magnetic field.

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CRIOGENIC COOLING SYSTEM OF THE HTS SUPERCONDUCTING COILS

According to the objectives of this designing phase, the followings were made:

O1. Cryostat designing

The superconducting HTS coils cryostat is schematically presented in fig. 1.

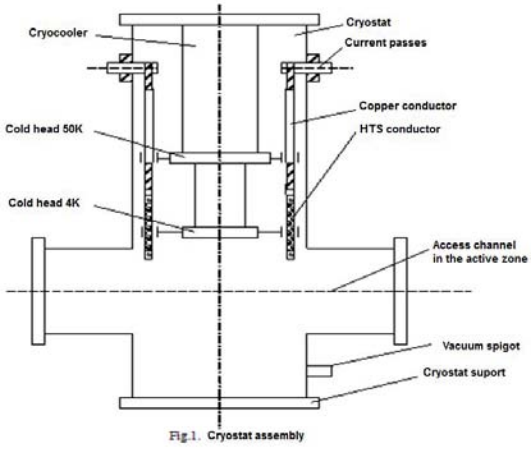

Fig. 1. Cryostat assembly

Within this phase of the project, the HTS superconducting coils cryostat was made. This device allows the assembling of the cryocooler and of the hybrid conductors system for the electrical power supply of the superconducting coils.

The cryostat has a double role: 1. it assures the mechanical resistance of the assembly and 2. it assures, in the same time, the thermal isolation of the coils in order for these to be cooled at the working temperature (4,2K).

Cryostat characteristics:

- fabrication material: austenitic stainless steel (2 mm thickness sheet);
- "T" shape fabrication which allows the existence of a horizontal central channel for the access in the uniform magnetic field zone;
- vertical channel for the cryocooler and the hybrid conductors for electric power supply of the HTS coils;
- General dimensions: h = 665 mm; $D_{vertical_channel}$ = 270mm; $D_{horizontal\ channel}$ = 210 mm.

SYSTEM FOR ELABORATING WORKING DRAWINGS FOR MULTIPOLAR SUPERCONDUCTIVE COILS AND ELABORATING WORKING DRAWINGS FOR THEIR ASSEMBLING DEVICES

1. Elaborating working drawings for the multipolar superconductive coils with cylindrical geometry

The working drawings for the dipolar, quadrupolar and sextupolar superconductive coils have been elaborated.

Their main characteristics are presented in table 1.

Table 1. Main characteristics of the coils

Coil	Dipole	Quadrupole	Sextupole	Sextupole
Coil No.	2	4	6	6
No. of turns /coil	68x2	83x4	56x6	55x6
Dimensions	187,6x183,5 mm 310x305,9 mm	310x149,2 mm	310x100,7 mm	310x98,2 mm
Wire length/ multipolar coil	212 m	220,2 m	218 m	217 m
Superconductive material	NbTi, 0,6 mm	NbTi, 0,6 mm	NbTi, 0,6 mm	NbTi, 0,6 mm

Dipolar coil

In Fig. 2 is presented the superconductive coil in its final cylindrical shape, together with the planar shape and angular distribution of the winding.

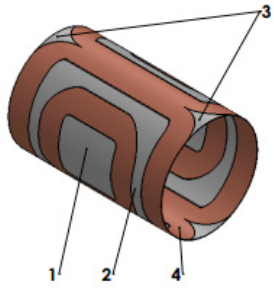

Fig. 2. The cylindrical shape of the dipole

Quadrupolar coil (working assembly drawing no. BQ-0) is displayed in fig.3.

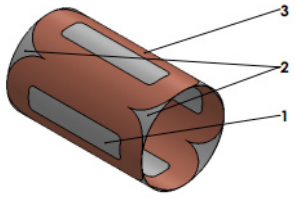

Fig. 3. The cylindrical shape of the quadrupole

Sextupolar coils I and II are displayed in fig.4 and 5.

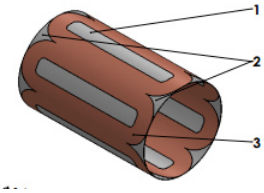

Fig. 4. Cylindrical shape of sextupole I

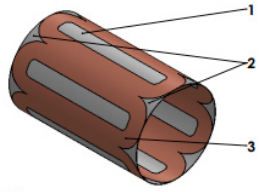

Fig. 5. Cylindrical shape of sextupole II

2. Elaborating working drawings for the assembling devices of the superconductive coils

2.1. Devices for making multipolar superconductive coils

This refers to the device used to make multipolar (dipolar, quadrupolar and sextupolar) superconductive coils in planar shape (fig. 6.).

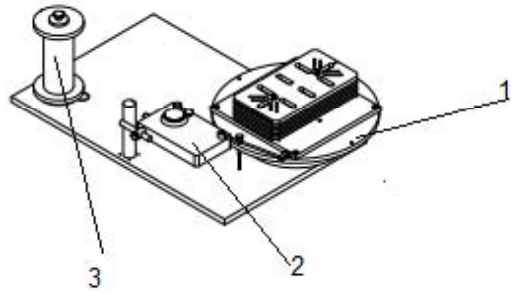

Fig. 6. Superconductive coils (1. Rotating system with ground plate; 2. Wire tensioning system; 3. Superconductive wire reel)

2.2. Multipolar superconductive coils assembling device

This device (working drawing assembly no. DUB-0) is used to make the cylindrical formatting of the superconductive coils initially made in planar shape and their assembling together on the same support (fig.7).

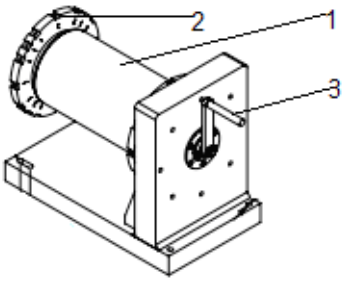

Fig. 7. Multipolar superconductive coil assembling device (1. Body device; 2. Montage guiding flange; 3. Crank device

In the same time, the device allows placing each type of winding at certain angles ones to another, so that there would be an angular distribution of these coils on the circumference of the multipolar coils.

EXECUTING MAKING DEVICES FOR SUPERCONDUCTIVE COILS WITH CYLINDRICAL GEOMETRY

O1. Executing the making device of the multipolar NbTi superconductive coils in planar geometry.

O2. Executing the assembling device in cylindrical geometry of the multipolar NbTi superconductive coils.

Fig. 8. Coils assembling device in cylindrical shape

EXECUTING DIPOLAR AND SEXTUPOLAR SUPERCONDUCTIVE COILS IN PLANAR SHAPE. THEIR ASSEMBLING IN CYLINDRICAL SHAPE

1st objective. Superconductive dipolar and sextupolar coils execution in planar shape. Their assembling in cylindrical shape

Table 2. Coils characteristics

Coil/characteristic	Dipolar	Sextupolar
Coils no.	2	6
Turns no./ coil	68x2	56x6
Dimensions	187,6x183,5 mm 310x305,9 mm	310x100,7 mm
Wire length/ multipolar coil	212 m	218 m
Superconductive material	NbTi, 0,55 mm	NbTi, 0,55 mm

A. Dipolar superconductive coil in planar shape

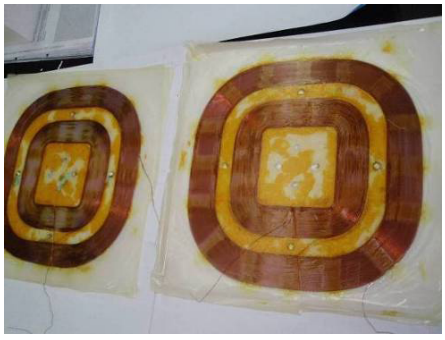

Fig. 9. Dipolar superconductive coil

B. Sextupolar superconductive coil in planar shape

Fig. 10. Sextupolar superconductive coil

C. Dipolar and sextupolar superconductive coils assembling in cylindrical shape

Fig. 11. Coils assembling in cylindrical shape

CONCLUSIONS

Considering the working projects elaborated in the former phase, no. DBBS – 00 and DUB – 00, within this phase, the followings were made:

A1. Superconductive coils making device made of:

- supporting and vertical adjustment system of the superconductive wire reel;
- guiding, tensioning and vertically adjusting system of the wire;
- coil wrapping system around the textolite support (which gives that coil shape) made of:

- supporting plate of the device which assures the uniform wrapping of the coil turns;
- supporting ground plate of the coils patterns;
- pattern plate;
- helping pattern plate, for observing the coils turns wrapping;
- guiding and pressing bolts for the pattern plate on the ground plate of the device;
- supporting plate bearing system which assures the easy rotation of the whole assembly device;
- coil support.

A2. Superconductive coil assembly device made of:

- device support;
- montage guiding flange;
- coils montage body;
- rotating crank system.

BIBLIOGRAPHY

[1] I. Dobrin, A.M. Morega, A. Nedelcu, M. Morega, J. Neamţu, *„A Conduction Cooled HTS Quadrupolar Superferric Magnet, Design and Realisation"*, EUCAS 2013, Genoa 2013.

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Advanced Composite Structures for Space Applications

ABSTRACT

The overall objective of the project involves the development and mechanical structure testing of the box which houses the electronics in a microsatellite, made of composite materials. At this stage we intended to establish the design and CAD models of structural elements for electronic box that houses a microsatellite, conducting numerical simulations, resistance calculations of box CAD models, selection of test configurations, composite materials and structural design, design of the mold needed for the box manufacturing, developing and customizing the materials structure, structural and mechanical characterization of the box materials, development of preliminary work protocol for manufacturing (using autoclave technology).

INTRODUCTION

Making composite materials in the last century has become the basis for many technical and economic considerations, among which: the development of materials with special properties (less weight, high strength and stiffness), increased operational safety and reliability, reducing the consumption of scarce or expensive materials, reducing the duration of labor and reducing manufacturing technology duration. In the space industry are numerous requirements imposed on the design space structures. Satellites must be light and stiff enough to maintain the alignment with precision of the measuring/control instruments in severe conditions of space. As a result of the cost reduction trends, became a common practice using non-certified electronics for use in space [1, 2, 3]. Ionizing particles from space could damage unprotected electronic devices to radiation, may affect the main functions of the satellites [4]. A structure that housing the electronics should attenuate the incident radiation and equipping the devices that operating in space with such a structure should provide them a satisfactory protection.

Traditionally, these structures that housing the electronics devices are made by aluminium.

This stage has the following general objectives: establishing the design and CAD models of structural elements for electronic box that houses a microsatelit; the development of numerical simulations, resistance calculations for CAD models of the box; selection of test configurations of the composite materials and structural design; the mold design required in the manufacture of electronic box that houses a microsatelit; development and customization of materials structure; laboratory tests to be conducted in order to characterize the structural and mechanical properties of the materials of the box; the development of the manufacturing process.

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EXPERIMENTAL

In this design stage three versions of CAD models for the box that houses the electronic components in a microsatellite were proposed, to be made of composite materials using advanced technology.

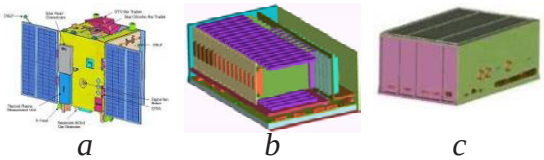

Fig. 1. PROBA-2 microsatellite, developed by Verhaert for ESA [3,4] a) Scheme of microsatellite components; b) The CADmodel of aluminum box, open configuration; c) the closed configuration [5]

Figure 2 presents the final design of spatial structure developed within the project.

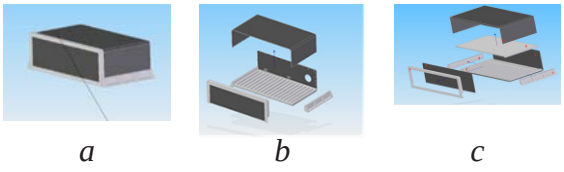

Fig. 2. Optimized IV Version - Final design of the satellite box: a) closed; b), c) box components

A series of composite materials were made using different technologies.

A series of configurations was performed by the project coordinator (COMOTI) by autoclave technique.

Another series of the material configurations, shown in table I, were made by ICPE-CA by lay-up technique.

Table I. Material configurations made

	CF fabric	Matrix	Filler
FC	10 ply + Al	Epoxy resin	-
FCW5	5 ply + Al	Epoxy resin	W 5%
FCW10	10 ply + Al	Epoxy resin	W10%
FCP5	10 ply + Al	Epoxy resin	Pb 5%
FCP10	20 ply + Al	Epoxy resin	Pb 20%

For better access, a box with 3 panels of composite material was chosen to be made: the front panel, the cover, the back panel. To ensure strength while reducing weight and vibration box, will be joining panels with aluminum popnituri. The materials studied for the development of structural design were:

Composites made by COMOTI:

- CFRP: prepreg UD-EP142-CR509-160-35; HexPly® M49/42%/200T2X2/CHS-3K; CC206/CE662 cyanate ester; EP 127-C20-45P;
- Aluminium (6082-T6) in order to catch the satellite box and cover joints in composite panels;
- Steel: 0.05 mm thick foil, chemically and mechanically treated in order to obtain high roughness and ensure a strong composite-to-metal interfaces in order to increase the resistance to radiation.

Composites made by ICPE-CA:

- carbon fibers fabric, having the function of reinforcing and preserving the mechanical properties of the material;
- impregnation mass of epoxy resin and heavy metal powders, which containing ionizing radiation shielding system consisting of heavy metal powders (Pb, W);
- aluminium foil placed on the semi-product faces that constitute the electromagnetic radiation shielding.

In order to determine the behavior of composite materials in LEO environment tests and specific structural investigations were proposed, which the most important of them are:

- exposure polymer composite materials to gamma radiation; testing the aging under the effect of radiation;
- adhesion tests; tribological characteristics;
- structural investigation by SEM micrography of the surface and interface of carbon ply/polymer matrix; the analyse by the energy-dispersive X-ray spectroscopy;
- determination of thermal properties.

RESULTS AND DISCUSSIONS

Polymer composite materials have been exposed to gamma radiation, the applied doses being of 10, 30, respectively 200 Gy.

Structural characterization of composites by scanning electron microscopy (SEM) was performed using an installation FESEM/FIB/EDS produced by Carl Zeiss Auriga Germany, with minimum resolution of 1 nm at 15 kV and 1.9 nm at 1 kV, acceleration voltage of 1-5 kV, the detector used was SESI type (Combined Secondary Secondary Electron Ion).

The figures below shows the results of the investigation by scanning electron microscopy of the set of samples M1-D and M1-E provided by COMOTI, before and after exposure to gamma radiation.

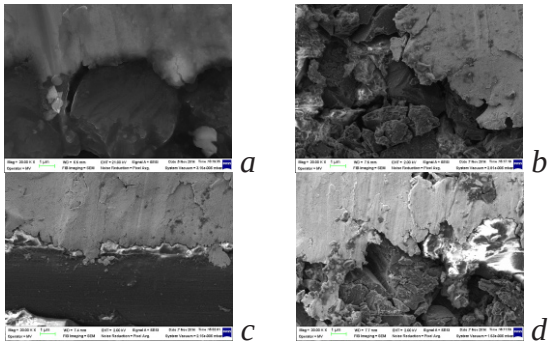

Fig. 1. SEM topographical images at the interface coating/carbon ply of the sample M1-D: a) reference, b) after exposure to gamma radiation at a dose of 10 Gy, c) 30Gy, d) 200 Gy

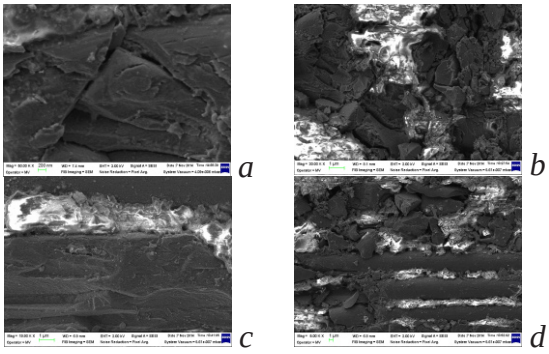

Fig. 2. SEM topographical images at the interface coating/carbon ply of the sample M1-E: a) reference, b) after exposure to gamma radiation at a dose of 10 Gy, c) 30Gy, d) 200 Gy

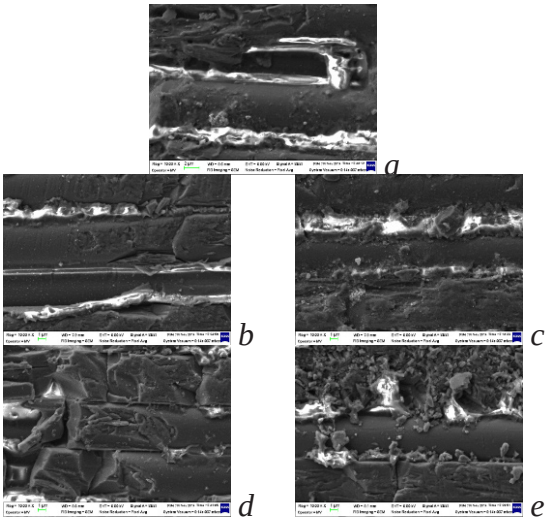

Fig. 3. SEM topographical images of the samples in section: a) FC, b) FCP5, c) FCP20, d) FCW5, e) FCW10

EDS analysis method was performed at 21 kV acceleration voltage at the interface coating/ carbon ply or on selected microareas on the metal coating, respectively inside the sample.

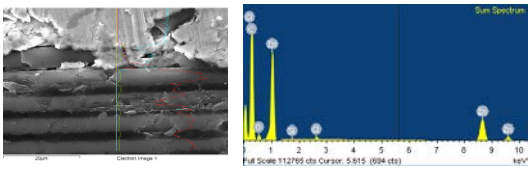

Fig. 4. EDS at the interface metal coating/carbon ply for sample M1-D 10 Gy

Table II. Elemental composition of the analyzed area of the sample M1-D 10 Gy

Element	Wt. percent %	Atomic percent %
C K	73.53	91.34
O K	3.66	3.41
Si K	0.03	0.02
Cl K	0.19	0.08
Zn K	22.58	5.15
Total	100.00	

Thermogravimetric analysis and differential scanning calorimetry (TG-DSC) were carried out using a device STA 449 F3 manufactured by Netzsch - Germany.

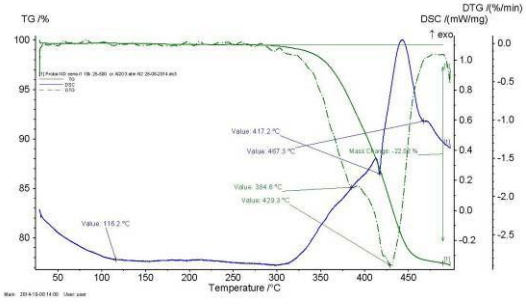

Fig. 5. The experimental curves TG, DTG, DSC obtained by thermal analysis of sample M1-D

Thermal diffusivity was measured using a device type LFA 447 NanoFlash - NETZSCH at 25°C.

Table III. Thermal parameters of investigated samples

Sample	Thermal diffusivity, mm^2/s	Thermal conductivity, W/(m*K)	Specific heat, Cp/ (J/g*K)
M1-D	0.407	0.599	1.069
M1-E	0.382	0.562	1.157
FCP5	0.63	0.85	1.17
FCP20	1.11	3.94	0.53
FCW5	0.56	0.73	1.08
FCW10	0.49	0.67	1.24

Determination of thermal expansion was performed with a dilatometer model DIL 402 PC NETZSCH.

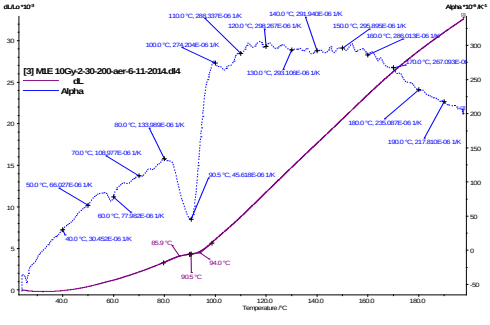

Fig. 6. The variation of thermal expansion coefficient of sample M1-E 10 Gy (+20; + 200°C)

Determination of linear scratch resistance of the samples was performed by an equipment of thin films mechanical characterization produced by CSM Instruments, Switzerland.

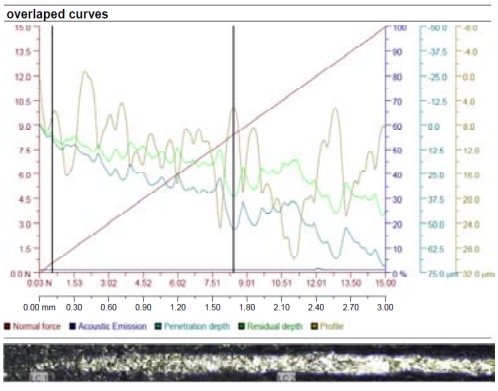

Fig. 7. The curves recorded after linear scratching of the sample M1-D

CONCLUSIONS

Samples were made consisting of: carbon fibers fabric, the impregnation mass of epoxy resin and heavy metal powders and aluminium foil.

The samples of material supplied by COMOTI and made at ICPE-CA were characterized in terms of morpho-structural, thermal and mechanical properties. It was found that:

- Investigation by SEM and EDS before and after samples exposure to gamma radiation showed that the applied radiation do not affect the morphology and chemical composition of the material.

- TG-DSC analysis shows an endothermic decomposition process characterized by a negative variation of enthalpy and a minimum peak of the DSC curve, accompanied by weight loss.

- Samples have a thermal diffusivity coefficient in the range 0.4-0.5 mm^2/s measured at 25°C, the thermal conductivity being in the range 0.5-0.7 W/mK, for the samples supplied by COMOTI. For the samples made at ICPE-CA thermal diffusivity coefficient and thermal conductivity decrease with increasing content of metal powder.

- The values of the thermal expansion coefficient increased in the temperature range 20-200°C.

- Thus we can see that increasing the dose of stored radiation produces a decrease in the temperature at which phase transformations take place in the composite, as well as a broadening of the thermal transformation interval.

REFERENCES

[1] Garcia, F., Kurvinen, K., «*Radiation Shielding Study of Advanced Data and Power Management Systems (ADPMS) Housing Using Geant4*", IEEE Nuclear Science Symposium Conference, 2006.

[2] Dodd, P., "*Physics-Based Simulation of Single-Event Effects*", IEEE Transactions on Device and Materials Reliability, Vol. 5, No. 3, September 2005, pp. 343-357.

[3] J.R. Koerselman, "*A Multidisciplinary Optimization of Composite Space Enclosures*", Teza de doctorat, Faculty of Aerospace Engineering, Delft University of Technology, iulie 2012.

[4] Bedingfield, K. and Leach, R., "*Spacecraft System Failures and Anomalies Attributed to the Natural Space Environment*", Tech. Rep. 1 390, NASA, 1996.

[5] de Vriendt, K. and Dayers, L., "*AED Qualification Vibration Test Report*", Tech. rep., Verhaert,Findland, 2004, AED-RP-015-VE.

The research was financed by the Research-Development-Innovation for Space Technology and Advanced Research Programme - STAR, contract no. 9/2012 (7094/2012).

Manufacturing preparation of the magnets and power supplies for the FAIR project

ABSTRACT

In order to achieve an appropriate manufacturing preparation for the magnets and power supplies covered by the in-kind contribution to the FAIR project there were performed following activities: elaboration of magnet's documentation of execution, procurement of materials, components and equipments necessary for manufacturing and testing, elaboration of procedures for implementing development, assembly and testing, development of space for assembly and testing and sub-contracting of main magnets and power supplies sub-assemblies execution.

INTRODUCTION

After the contract that covers the in-kind contribution that ICPE-CA will ensure to the FAIR project was signed and launched in November 2013, and after the financing of the activities to be carried out within contract was started in December 2013, were substantially intensified already started works, regarding the manufacturing preparation of the magnets and power supplies covered by the in-kind contribution, which consisted mainly in carrying out the following works:

- Generate 3D models of constructive solutions for the magnets covered by the contract;
- Elaboration of the documentation for the series of magnets;
- Magnets and power supplies analyze, in terms of execution technology, materials, components and equipment required for the development, assembly and testing of magnets and power supplies;
- Purchase of materials, components and equipments identified as necessary;
- Elaboration of working procedures for execution, assembly and testing;
- Development of a new laboratory for the assembly and testing of magnets;
- The development, negotiation and signing of contracts with subcontractors;
- Realization of stands and test devices for short circuit in magnet's coils test, to check the insulation resistance of these coils and for the characterization of the magnetic field inside the aperture of the magnets;
- Testing, from the magnetic point of view and from the point of view of the insulation resistance of the material to be used for the lamination of the magnets.

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EXPERIMENTAL

In accordance with the technical specifications required by the customer of the equipments, the material from which will be manufactured the lamination of the sextupole and steerer magnets subjected to the following tests:

- The thickness of the insulating layer deposited on both sides of the sheet;
- Insulation resistance between two plates before and after gluing, under a pressure of 250 N/cm^2;
- Magnetization curve B = f (H);
- Coercive force at an excitation of 25 kA/m;
- Anisotropy of magnetic induction.

The thickness of the coating layer deposited on both sides of the sheet was measured by electron microscopy, the results being included between 2 and 24 μm;

Insulation resistance between two plates was measured by the method required by ASTM A 937 / A 937 M - 01. In applying the test were used following equipment and devices:

- Device for applying pressure;
- Device for bonding samples;
- Constant current power supply;
- Voltmeter for measuring the voltage between the electrodes of pressing device;
- Ammeter for applied current measuring;
- Equipment for gluing temperature application.
- Equipment for application of required pressure, before and after bonding.

Magnetic measurements were carried out on toroids using the PS1010-C module produced by Walker Scientific, as well as on lamination, using a single sheet device from Brockaus Messtecnik. Toroids were used to evaluate the first magnetization curves and single sheet device was used to assess coercive force and anisotropy. Average measurements revealed a value of coercive force of 69 A/m and anisotropy amounted to 4.6%. Initial magnetization curve obtained by the

measurement is shown in *Figure 1*.

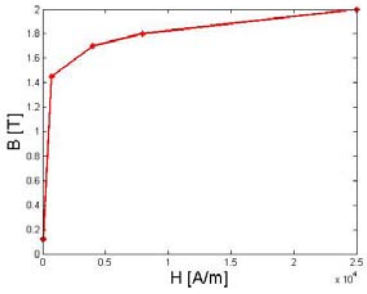

Figure 1

RESULTS AND DISCUSSIONS

In order to elaborate the documentation for the execution of the magnets was necessary to create magnet's 3D models, thus allowing, before actual manufacturing of products, to verify the correctness of the constructive solutions adopted. 3D models were developed using the SolidWorks parametric software, which allows highlighting component parts dimensions, the materials from which they will be manufactured and hence the quantities required and highlight all standard components to be purchased.

Based on the 3D models there was elaborated the drawings to allow subsequent launch of magnets series production. The execution documentation contains drawings of all parts, sub-assemblies and assemblies that are part of the magnets.

Developed execution documentation contains all the technical and technological information necessary for the magnets covered by the in-kind contract to be made in accordance with the requirements of the customer specified in the detailed specifications of the equipments. This information includes overall and mounting dimensions of the magnets assemblies and sub-assemblies, all the dimensions required to manufacture the component parts, tolerances of these dimensions, tolerances of form and position, materials to be used and surface quality component parts.

Were purchased all materials and components required manufacturing the magnets and power supplies covered by in-kind contribution to the project FAIR, the most important being:

- Electrical steel sheet for making the yokes of the magnets;
- Copper wire for making the coils of the magnets;
- Power supplies cabinet;
- Power supplies transformer.

Due to extremely high dimensional accuracy to be provided for the manufacturing and assembling of the magnets mechanical structure, and do to the complexity and diversity of dimensional, form and shape tolerances checks needed to determine the compliance of the equipments with the specifications of the magnets, and to eliminate the need to purchase a large number of measurement means and the need to design and achieve a large number of specific devices, it was decided to purchase a coordinate measuring machine, XOrbit 87-1500 Next Generation, produced by WENZEL Präzision GmbH, Germany, equipment capable of performing under conditions of extremely high precision (of the order of 5 - 10 μm) all dimensional checks specified in the execution documentation of the magnets. Measuring machine is shown in *Figure 2*.

Figure 2

To perform the magnetic testing of the magnets, a stand has been designed to allow controlled positioning of a 3D Hall probe inside the aperture of the magnets, as well as the acquisition of measured data and then their processing. The test stand consists of the following main equipments:

- Magnet itself;
- The power supply of the electromagnet;
- 3D Hall probe Gauss meter;
- The probe positioning system;
- Digital multimeter to measure the current;
- Interface for communication between the Gauss meter and the system for control and data acquisition;
- Computer system for entering commands and save measured data.

Hall-probe measurement system is shown in Figure 3.

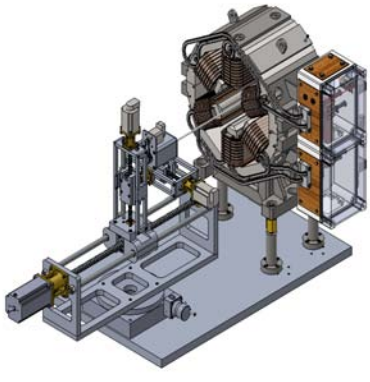

Figure 3

Based on the execution documentation, technical specifications regarding the conditions for the realization of equipment covered by the in-kind contribution and technical specifications on mechanical, electrical and magnetic testing of the equipment has been developed procedures for magnets manufacturing, assembling and testing.

Given the outstanding performance that the equipments covered by the in-kind contract must meet and rigorous conditions that must be carried out to test this equipments, including from the point of view of the testing devices and apparatus, was necessary to develop a particular space for final assembly and for mechanical, electrical and magnetic testing operations, space provided with access to electricity and compressed air networks, equipped with facilities and devices stands for handling, assembling and testing of magnets and power supplies.

To avoid the high costs required by the fulfillment by ICPE-CA of a manufacturing preparation to enable completion of the execution of all operations in the institute and related personnel costs, it was decided that the manufacturing of the main parts of the magnets and power supplies to be made by subcontracting to specialized companies. In this respect, commercial contracts have been signed with SC Nuclear & Vacuum SA Magurele, to manufacture mechanical structure and winding for magnets and with SC AAGES SRL Sângeorgiu de Mures, to manufacture the power supplies.

CONCLUSIONS

The main conclusions drawn from the analysis of the performed activities are:

- The 3D models of the three types of magnets covered by the in-kind contribution of ICPE-CA to the FAIR project contain information on dimensions, shape and appearance imposed to the magnets and allow virtual verification of the adopted constructive solution;
- The documentation developed based on 3D models contain all information necessary to manufacture the magnets that are subject of the in-kind contract in accordance with the requirements imposed by equipments specifications;
- In ICPE-CA there will be performed final assembly and final testing of the magnets and power supplies, in accordance with the requirements imposed by the customer of the equipments; also, ICPE-CA will provide delivery, installation on location FAIR and commissioning of the magnets and power supplies;
- All the materials and components required to manufacture the magnets and power supplies covered by in-kind contribution there have been purchased;
- Taking into account particularly high dimensional accuracy to be provided to manufacturing and assembly of the magnets, and the mechanical complexity and diversity of checks to be conducted to determine compliance with the beneficiary specifications, has acquired a coordinate measuring machine, equipment capable of performing with high precision all the checks specified in the magnets documentation;
- For magnetic testing was designed and manufactured a stand enabling controlled positioning of a 3D Hall probe inside the aperture of the magnets, measured data acquisition and processing, thus achieving a complete characterization of the magnetic field created by the magnets;
- Based on the documentation of the magnets and on the technical specifications relating to the conditions for manufacturing and testing of equipment covered by the contract, there have been developed procedures for magnets assembling and for mechanical, electrical, hydraulic and magnetic testing of them;
- A special space for final assembly operations and for mechanical, electrical and magnetic testing of magnets and power supplies was created;
- There were concluded contract for subcontracting operations for manufacturing the main sub-assemblies of magnets and power supplies and advanced payments have been made to subcontractors to enable them to perform their manufacturing preparation.

REFERENCES

[1] I. Chiriţă et al, *Technical Report* contract no. IKC 2.11.2.3, stage 1, Manufacturing preparation, material purchase and advance payments for subcontractors.

[2] - I. Chiriţă et al, *Technical Report* contract no. IKC 2.11.2.3, stage 2, Manufacturing preparation for zero series.

[3] - ***, FAIR Technical Specifications.

[4] - ***, ASTM A 937 / A 937 M - 01

The activities were financed by the contract no. IKC 2.11.2.3 / 2013.

SERVICES

Study concerning the characterization of vegetable oils for turbo-engines

ABSTRACT

It was performed the physical characterization of a camelina oil and two mixtures of this oil with kerosene, supplied by National Research and Development Institute for Gas Turbines COMOTI – Bucharest. The density and the viscosity of these liquids were determined.

The thermal behavior of camelina oil and camelina oil - kerosene mixtures were determined by simultaneous thermal analysis TG/DTG + DTA.

The data obtained by thermal analysis were used for evaluation of the oxidation state of camelina oil.

The procedures of thermal life prediction of oils were presented. The results obtained by thermal analysis were also used for planning of the experiments of accelerated aging of camelina oil.

INTRODUCTION

The objectives of the present Contract of services were:

- Physical characterization of camelina oil and camelina oil – kerosen mixtures
- Thermal analysis of camelina oil and camelina oil – kerosene mixtures
- Assessment of camelina oil oxidability
- Presentation of the procedures used for prediction of thermal life time of camelina oil
- Planning of the experiments of accelerated aging of camelina oil, which could be performed for thermal lifetime prediction.

Research staff of the project

Dr. Chem. Budrugeac Petru – contract responsible

Dr. Chem. Cucoş Andrei

Dr. Chem. Ştefănescu Carmen

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PhDs. Eng. Clicinschi Florentina

Techn. Petrache Mărioara

EXPERIMENTAL

Materials

- Camelina oil obtained by cold pressing (seed: Camelina, pressed by INMA in 2012);
- camelina oil - kerosene mixture 25-75%;
- camelina oil - kerosene mixture 50-50%.

Methods

- Densities of camelina oil and the camelina oil - kerosene mixtures were determined by weighting with an analytical balance of 10 ml of each liquid;
- Apparent viscosities (μ) of camelina oil and the camelina oil - kerosene mixtures were determined by using Brookfeld DV-II+ - SUA apparatus;
- Simultaneous TG/DTG +DTA thermal analyses were performed using apparatus STA 409 PC Luxx produced by Netzsch – Germany. The conditions of analyses were:
- temperature range: 25^0-700^0C;
- Pt crucibles;
- atmosphere: synthetic air flow (purity of 99.999%; 100 ml.min^{-1});
- heating rate: 10 K.min^{-1};
- sample masses: 13,51 mg for "Camelina oil", 18,77 mg for 16,23 mg for „Camelina oil - kerosene mixture 25-75%", and 16,23 mg for „Camelina oil - kerosene mixture 50-50%".

RESULTS OF AND DISCUSSIONS

Table 1. Densities of analyzed samples

Sample	*Density/g.cm^{-3}*
Camelina oil	0.933
Camelina oil - kerosene mixture 25-75%	0.825
Camelina oil - kerosene mixture 50-50%	0.854

Table 2. Apparent viscosities of analyzed samples

Sample	*Viscosity / cap*
Camelina oil	194
Camelina oil - kerosene mixture 25-75%	22
Camelina oil - kerosene mixture 50-50%	6,07

The TG, DTG and DTA curves for „Camelina oil" are shown in Fig. 1. It results that five successive processes occur on progressive heating, namely an initial process with formation of liquid products and four processes with formation of volatile compounds. The total mass loss is 99.76%. The initial process put in evidence in DTA curve consists in oxidation of oil by oxygen addition at unsaturated compound of oil, and is followed by cross-linking of glycerides.

According to obtained results the analyzed oil is stable in air until 155.6^{0}C, it results that **Camelina oil exhibits a rage of thermo-oxidative stability of 25^{0}C – 155.6^{0}C when is heating with heating rate of 10 K.min^{-1}. The onset temperature of thermo-oxidation increases with the heating rate. Therefore, the rage of thermo-oxidative stability of Camelina oil in isothermal condition is with approx. 20^{0}C lower than 155.6^{0}C.**

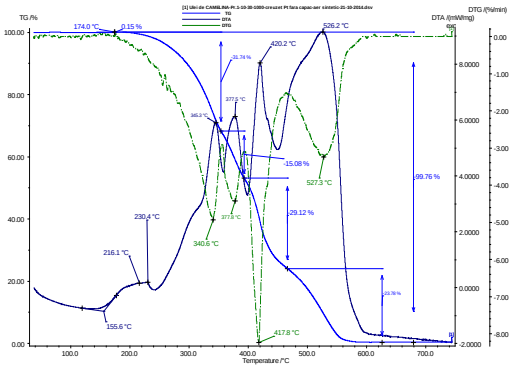

Fig. 1. TG, DTG and DTA curves for Camelina oil

The TG, DTG and DTA curves for „Camelina oil - kerosene mixture 25-75%" are shown in Fig. 2. It results that three successive processes occur on progressive heating. The total mass loss is 96.62%.

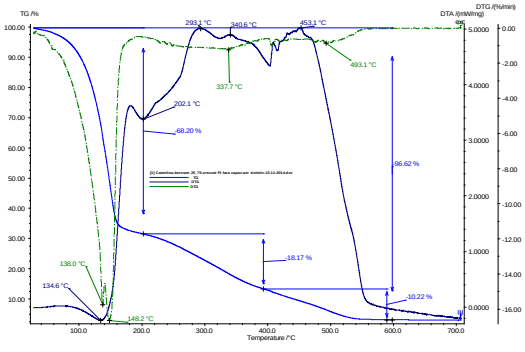

Fig. 2. TG, DTG and DTA curves for Camelina oil - kerosene mixture 25-75%

In the temperature range 30.0 – 200.0^{0}C, there are two over-lapped processes, namely the vaporization of kerosen (endothermic process) and the thermo-oxidation of oil (exothermic process). The total effect of these processes is endothermic.

The TG, DTG and DTA curves for „Camelina oil - kerosene mixture 50-50%" are shown in Fig. 3. It results that five successive processes occur on progressive heating. The total mass loss is 92.25%.

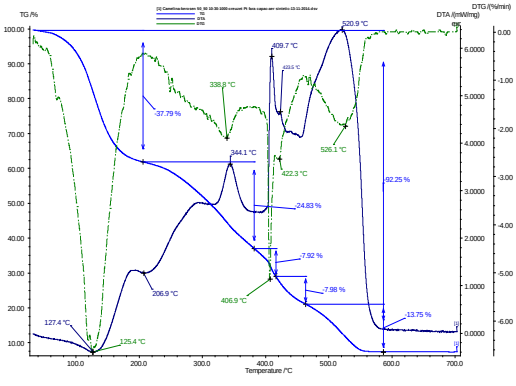

Fig. 3. TG, DTG and DTA curves for Camelina oil - kerosene mixture 50-50%

Procedures that could be used for thermal life time prediction of Camelina oil. Planning of the experiments of thermal accelerated aging

The following Procedures that could be used for thermal life time prediction of Camelina oil were presented:

- General procedure for thermal lifetime prediction of a material, recommended by IEC-2016 [1];
- Rapid method for thermal lifetime prediction of a material, based on the results obtained by thermal analysis [2].

The planning of experiments of accelerated thermal aging of Camelina was performed on the basis of these procedures. The results obtained by these agings could be used for prediction of thermal lifetime of Camelina oil.

Taking into account of the results obtained by thermal analysis (Fig. 1), **the suggested temperatures for accelerated aging of Camelina oil are: 125^{0}C, 130^{0}C and 136^{0}C.**

CONCLUSIONS

- It was performed the physical characterization (density and viscosity) of a Camelina oil and two mixtures of this oil with kerosene, supplied by National Research and Development Institute for Gas Turbines COMOTI – Bucharest.
- The thermal behavior of camelina oil and camelina oil - kerosene mixtures were determined by simultaneous thermal analysis TG/DTG + DTA.
- The **state of oxidability** was determined for Camelina oil.
- The procedures for prediction of thermal life time of oils were presented. These procedures could be used for establishment of the limits of acceptation of Camelina oil.
- The planning of experiments of accelerated thermal aging of Camelina was performed taking into account the results obtained by thermal analysis methods.

REFERENCES

[1] IEC 216/1990, *Guide for determination of thermal endurance properties of electrical insulating materials*, Ed. Bureau Central de la Commision Electrotechnique Internationale Geneve, Suisse, 1990.

[2] D. J. Toop D. J., *Theory of Life Testing and Use of Thermogravimetric Analysis to Predict the Thermal Life of Wire Enamels*, IEEE Transactions on electrical insulation, 6 (1971) 2-14.

The research was financed by contract with third-parties no. 184/2014 (1096 / 2014).

Services Research on determination of the microelectrodes hybrid interface

SUMMARY

In this work were performed following objectives required by the customer:

- *electrochemical impedance spectroscopy (in the range of f = 100 kHz ÷ 10 MHz frequency at an amplitude of 10 mV);*
- *Analysis of variance ability to interface with the electrical potential applied at constant frequency;*
- *ability to interface with variance analysis applied signal frequency at constant potential;*
- *Analysis of dielectric losses at the interface with the applied signal frequency at constant potential.*

Analyses will be performed on 3 types of evidences provided by the beneficiary. Service was requested by SC INTELECTRO SRL

INTRODUCTION

Electrochemical measurements were performed on three types of evidence provided by the beneficiary. Using sinusoidal disturbance, both current and potential, is probably the most popular and pervasive method of study of electrochemical processes arising at the interface [1].

Electrochemical impedance spectroscopy Impedance implies a dependence on the wavelength and also on the frequency. In this case, the frequency of the alternating current is applied to an electrolytic cell. Impedance concept is often framed in electrical circuit theory, where the transfer function is obtained by passing current through the input circuit and the potential fall in the output circuit is considered. This concept however is not limited only to electrical circuits. In fact, the definition of any transfer functions as a stable, causal and linear, as an impedance (or admittance) requires, on the one hand that this linear system theory is relevant system (linearity) and the other part of the system to be able to give a physical interpretation (causality, stability) [2].

Impedance is the term given voltage (V) / current (I) to systems other than metal resistors. Correlation V / I interface system including the electrode / solution of different types includes two types of information. Involved angle refers to the size of t, where $=2\varpi$ and frequency alternating current is applied system, t is the time when one cycle of sinusoidal oscillations of current is applied to the system. The phase angle , may change from zero to 90° [3].

Personal research project

Dr. Eng. Alina Ruxandra Caramitu - agreement Responsible

Dr. Eng. Mihai Iordoc

Dr. Eng. Paula Ionela Prioteasa

EXPERIMENTS, RESULTS AND DISCUSSION

For this service, the following tests were performed:

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Electrochemical impedance spectroscopy measurements carried out on samples examined in this report, technical and scientific were carried out on stationary potential on the frequency f = 100 kHz ÷ 10 MHz, at an amplitude of 10 mV AC voltage superimposed electrode potential These tests were carried out on the frequency f = 100kHz ÷ 10MHz, at an amplitude of 10mV.

In Fig. 1, 2 and 3 show the Nyquist diagrams for the samples studied; as follows:

- for M01 were drawn from OCP = -37mV and 400mV;
- for M02 were drawn from OCP = 45mV and 400mV;
- for M03 were drawn from OCP = 112mV and 400mV.

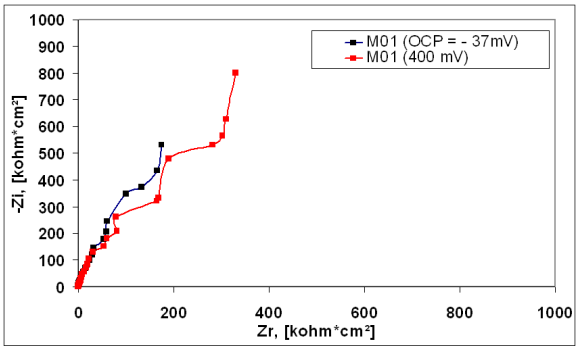

Fig. 1. Nyquist diagrams for sample M01

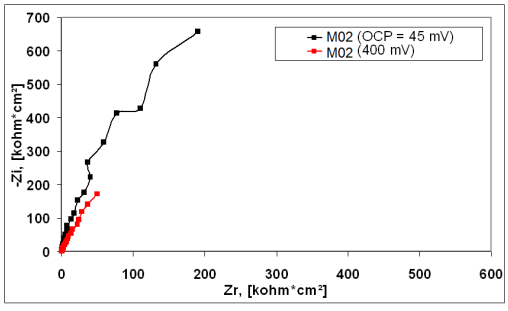

Fig. 2. Nyquist diagrams for sample M02

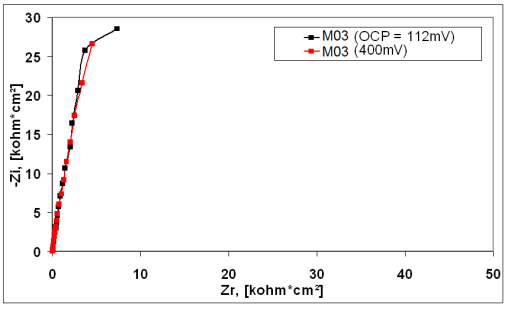

Fig. 3. Nyquist diagrams for sample M03

In Figures 1, 2 and 3 show Nyquist diagrams for the three samples studied in 0.2 M H2SO4 electrolyte solution, the stationary potential and the potential diagram corresponding to the maximum capacity of C = f (E). It is observed in all cases by the appearance of a semicircle Debye, well outlined, highlighting the capacitive behavior of the stage. The circular regression was determined electrochemical parameters corresponding to each semicircle Debye, summarized in Table 2. It is observed that in all cases the values calculated by regression circular capacities are greater in the case of registered semicircles potential diagram corresponding maximum capacity C = f (E) and the maximum recorded capacity for measurement performed at 400mV vs Ag potential for sample M03 (34.08 μF / cm^2).

Table 2. Electrochemical parameters obtained by regression circular Nyquist diagrams. Solution potential, mV / Ag Rs, Rp Ω * cm^2, kΩ * cm^2 C, μF / cm^2

Solution	Potential, mV/Ag	Rs, Ω*cm^2	Rp, kΩ*cm^2	C, μF/ cm^2
0	1	2	3	4
M01	-37	428,7	2008	5,006
	400	1765	1742	14,42
M02	45	405,5	3182	10
	400	60,41	1593	19,98
M03	112	18,53	747,8	17,02
	400	12,11	466,9	34,08

In Figures 8, 9 and 10 are Bode diagrams given for the three samples obtained studied.

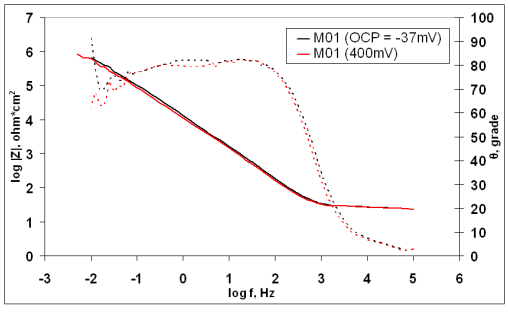

Fig. 4. Bode diagrams for sample M01

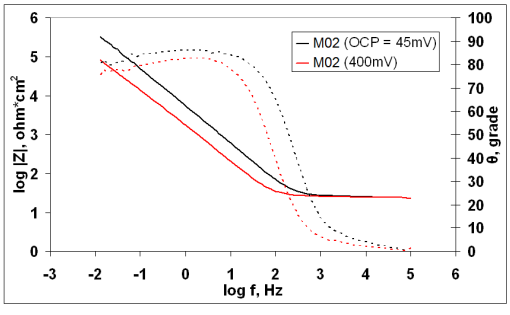

Fig. 5. Bode diagrams for sample M02

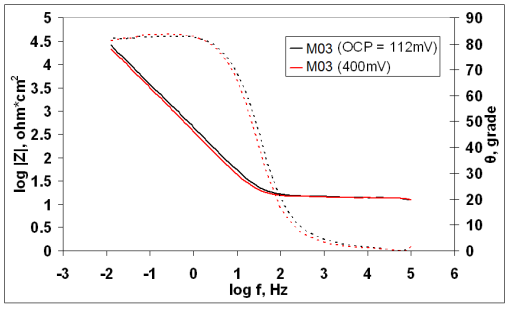

Fig.6. Bode diagrams for sample M03

In Fig. 4 the Bode diagrams M01 test in 0.2 M H2SO4 solution, the stationary potential (-37mV vs Ag) and the potential diagram corresponding to the maximum capacity of C = f (E) (400mV vs Ag). It is noted that the maximum phase angle is recorded at a frequency of 10Hz when Bode diagram recorded at open circuit potential. As a result, the chart C = f (E) that the frequency has been drawn. In Fig. 5 and 6 are presented Bode diagrams M02 and M03 samples in 0.2 M H2SO4 solution, stationary potential (45mV 112mV vs vsAg and Ag) and corresponding potential diagram maximum capacity C = f (E) (400mV vs Ag).

It is observed that in both cases the maximum phase angle is recorded at a frequency of 1Hz when Bode diagram recorded at open circuit potential. As a result, the chart C = f (E) has been drawn frequency.

CAPACITY BY FREQUENCY VARIATION IN CONSTANT POTENTIAL

These tests were run under the following conditions:

- for M01: capacity variation with frequency OCP

= -37mV and 400mV;

- for M02: capacity variation with frequency OCP = 45mV and 400mV;
- for M03: capacity variation with frequency OCP = 112mV and 400mV.

Figures 7, 8, and 9 presents the variation of frequency capacity for the samples studied.

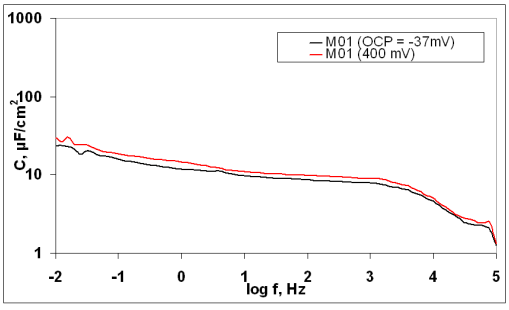

Fig. 7. Variation of frequency capacity for M01

In Fig. 7 presents the variation of the capacity curves for the sample frequency M01, the stationary potential (-37mV vs Ag) and the potential diagram corresponding to the maximum capacity of C = f (E) (400mV vs Ag). It is noted in both cases that the amount of capacity increases linearly with decreasing frequency. Both curves reach a maximum at a frequency of 10 Hz, the maximum value of the capacity obtained with the measurement carried out if the potential of 400mV vs Ag.

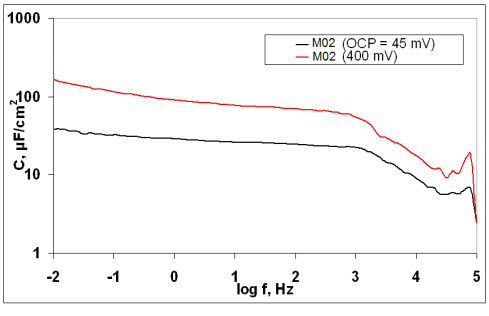

Fig. 8. Variation of frequency capacity M02

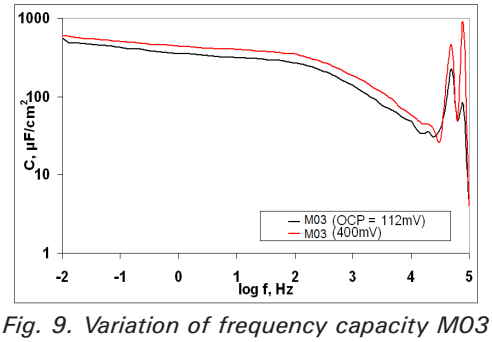

Fig. 9. Variation of frequency capacity M03

In Fig. 8 and 9 are shown the curves of variation of capacity with M02 and M03 frequency samples, the stationary potential (vs 45mV 112mV vs Ag and Ag) and corresponding potential diagram maximum capacity C = f (E) (400mV vs Ag). In both cases, M02 and M03 samples is observed that the amount of capacity increases linearly with decreasing frequency. Both curves reach a maximum at a frequency of 1 Hz, the maximum capacity for obtaining measurements made at 400mV vs Ag potential.

VARIATION WITH POTENTIAL CAPACITY

These tests were run under the following conditions:

- for M01: frequency 10 Hz (as the maximum phase angle Bode diagram drawn OCP = -37mV);
- for M02: 1Hz frequency (as the maximum phase angle Bode diagram drawn OCP = 45mV);
- for M03: 1Hz frequency (as the maximum phase angle Bode diagram drawn OCP = 112mV).

Figures 10, 11 and 12 are shown the curves of variation of the potential capacity of a fixed frequency for the investigated samples.

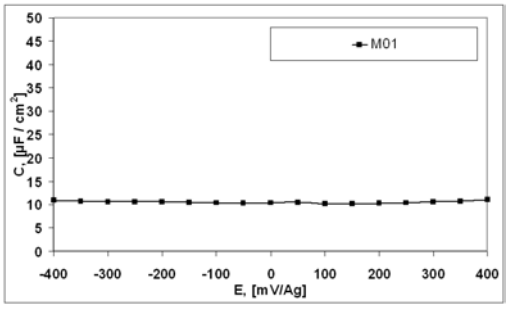

Fig. 10. Variation of potential capacity for sample M01

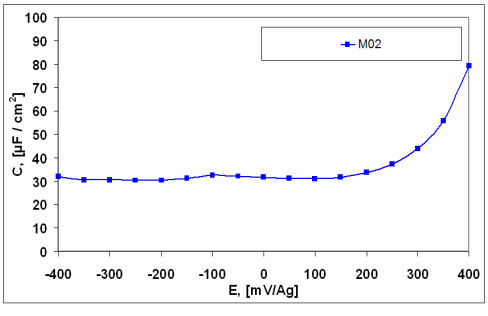

Fig. 11. Variation of potential capacity for sample M02

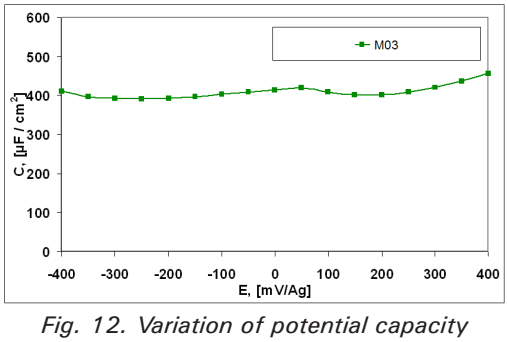

Fig. 12. Variation of potential capacity for sample M03

In Fig. 10, 11 and 12 are shown the curves of variation of the capacity to the potential at a fixed frequency, for the investigated samples in 0.2 M H2SO4 electrolyte solution (the fixed frequency of 10 Hz and 1 Hz). It is noted that capacity development is an upward values directly proportional to the applied potential values increase, the maximum capacity occurring in 400mV vs Ag.

VARIATION LOSS ANGLE TANGENT FREQUENCY

These tests were performed:

- the M01 at OCP = -37mV and 400mV;
- the M02 at OCP = 45mV and 400mV;
- the M03 at OCP = 112 mV and 400mV.

Figures 13, 14 and 15 are shown curves of loss tangent in the frequency of the samples.

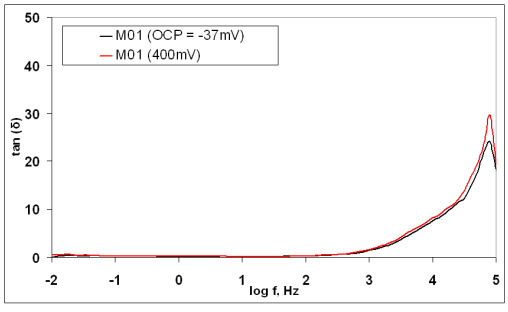

Fig. 13. Variation of loss tangent with frequency M01

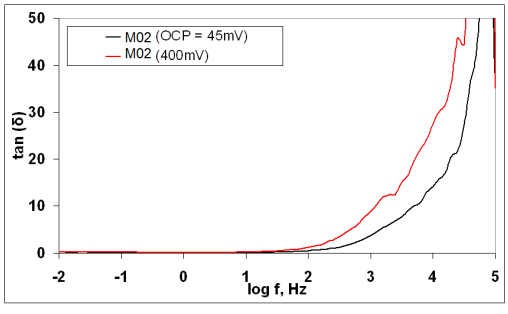

Fig. 14. Variation of loss tangent with frequency M02

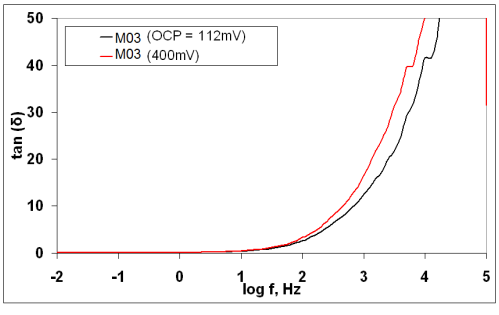

Fig. 15. Variation of loss tangent with frequency M03

In Fig. 13, 14 and 15 are shown curves of loss angle tangent function of frequency, the stationary potential (-37mV vs Ag, Ag and 112 mV vs 45mV vs Ag) and corresponding potential diagram maximum capacity C = f (E) (400mV vs Ag) samples M01, M02, M03 studied.

It is noted that the minimum values of loss tangent is recorded at low frequencies, the lowest values for obtaining measurements at open circuit potential (OCP -37mV vs Ag, Ag 45mV and 112mV vs Ag).

CONCLUSIONS

After processing and interpretation of experimental results obtained in this work can be concluded that:

- the electrochemical parameters calculated from Nyquist diagram can be seen that the values calculated by regression circular capacities are greater in the case of registered semicircles potential diagram corresponding maximum capacity C = f (E) than the semi-circles recorded at open circuit potential (OCP);
- the largest capacity value calculated by regression circular Nyquist diagram was 34.08 μF / cm^2 for sample M03;
- if the samples studied (MO1, M02, M03) can be seen that the value of capacity increases linearly with decreasing frequency;
- minimum values recorded loss tangent at low frequencies, the lowest values for obtaining measurements at open circuit potential (OCP -37mV vs Ag, Ag 45mV and 112mV vs Ag) in the samples studied

REFERENCES

1) Visan T., M. Buda, Ibris N., "*Electrochemical methods in electrochemistry and corrosion research*" Univ.Politehnica Bucharest, 1999

2) MU MacDonald Real S., DD MacDonald, J. Electrochem., 133, 1986, p. 2018

3) P. Agarwal, Orazi ME, Garcia-Rubio, LH, J. Electrochem., 139, 1992, p. 1917

4) JR Macdonald, *Impedance spectroscopy*, J. Wiley & Sons, New York, 1987

5) MacDonald MU, Real S., MacDonald DD, Electrochem. Acta, 35, 1990, p. 1559

The research was financed by contract with third-parties no. 284/2014 (1086/2014).

Services Research on determination of physico-chemical properties of carbon-polymer hybrid layers

SUMMARY

In this work was done following objectives required by the customer: tests to determine the diffusivity / conductivity and heat capacity and specific structural morphological analysis by scanning electron microscopy technique.

Service was requested by SC .INTELECTRO SRL.

Personal research project

Dr. Eng. Alina Ruxandra Caramitu - agreement Responsible

Eng. Sorina Mitrea - agreement co-responsible

Dr. Eng. Violeta Tsakiris

PhDs. Eng. Phys. Virgil Marinescu

EXPERIMENTS

In this work were performed the following tests:

- determination of diffusivity / conductivity and specific heat capacity and
- morpho-structural analysis by scanning electron microscopy technique.

Samples that were conducted these tests were provided by the customer and were coded M01, M02 and M03.

RESULTS AND DISCUSSION

DETERMINATION DIFFUSIVITY / CONDUCTIVITY THERMAL CAPACITY AND SPECIFIC [1, 2]

Table 1 and Fig. 3 below shows the comparative results.

Table nr. 1

Materials	Temperature	Difuzivity (mm^2/s)	Deviation (mm^2/s)	Conductivity (W/(m*K)	Specyfic Capacity (Cp) (J/g/K)
0	1	2	3	4	5
M01	25	0,981	0,013	3,571	0,600
M02	25	0,950	0,002	3,448	0,412
M03	25	1,111	0,012	3,968	0,604

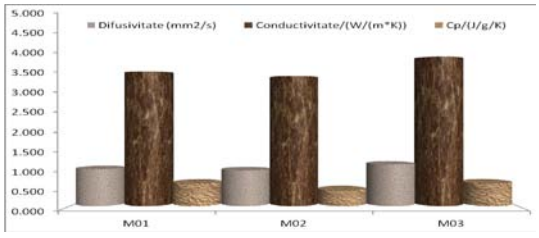

Fig. 1. The variation of conductivity, thermal diffusivity and specific capacity

TECHNICAL ANALYSIS MORPHOLOGICAL STRUCTURES BY ELECTRON MICROSCOPY (SEM) [3]

Samples M01, M02 and M03 analyzed were viewed using workstation type FESEM-FIB model Auriga (Carl Zeiss Germany). For the study of the surface topography and morphology, we used secondary electron detector/ion (sessile) of the sample chamber. Both the acceleration voltage and working distance were maintained at constant values of 2kV and 8 mm for all samples. Surface micrographs were made of samples analyzed in magnificatiile by: 1000x, 5000x, 10000x, 20000x, 50000x and 100,000 x. Chemical composition and verification was performed using probe EDS (energy dispersive spectrum characteristic X radiation) PET model X3 - Oxford Instruments, cooled with liquid nitrogen, which is well integrated workstation FIB-FESEM Auriga. [4]. It used acceleration voltage: 21 kV. For accuracy of results, so topography image acquisition (secondary electron - SE) and elemental chemical analysis was performed on several points in the same micro-area analysis. The images obtained and identified elemental chemical composition of the analyzed samples are shown in Figures 2-33 below:

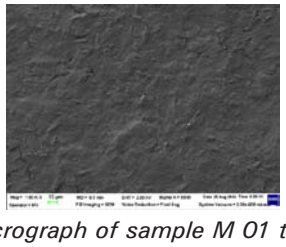

Fig. 2. Micrograph of sample M 01 to 1,000 X magnification

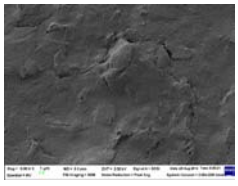

Fig. 3. Micrograph of sample M 01 to 5,000 X magnification

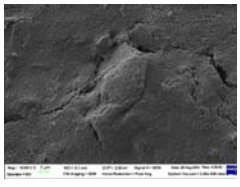

Fig.4. Micrograph of sample M 01 to 10000 X magnification

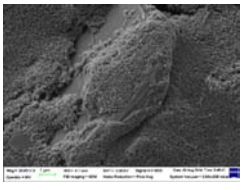

Fig. 5. Micrograph of sample M 01 to 20,000 X magnification

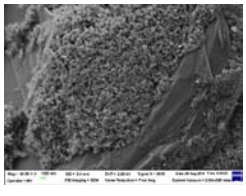

Fig. 6. Micrograph of sample M 01 to 50000 X magnification

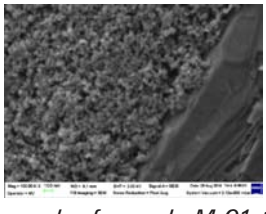

Fig. 7. Micrograph of sample M 01 to 100000 X magnification

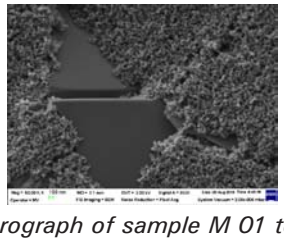

Fig. 8. Micrograph of sample M 01 to 50000 X magnification

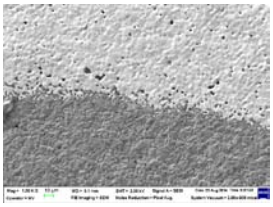

Fig. 9. Micrograph of sample M 01 to 1000 X metallic side

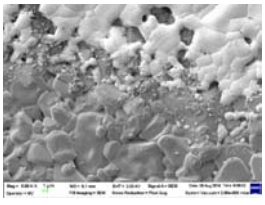

Fig. 10. Micrograph of sample M 01 to 5000 X metallic side

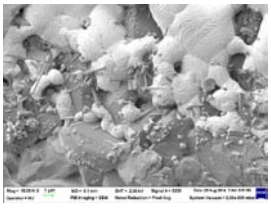

Fig. 11. Micrograph of sample M 01 to 10000 X metallic side

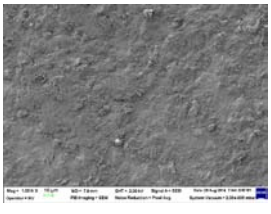

Fig. 12. Micrograph of sample M 02 to 1000 X magnification

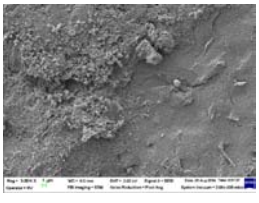

Fig. 13. Micrograph of sample M 02 to 5000 X magnification

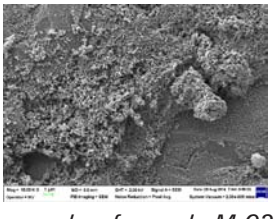

Fig. 14. Micrograph of sample M 02 to 10000 X magnification

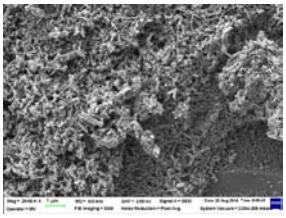

Fig. 15. Micrograph of sample M 02 to 20000 X magnification

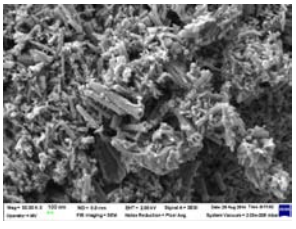

Fig. 16. Micrograph of sample M 02 to 50000 X magnification

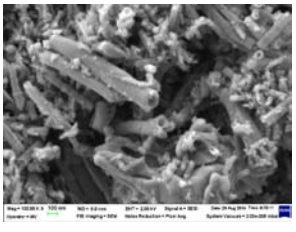

Fig. 17. Micrograph of sample M 02 to 100000 X magnification

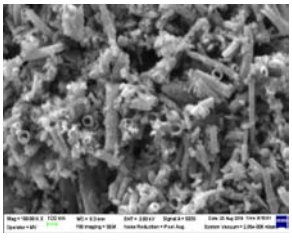

Fig. 18. Micrograph of sample M 02 to 100000 X magnification

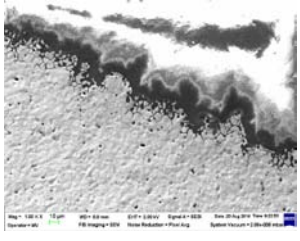

Fig. 19. Micrograph of sample M 02 to 1000 X magnification with metallic side

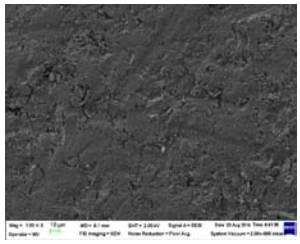

Fig. 20. Micrograph of sample M 03 to 1000 X magnification

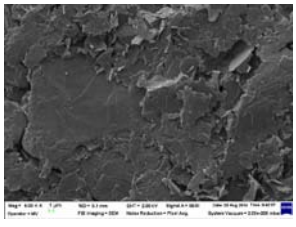

Fig. 21. Micrograph of sample M 03 to 5000 X magnification

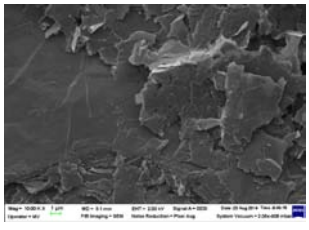

Fig. 22. Micrograph of sample M 03 to 10000 X magnification

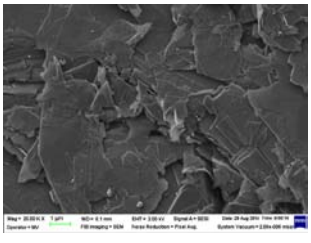

Fig. 23. Micrograph of sample M 03 to 20000 X magnification

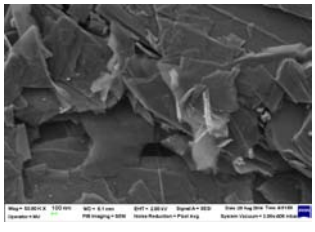

Fig. 24. Micrograph of sample M 03 to 50000 X magnification

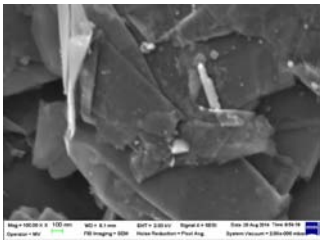

Fig. 25. Micrograph of sample M 03 to 100000 X magnification

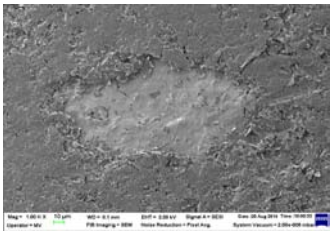

Fig. 26. Micrograph of sample M 03 to 1000 X magnification

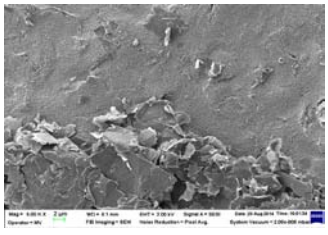

Fig. 27. Micrograph of sample M 03 to 5000 X magnification

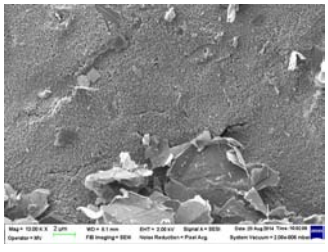

Fig. 28. Micrograph of sample M 03 to 10000 X magnification

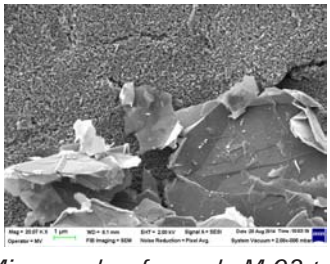

Fig. 29. Micrograph of sample M 03 to 20000 X magnification

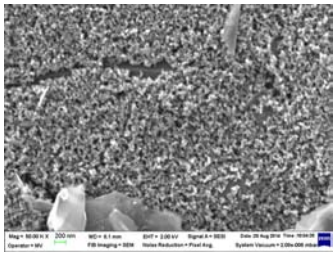

Fig. 30. Micrograph of sample M 03 to 50000 X magnification

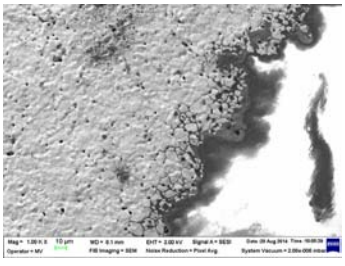

Fig. 31. Micrograph of sample M 03 to 1000 X magnification with metallic side

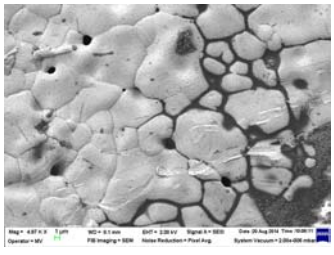

Fig. 32. Micrograph of sample M 03 to 5000 X magnification with metallic side

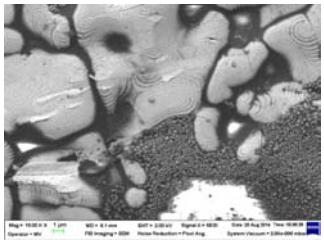

Fig. 33. Micrograph of sample M 03 to 10000 X magnification with metallic side

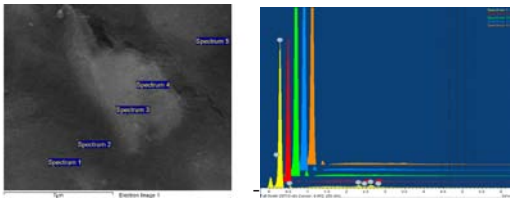

Fig. 34. (a) Imagine Image of a micro areas on the surface of M 01 sample points corresponding spectral analysis, (b) Overlapping spectra acquired spectral analysis sample points M 01

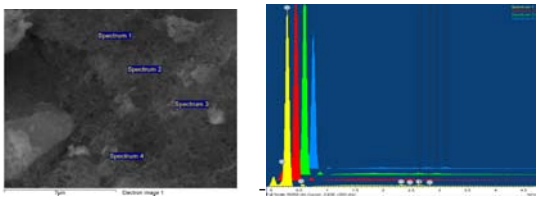

Fig. 35. (a) Image of a micro areas on the sample surface M 02 points corresponding spectral analysis, (b) Overlapping spectra acquired spectral analysis sample points M 02

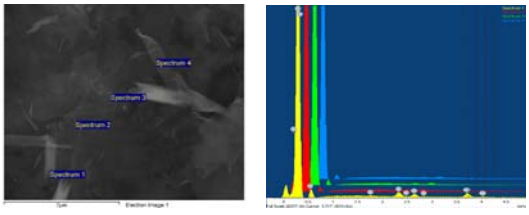

Fig. 36. (a) Image of a micro areas on the sample surface M 03 points corresponding spectral analysis, (b) Overlapping spectra acquired spectral analysis sample points M 03

Elemental chemical analysis and made morphostructural led to the following conclusions:

- M01 sample: in terms of morphology, the surface is composed of electro pieces (micron) and is coated with carbon nanopulbere. Coverage is relatively uniform, with small areas of interference. Chmice elemental analysis by EDS probe confirms this, there were no residual elements are only two minor - S and Cl, which may come from various sources (polymer matrix or substances used in the synthesis of composite material);
- M02 probe - surface of the sample is the same as that of M01, but the covering is composed of porous carbon nanofibers [5];
- sample M03 - the surface is identical to the M01 sample, but is composed of electro-deposition. Were revealed plans submitted electrographite cleavage (very thin layers, transparent electronically close to those of graphene).
- metal electrode is observed even coating of Ag from morphologically dress (including interfaces) the material support of Sital (clearly highlights the grains of ceramic material). This was observed in all 3 samples analyzed.

REFERENCES

[1] *Linear Thermal Expansion ASTM E831-2006 of Solid Materials by Thermomechanical Analysis*

[2] ASTM E-1461: 2007 *Standard Test Method for Thermal diffusivity by the Flash Method*

[3] Auriga Workstation Smarts V05.04

[4] *Test procedure* PI-16 "morpho-structural analysis by scanning electron microscopy (SEM) and microprobe elemental chemical analysis of energy dispersive X radiation characteristic

[5] GW Lee, S. Jagannathan, Chae HG, Minus ML, Kumar S., "*Carbon nanotube dispersion and exfoliation in polypropylene and structure and properties of the resulting composites*", Polymer, 2008, 49 (7), 1831-1840

The research was financed by third parties, contract no. 227 (1084/2014)

Technical knowledge: Technical documentation on the methods and schemes for achieving Salisbury and Jaumann electromagnetic shields

ABSTRACT

A study regarding: "The technical documentation on the methods and schemes for achieving Salisbury and Jaumann electromagnetic shields" was obtained within this project. This study describes the concept of Salisbury and Jaumann shielding systems, the methods and schemes used to make the Salisbury and Jaumann electromagnetic shields referring to: the critical evaluation of shielding systems advantages; instructions concerning the design of shielding systems; critical evaluation of achieving methods; the description of an implementation scheme as well as of a testing procedure for electromagnetic Salisbury and Jaumann shields.

INTRODUCTION

One of the methods of reducing radar echo consists in the absorption of the incident electromagnetic energy, which means the reduction of the energy reflected by the target. In order to absorb this energy, materials must be so that the induced currents to be in phase with the incident electric fields, just like the currents in resistors. In the same time, however, these materials should reflect an amount of energy as small as possible out of the incident energy. Many absorbing materials are made with carbon thus assuring the loss mechanism, namely the conversion of electromagnetic energy in heat.

The oldest type of radar absorber is the **Salisbury shield**, consisting in a sheet of porous material impregnated with graphite and placed at a distance of /4 from a metallic plate. Thus the incident wave "sees" the free space and there is no reflection. If the space between the resistive sheet and metal plate is not /4, the wave sees finite impedance in parallel with the impedance of the resistive sheet yielding complex impedance different from the one of free space. Consequently, a portion of the incident wave energy is reflected and this reflection is greater as the frequency of the incident wave moves away from the ideal case (/4). Therefore, the Salisbury shield is a narrow band absorber.

The bandwidth can be increased by using multiple overlapped sheets, separated by spaces. The resistance must decrease from one sheet to another with smaller values towards the metal plate. This sheet overlapping is called Jaumann absorber and the bandwidth increases with each added sheet.

Research staff

Dr. Eng. Phys. Jana Pintea – contract Responsible

Members: Dr. Eng. Mihai Badic

PhDs. Eng. Cristian Morari

EXPERIMENTS

One frequently used method of testing shielding materials consists in a coaxial TEM cell and a vector network analyzer. In this case, the scattering parameters S11 and S21 are measured.

The experimental results obtained with this method are given in figures 1 and 2.

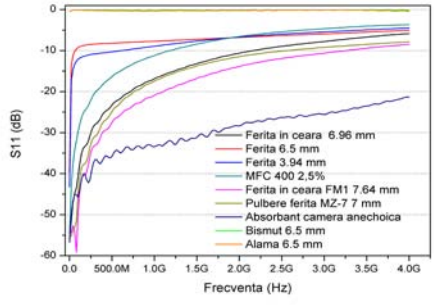

Fig. 1. S11 parameter versus frequency for various materials

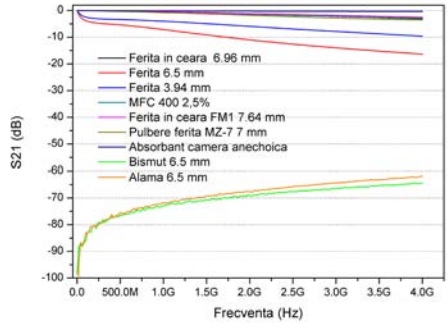

Fig. 2. S21 parameter versus frequency for various materials

RESULTS AND DISCUTIONS

A study was obtained regarding the methodology of attaining the Salisbury and Jaumann shields. Salisbury shields were not intensively used because they work at only one radar frequency. Experimentally, Salisbury shields were built by modifying not just the separation between resistive sheets and metal plates but also the material between them. Nevertheless, only a portion of radar spectrum could be covered.

Another problem is the shield thickness itself. Radar wavelengths are ranging between 10 cm and 1 mm so that the shield thickness (/4) should be of only 2.5 cm and a multilayered shield is much thicker. Researches on ultrathin Salisbury shields using *Sievenpiper HIGP (high impedance ground plane)* (source: *Wiley Periodicals, Inc., Microwave Opt. Technol. Lett.*) show remarkable improvements in shields thickness.

Jaumann absorber is efficient over a wide wavelength range because the tests regarding the reflection from a flat metallic plate show a reflection coefficient of 10% or smaller for all wavelengths between 3 cm and 30 cm.

At this time, the use of Jaumann absorber is limited due to its thickness on one hand, and to the mechanical properties of cellular igelit. It has dielectric constant of 2.7. Cellular igelit is a pure igelit treated by inserting 70% air and 30% PVC in order reduce its density. However, nowadays these drawbacks can be overcome by using composite materials or even metamaterials.

CONCLUSIONS

In this project, a study which describes the shielding concept, methods and schemes of attaining Salisbury and Jaumann electromagnetic shields was achieved. Also, this study presents several methods for testing absorbers as well as for measuring the material parameters. Precise measurement of material parameters is critical for tuning the absorber performances.

The study is useful for choosing the type of configuration when making electromagnetic shields and for testing their performances.

The research was financed through contract with third parties no. 1089 /2014, beneficiary: SC ALL GREEN SRL, Romania.

Integrated services based on the satellite data processing

ABSTRACT

In the project «Integrated services based on the satellite data processing» financed by Sectorial Operational Program "Increasing Economic Competitiveness", the "Consulting Services for Innovation, Protection of Intellectual Property Rights" are performed. It proposes to identify the results obtained in their own regime as well as the results obtained within the services contract and assign their ownership rights.

Project research staff

Eng. Macamete Elena, Consultant PI – contract Responsible

Eng. Ivan Ion – IDT I

RESULTS AND DISCUTIONS

The results of the project contain:

- Elaboration of the documentation necessary to identify the creations, original technical solutions likely to be protected, resulted within the project, through the intellectual property objects.
- Consultancy in every project stage, for innovation.
- Property rights protection generated during its implementation, following that in the end the documentation that is forwarded to OSIM to be performed.

CONCLUSIONS

- The absolute novelty results protection necessity;
- The protected results exploitation necessity.

The research was financed by the Sectorial Operational Programme „Increasing Economic Competitiveness", services contract no. 33/2013 (1072/2013).

Optical nanofabrication in range of 5 nm – 50 nm

ABSTRACT

The aim of this project is to achieve studies and researches related to get complex structures from fluorescent and photosensitive materials like metals and vitro-ceramic with minimal dimensions of 5nm.

In this way will conduct researches like: obtaining uniform metallic structures in two dimensions (2D cu minimal length of 50 nm and then 5 nm, to obtaining fluorescent and photosensitive vitro-ceramics and metallic structures in three dimensions (3D) also with minimal length of 50 nm and finally to achieve these complex structures to have a downsize dimension of 5 nm.

INTRODUCTION

The aim of INCDIE ICPE –CA in this project in 2014, was to achieve high resolution morpho-structural investigations of written (lithographed) samples by complex techniques (SEM/AFM/DRX)

PROJECT PERSONNEL

PhDs Eng.Phys.Virgil Marinescu – project responsible

Eng. Sorina Adriana Mitrea

PhD Eng. Phys. Delia Patroi

Assist. Eng. Carmen Hajdu

EXPERIMENTAL

In the framework of the scheduled tasks of this project, the project coordinator, Storex Technologies SRL, obtained a set of four samples - lithographed silicon wafers who was investigated and analyzed by surface topography and morphology. This work was done on the Auriga workstation type FESEM-FIB produced by Carl Zeiss Germany.

The samples were investigated, attached on aluminum supports using one agar carbon conductive tape, without any mechanical and chemical preparation.

RESULTS AND DISSCUSIONS

Samples were recorded at magnifications between 100X and 200000X.

In the figures 1-4 below, are presented some SEM images (micrographs) recorded on the four samples codified: F205, F206, F207 and F227.

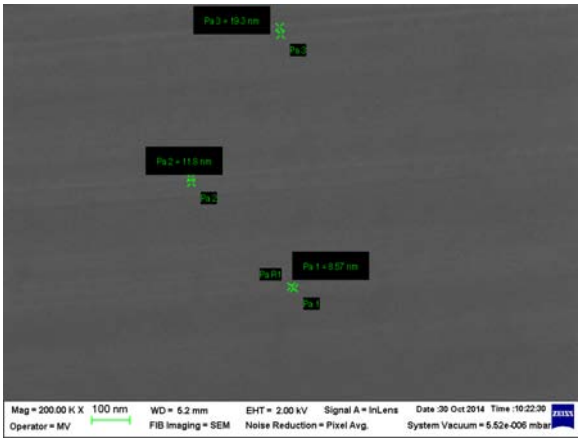

Fig. 1. SEM micrograph of the sample F205 at magnification 200000X, with an detail of obtained nanostructures (parallel channels with determined length)

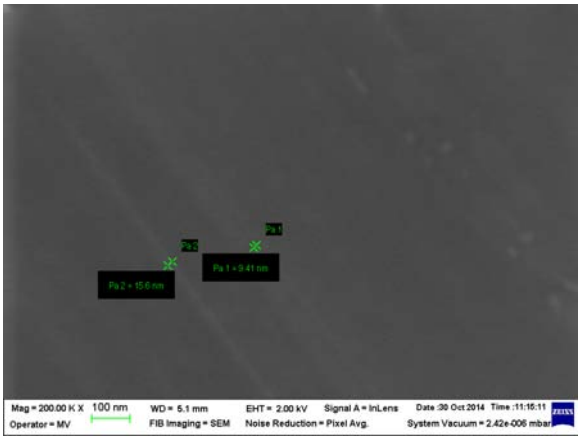

Fig. 2. SEM micrograph of the sample F206 at magnification 200000X, with an detail of obtained nanostructures (parallel channels with determined length)

Fig. 3. SEM micrograph of the sample F207 at magnification 200000X, with an detail of obtained nanostructures (parallel channels with determined length)

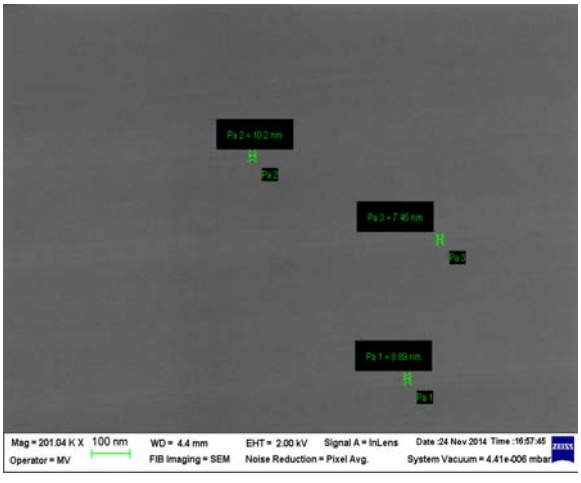

Fig. 4. SEM micrograph of the sample F227 at magnification 200000X, with an detail of obtained nanostructures (parallel channels with determined length)

CONCLUSIONS:

The four samples of lithographed silicon wafers, were investigated (surface topography and morphology), using a scanning electron microscope embedded in FESEM-FIB workstation produced by Carl Zeiss Germany.

The samples were recorded at different magnifications like: 100X, 5000X, 50000X, 100000X and also 200000 X.

The samples investigation at 200000X magnification clearly relieved the presence of some structures type "tape", composed by parallel channels with average dimensions in range of 5 nm to 20 nm.

BIBLIOGRAPHY

[1] Equipment manual „Workstation Auriga SmartSEM V05.04"

[2] Testing procedure PI-16 „Morpho Structural analysis by scanning electron microscopy (SEM) coupled with microprobe energy dispersive analysis of characteristic X-Rays (EDS)

The research was financed by the National Programme of Research, Development and Innovation - PNCDI II, contract no. 237/2014 (4.1-7102/2014)

Renergy - Regional strategies for energy conscious communities

ABSTRACT

INCDIE ICPE-CA acts as external expert of Avrig City Hall, Sibiu County, the city being Romanian partner in the Renergy project consortium. The project is co-funded by INTERREG IVC Programme. As external expert ICPE-CA organized one Energy Laboratory.

INTRODUCTION

Energy Laboratories are workshops in which are discussed problems concerning using of Renewable Energy Sources (RES) and the locally implementation of the principles of energy efficiency (EE).

Research staff of the project
Eng. Ion Ivan, TDE I – contract Responsible

EXPERIMENTAL

The topics discussed within Energy Lab were experience exchange and dissemination, good practices transfer, developing new perspectives of activities based on good practices transfer and new tools of policies and also how to implement these plans.

RESULTS AND DISCUSSIONS

The materials presented in Energy Lab have treated the issue of coherence between the Sustainable Energy Action Plan and the Implementation Plan of the city Avrig. Another topic treated was referring to regional policy recommendations for the development of sustainable energy communities. It also discussed the use of waste from livestock farms in biogas plants and was presented the latest achievements of ICPE-CA in the field of renewable energy.

CONCLUSIONS

By information provided and the ensuing debate Energy Laboratory, allowed the identification of concrete steps based on best practices that lead to successful implementation of Avrig City Development Strategy towards 2020.

The research was financed by the service contract no. 1068/2012.

Study about the network connection of a screw turbine turbogenerator group in the case of operation with an installed power of 180 kW in island mode and network connected mode. Specific technical conditions for the cases: start, long operation at constant speed of turbogenerators and variable speed respectively, in the limit of ±10%, stop and damage cases

ABSTRACT

It is proposed the automated scheme for the network coupling of a screw turbine turbogenerator group, with the installed power of 180 kW as a main power supply or as a secondary power supply, in island mode and in network mode, for the cases of start, long operation at constant speed of the turbogenerators, stop and damage cases. Also, it is proposed the automated scheme for the network coupling of a screw turbine turbogenerated group, for the cases of start, long operation at variable speed in the limit of ±10%, stop and damage cases of the turbogenerators, using a constructive solution with a frequency inverter.

INTRODUCTION

Study about the network connection of a screw turbine turbogenerator group in the case of operation with an installed power of 180 kW in island mode and network connected mode are made in specific technical conditions for the cases: start, long

operation at constant speed of turbogenerators and variable speed respectively, in the ±10% limit, stop and damage cases. The system screw expander – generator is intended for electric energy production in own installations or for supplying regional networks of natural gas distribution. There are solutions for network coupling of turbogenerators, using classical power switching devices, as well as synchronizers, but only in the case of constant speed. In this study is proposed a modern automated solution, which answers unitary to both cases and namely the group operation both in island mode and in network mode. In Fig. 1 and Fig. 2 is presented the layout of the electric equipment in the interior/exterior of the command power panel.

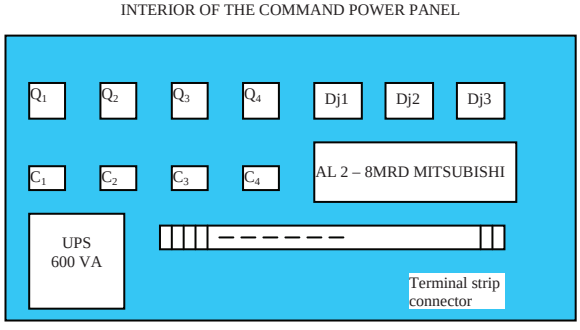

Fig. 1. Layout of the power equipment in the interior of the command power panel

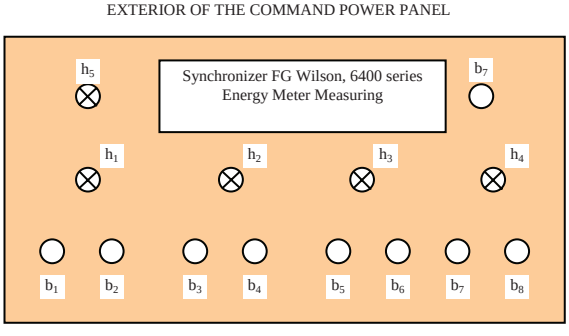

Fig. 2. Layout of the power equipment in the exterior of the command power panel

The proposed solution for the cases of start, long operation at constant speed and variable speed respectively, in the ±10% limit, stop and damage cases of the turbogenerator, uses a frequency converter.

Project research staff

PhD Eng. Lucian Pîslaru-Dănescu, IDT II – head of the project

PhD. Eng. Sergiu Nicolaie, IDT I
PhD. Eng. Dorian Marin, CS III
PhDs. Eng. Marius Popa, CS III
PhD. Eng. Florentina Bunea, CS III
PhD. Eng. Corina Babutanu, CS
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PhDs. Eng. Andreea Mitulet, ACS
PhDs. Eng. Rares-Andrei Chihaia, ACS

RESULTS AND DISCUSSIONS

A. Solution proposed for the cases of start, long operation at constant speed of the turbogenerators, stop and damage treatment cases:

- two identical turbogenerators, G1 and G2, with screw turbine and the electrical parameters mentioned in the technical theme, one considered the main source and the second the secondary source, Fig. 3, can charge a three phase electric network, through the automated command of two power contactors C1 and C2;

- in island mode, the screw turbine turbogenerator G1 or G2 charges the internal three – phase electric network and further towards the users (charge), through the following command sequence, respecting the order:

a) The contactor C4 and the breaker Q4 / open;
b) The contactor C3 and the breaker Q3 / closed;
c) The breakers Q1 or Q2 / closed;
d) The contactors C1 or C2 / closed.

The breakers Q1, Q2, Q3 and Q4 are used for a visible separation of the power three – phase circuits.

- in the network mode, the screw turbine turbogenerator G1 or G2 charges the external three – phase electric network through the following command sequence, respecting the order:

a) The contactor C3 and the breaker Q3 / open;
b) The contactor C4 and the breaker Q4 / closed;
c) The synchronization between the voltage at the turbogenerator outputs and the voltage of the external three – phase electric network is made with the synchronizer Sincronizor FG Wilson 6400 Series;
d) The breakers Q1 or Q2 / closed;
e) The contactors C1 or C2 / closed.

In this case also, the breakers Q1, Q2, Q3 and Q4 are used for the visible separation.

In permanent operation mode of the screw expander – electrical generator, the breakers Q1, Q2, Q3 and Q4 are closed.

The order of closing/opening of the contactors C1, C2, C3 and C4, for achieving the two permanent operation modes of the screw expander – electrical generator, is established through the software, [1], of the programmable microautomat Mitsubishi AL 2 – 24 MRD, Fig. 4.

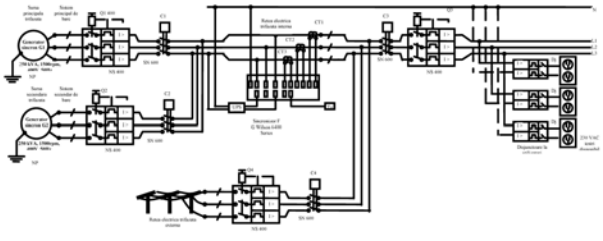

Fig. 3. Network coupling of a screw turbogenerator group, as a main power supply or as a secondary power supply, in island mode and in network mode

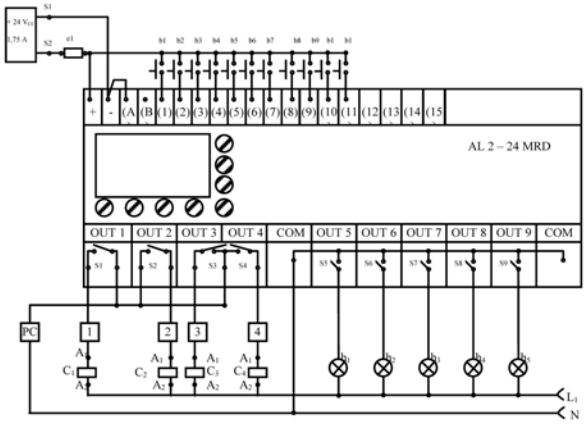

Fig. 4. The automated scheme for network coupling of a screw turbogenerator group, as a main power supply or as a secondary power supply, in island mode and in network mode

B. Solution proposed for the cases of start, long operation at variable speed in the limit of ±10%, stop and damage cases of the turbogenerator.

In this conditions, is expected for the constructive solution the main scheme presented in Fig. 5.

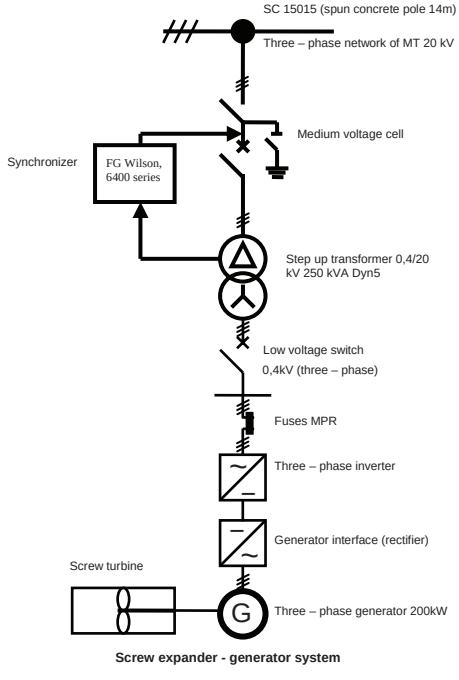

Fig. 5. The main scheme for the constructive solution of connection of the screw expander – generator system, in the case of long operation at variable speed in the limit of ±10%

It is ensured thus the electric separation of the alternative voltage, of variable frequency fs, at the synchronous generator terminals, of fixed frequency (f = 50 Hz) of the electric network at which the installation is connected. In this way, the rapid fluctuations at the synchronous generator terminals are transmitted alleviated to the electric supply network. Also, on a normal operation of the frequency inverter there is no unbalance in ther connection node of the medium voltage electric network.

CONCLUSIONS

The network connection of a screw turbine turbogenerator group in the case of the operation with an installed power of 180 kW in island mode and network connected mode are made in specific technical conditions for the cases: start, long operation at constant speed of turbogenerators, stop and damage treatment cases can be achieved through an automated solution with programmable micoautomat. The closing/opening order of the contactors for achieving the permanent operation modes of the screw expander – electric generator system, is established through the software of the programmable microautomat Mitsubishi AL 2 – 24 MRD. The synchronization between the voltage at the turbogenerator output and the voltage at the external three – phase electric network is made with the synchronizer "Sincronizor F G Wilson 6400 Series".

The network connection of a screw turbine turbogenerator group in the case of the operation with an installed power of 180 kW in island mode and network connected mode for the cases of start, long operation at variable speed in the ±10% limit, stop and damage cases of the turbogenerator can be achieved through a constructive solution with the use of a frequency inverter, [2].

REFERENCES

[1] Mitsubishi Electric, *Simple Application Controllers, Alpha XL*, Technical Catalogue, www.mitsubishi-automation.com

[2] Mitsubishi Electric, *Inverter, FR-A700 Series, Instruction manual (applied), Code: 1A2-P10*, www.mitsubishi-automation.com

The research was financed by extrabudgetary sources, contract no. 153/2014 (1090/2014).

Beneficiary: INCD TURBOMOTOARE COMOTI Bucharest, Romania

Obtaining specimens of thermoplastic polymer composite powder nanoconductive on specialized equipment and integrated analysis of mechanical, chemical and thermal specimens results

SUMMARY

In this work were performed following objectives required by the customer: Getting 16 formulations of polymer composite, hydrostatic density determination, identification of crystalline phases, mechanical characterization: determination of tensile strength, resistance to bending in three points, determination of hardness Shore a, to determine the degree of swelling in water and solvent (toluene) Elemental chemical analysis by fluorescence X-ray spectrometry with (XRF) and elemental chemical analysis with EDX dispersive probe mounted on the FIB SEM-type microscope, thermogravimetric analysis and differential calometrie TG-DSC dynamic determination of thermal conductivity and difusivităţii.

Service was requested by SC ALL GREEN SRL.

INTRODUCTION

To obtain composite materials used were provided by the customer: low density polyethylene, high density polyethylene and polypropylene, as well as reinforcing element which was a powder nanoconductive. These raw materials were obtained from electronic waste recycling.

Were obtained over 500 samples to characterize the physico-mechanical, chemical and thermal.

Research staff of the project

Dr. Eng Alina Ruxandra Caramitu - Responsible of the contract

Eng. Sorina Mitrea – Co-responsible of the contract

Dr. Eng. Violeta Tsakiris

Dr. Eng. Phys. Delia Pătroi

PhDs. Eng. Aristofan Teişanu

PhDs. Eng. Phys. Virgil Marinescu

Assist. Eng. Carmen Hajdu

Techn. Dorina Vlad

Techn. Florin Dobrin

Techn. Gheorghe Iancu

Techn. Paul Stean

EXPERIMENTS

Within this service were made following tests after obtaining composite materials:

- hydrostatic density determination,
- identification of crystalline phases,
- mechanical characterization:

a resistance to traction,

a resistance to bending in three points,

a Shore A hardness determination,

- determining the degree of swelling in water and solvent (toluene),
- elemental chemical analysis by fluorescence X-ray spectrometry with (XRF) and dispersive EDX probe type mounted on microscope SEM FIB,
- dynamic thermogravimetric analysis and differential TG-DSC calometrie,
- determination of thermal conductivity and difusivităţii.

RESULTS AND DISCUSSION

In this work were obtained 16 kinds of experimental composite materials have been tested for mechanical, thermal, chemical and structural. Coding samples is as follows: LDPE natural - M1, PP natural - M2, LDPE regranulated electronic waste - M3, regranulated of electronic waste LDPE / 3 powder NC - M4, regranulated of electronic waste LDPE / 7 powder NC - M5, LDPE regranulated in electronic waste / 10 powder NC - M6, HDPE paprika electronic waste - M7, paprika from electronic waste HDPE / 3 powder NC - M8, paprika from electronic waste HDPE / 7 powder NC - M9, electronic waste HDPE paprika / 10 NC powder - M10, PP regranulated of electronic waste - M11, electronic waste regranulated PP / 3 powder NC - M12, PP regranulated of electronic waste / 7 powder NC - M13, electronic waste regranulated PP / 10 powder NC - M14, LDPE natural regranulated - M15, HDPE paprika electronic waste (batteries housings) - M16.

DETERMINING THE DENSITY OF HYDROSTATIC [1]

From the results it is found that by adding increasing percentages nanoconductive powder composite material density increases. It is noted that M3, M4 and M5 were almost identical densities, which leads to the conclusion that an increasing filler powder nanoconductive (0-7%) in the polymer does not affect the density of electronic waste. For 10% composite nano-conductive powder is an increase in density to the composite powder with no added about 6%. Of all the formulations analyzed shows that the highest density material presents the smallest M10 is M2.

IDENTIFICATION CRYSTALLINE PHASE [2]

- for composites based on high density polyethylene (HDPE electronic waste) base polymer composition comprising a mixture of HDPE and PP and the addition

of conductive nano powder led to the emergence of peaks existing in this specific compounds (oxides calcium, titanium oxides, silicon oxides and / or combinations thereof);

- for re-granulated composites based on LDPE obtained from electronic waste: the basic polymer composition comprising low density polyethylene and conductive nano powder addition resulted in the appearance of peaks existing in the specific compounds (oxides, calcium oxide silica and / or combinations thereof);
- for composites based on PP regranulate obtained from electronic waste: basic polymer composition comprises polypropylene and the addition of conductive nano powder led to the emergence of peaks existing in this specific compounds (oxides of calcium, silicon oxide).

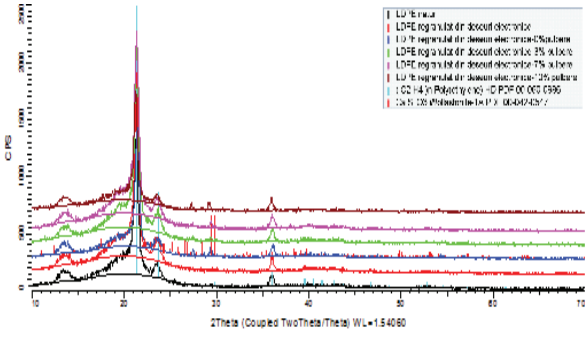

Fig. 1. XRD spectra of composite materials which have as their base polymer LDPE

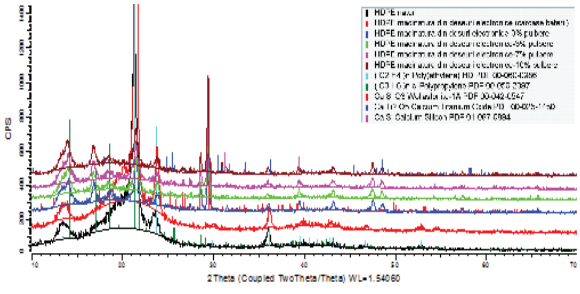

Fig. 2. XRD spectra of composite materials which have as their base polymer of HDPE the mill

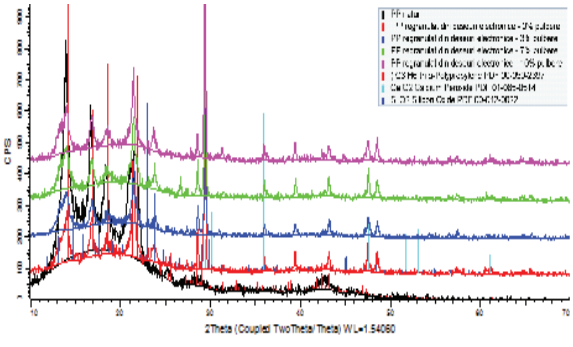

Fig. 3. XRD spectra of composite materials which have as their base polymer PP

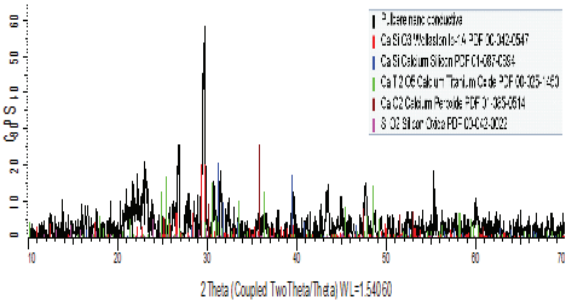

Fig. 4. Powder XRD spectrum for nanoconductive

DETERMINATION OF MECHANICAL CHARACTERISTICS [3]

Tensile strength and resistance to bending in three points were made on one set of 10 samples and was considered average.

Determination of tensile mechanical strength

- composite materials with polymer matrix of LDPE

The experimental results for these materials are shown in Fig. 5.

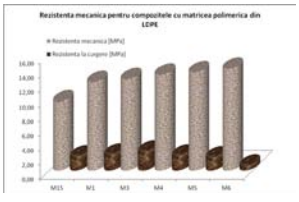

Fig. 5. The tensile strength of all the comparative composite material of the polymeric matrix of LDPE

Fig. 5 shows that of all composite materials with polymeric matrix of LDPE, the resistance is the best material M6.

By adding increasing percentages of powder nanoconductive it is noted that:

- by regranulation LDPE's kind of electronic waste is found that M15 Rm <29% Rm M1 (Natural LDPE); this can be explained by the fact that the regranulation LDPE's mechanical strength deteriorates greatly;
- 0% powder nanoconductive (M3) Rm M3> M1 Rm 3%;
- 3% powder nanoconductive (M4) Rm M4> 8% Rm M1;
- 7% nanoconductive powder (M5) M5 Rm> Rm M1 and 11.16%
- 10% powder nanoconductive (M6) M6 Rm> Rm 15.19% M1.

This mechanical behavior is explained by the fact that the addition of nano-powder in the conductive polymer matrix, there is a stiffening of the material, which implies an increase in the mechanical strength, but also a decrease in elongation.

- ***composites with polymeric matrix materials of HPDE***

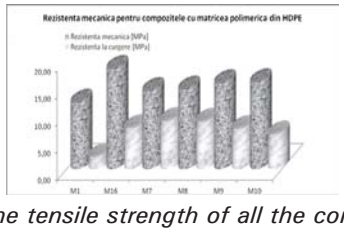

Fig. 6. The tensile strength of all the comparative composite materials HDPE

Fig. 6 shows that of all composite materials with polymeric matrix of HDPE, the mechanical strength is best the mill HDPE material in electronic waste (batteries housings) - M16. Comparing reinforced materials, it is found that the best mechanical strength has M10.

Comparing M1 to M16 HDPE the mill electronic waste (frames batteries), it appears that Rm M1 <51% Rm M16 and A (%) M1> 241% A (%) M16; this can be explained by the fact that the battery contains the mill frame as reinforcing elements other materials, eg .: CaO, P_2O_5, Fe_2O_3, CuO, ZnO, such as XRF analysis showed that they reinforce the composite material , which leads to an increase in the mechanical strength.

By adding increasing percentages of powder nanoconductive it is noted that:

- by grinding HDPE's electronic waste (0% powder nanoconductive - M7) shows that Rm M7> 18% Rm M1;
- 3% powder nanoconductive (M8) Rm M8> 20% Rm M1;
- 7% nanoconductive powder (M9) Rm M9> 29% Rm M1;
- 10% powder nanoconductive (M10) M10 Rm> 31% Rm M1.

This mechanical behavior can be explained by the fact that the powder addition nanoconductive stiffening occurs in the polymer matrix composite material, which implies an increase in mechanical strength.

- composite materials with polymer matrix PP

Fig. 7 shows that of all composite materials with polymeric matrix of PP, the best mechanical resistance is natural PP material M2. Between reinforced composite materials with powder nanoconductive best resistance presents maximum powder material, M14.

Fig. 7. The tensile strength of all the comparative composite materials based on PP

Considering only those reinforced nanoconductive powder, it is found that the mechanical strength of the best presents PP regranulated of electronic waste - M11.

By adding increasing percentages of powder nanoconductive it is noted that:

- by regranulation PP from electronic waste (with the addition of 0% powder nanoconductive - M11) M11 shows that Rm <70% Rm M2;
- the addition of 3% powder nanoconductive (M12) M12 Rm <69% Rm M2;
- 7% for added powder nanoconductive (M13) Rm M9 <61% Rm M2;
- the addition of 10% powder nanoconductive (M14) M10 Rm <55% Rm M2.

In this case the addition of nanoconductive powder in the polymer matrix leads to an increase in the mechanical strength. For reinforced composite materials are the highest mechanical resistance of those with a maximum nanoconductive powder or materials M6, M10 and M14.

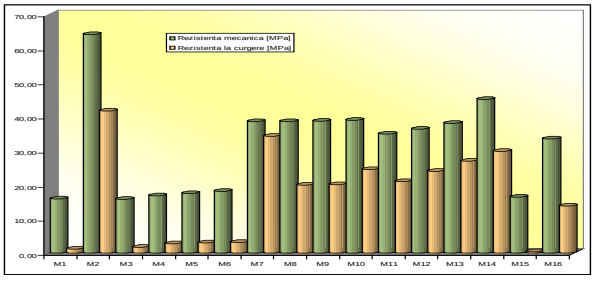

Fig. 8. Comparative presentation of mechanical tensile strength composite materials studied

- **resistance to bending in three points for composite materials obtained**

The experimental results for these materials are shown in Fig. 9, 10 and 11 for the polymers of LDPE, HDPE and PP. In Fig. 12 is shown a picture of the behavior of materials under study in terms of mechanical strength to strength.

- **the polymer matrix composite material of LDPE**

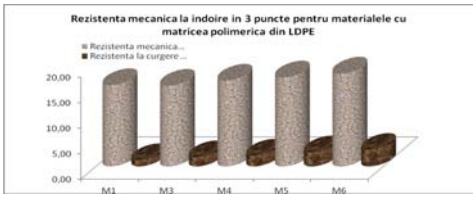

Fig. 9. 3-point flexural strength, in comparison to composites for all the polymeric matrix of LDPE

Fig. 9 shows that of all composite materials with polymeric matrix of LDPE, the mechanical resistance to bending in three points, the better the material M6. In the case of these composite materials is an increase in mechanical resistance to bending at three points with the addition of the conductive powder.

Thus, by the addition of increasing percentages of powder nanoconductive be seen that:

- by regranulation LDPE's kind of electronic waste is found that M15 Rm> 3.4% Rm M1 (Natural LDPE);
- 0% powder nanoconductive (M3) M3 Rm <0.75% Rm M1;
- 3% powder nanoconductive (M4) M4 Rm> 5.5% Rm M1;
- 7% nanoconductive powder (M5) M5 Rm> 9.4% Rm M1;
- 10% powder nanoconductive (M6) M6 Rm> 5.5% Rm M1.

This mechanical behavior can be explained by the fact that the powder addition nanoconductive stiffening occurs in the polymer matrix composite material, which implies an increase in mechanical strength.

- composite materials with polymer matrix of HPDE

Fig. 10 shows that of all composite materials with polymeric matrix of HDPE, the mechanical resistance to bending in three points, the better the material M10. As in the case of composites on the basis of LDPE,

in the case of this composite is an increase in the mechanical strength of the three-point bending with the addition of the conductive powder.

Thus, by the addition of increasing percentages of powder nanoconductive be seen that:

- by grinding HDPE's electronic waste (0% powder nanoconductive - M7) shows that M7 Rm> Rm 142% M1;
- 3% powder nanoconductive (M8) M8 Rm> Rm M1 142.1%;
- 7% nanoconductive powder (M9) M9 Rm> Rm 143% M1;
- 10% powder nanoconductive (M10) M10 Rm> Rm 145% M1.

In the case of these composite materials is found that by adding nanoconductive powder in the polymer matrix composite material undergoes a glass transition, which implies an increase in the mechanical strength.

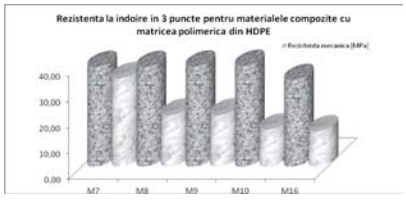

Fig. 10. 3-point flexural strength, in comparison to composites for all the polymeric matrix HDPE

- composite materials with polymer matrix PP

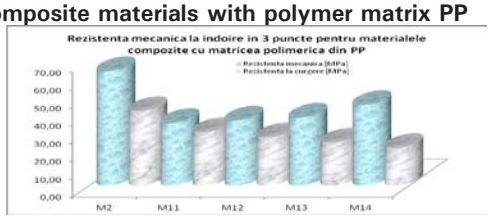

Fig. 11. 3-point flexural strength, in comparison to composites for all the polymeric matrix PP

Fig. 11 shows that of all composite materials with polymeric matrix of PP, the best mechanical resistance is natural PP material M2. Considering only those reinforced nanoconductive powder, it is found that the mechanical strength of the best presents M14.

Thus, by the addition of increasing percentages of powder nanoconductive be seen that:

- by regranulation PP from electronic waste (0% powder nanoconductive - M11) M11 shows that Rm <83% Rm M2;
- 3% powder nanoconductive (M12) M12 Rm <76% Rm M2;
- 7% powder nanoconductive (M13) Rm M9 <67% Rm M2;
- 10% powder nanoconductive (M14) M10 Rm <43% Rm M2.

Adding nanoconductive powder in the polymer matrix leads to an increase in the rigidity of the material, so an increase in the mechanical strength. However, to witness PP material nature is found that the mechanical strength decreases.

In Fig. 12 there is shown a statistical comparison of the composite materials under study. In terms of composite materials reinforced nanoconductive powder, the highest mechanical resistance of materials are maximum nanoconductive powder or materials M6, M10 and M14.

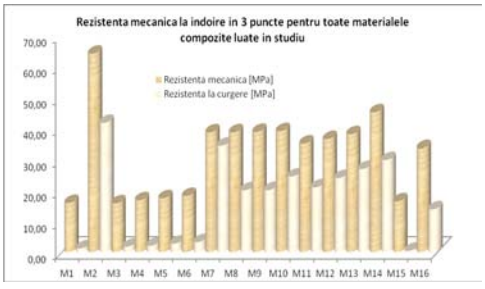

Fig. 12. Resistance to bending 3-point comparison of all the composites studied

DETERMINATION OF HARDNESS SHORE [4]

A statistical analysis of the values obtained for this test, shown in fig. 12, it is found that all the formulations are close values are obtained which are in the range characteristic of the three types of polymers (PP, LDPE and HDPE). Hardness largest natural PP and HDPE presents the mill skeleton batteries.

For composites with increasing percentage of powder not give a significant difference between hardness. At the same time, it can be said that the addition of increasing percentages (3, 7 and 10%) did not lead to an increase in hardness.

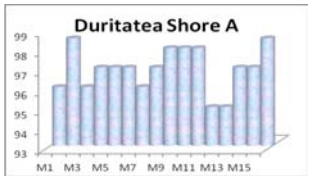

Fig. 12. Hardness Shore A for all subjects

Following Shore hardness test, it is found that the addition ascending (3, 5 and 10%) nanoconductive powder does not lead to an increase in hardness Shore.

DETERMINATION OF SWELLING IN WATER AND SOLVENT [5]

The swelling in water at room temperature

The results of the swelling tests at room temperature are shown in Fig. 13.

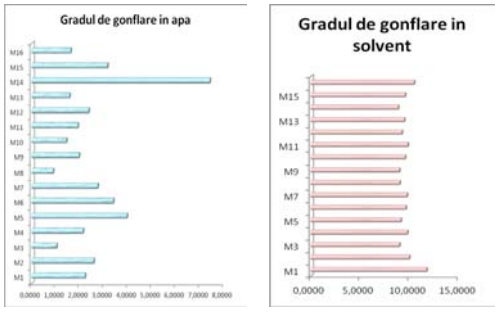

Fig. 13. (a) Degree of swelling in water at room temperature for composite materials studied, (b) Degree of swelling in a solvent (toluene) at room temperature for the materials studied

A statistical analysis of experimental data shows that the highest inflation posed M14 material.

A classification according to the degree of swelling in water studied materials can be presented as follows: M8 <M3 <M10 <M13 <M16 <M11 <M9 <M4 <M1 <M12 <M2 <M7 <M15 <M6 <M5 <M14.

From the point of view of the degree of swelling in water at room temperature (Fig. 13) of all the composite materials under study can be selected as the optimal variant for use in conditions of high humidity, the range of materials that will contain the most low swelling, namely M8.

Swelling at room temperature in a solvent (toluene)

The results of the swelling tests at room temperature are shown in fig.13 b.

The degree of swelling in solvent was determined as the average of 5 measurements on five different samples excluding non-string values with 95% confidence level.

A statistical analysis of experimental data shows that the greatest degree of swelling in solvent presents LDPE material nature - M1.

A classification according to the degree of swelling in solvent materials studied are: M14<M9<M3<M8 <M5<M12<M13<M15<M10<M6<M7<M4<M1 1 <M2<M16 <M1.

From the point of view of the degree of swelling at room temperature in a solvent of all the composite materials under study can be selected as the optimal variant for use in conditions of exposure to the organic solvent, the version of the material which has the lowest degree of swelling, namely M14.

CHEMICAL ANALYSIS ITEM IN X-RAY FLUORESCENCE SPECTROMETRY - XRF [6]

Of the samples were reinforced with the powder nanoconductive tests were carried out on the formulations ranfosate 0% to 10%. Formulations intermediate (3% and 7%), in chemical terms, do not have more information.

In Fig. 14 to 24 are shown chemical compositions of the studied

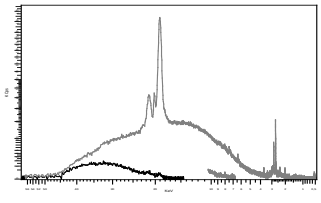

Fig. 14. XRF spectrum for natural LDPE - M1

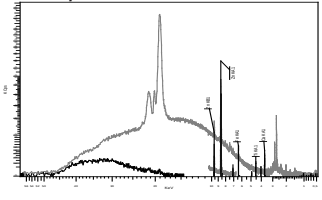

Fig. 15. XRF spectrum for LDPE natural regranulated - M15

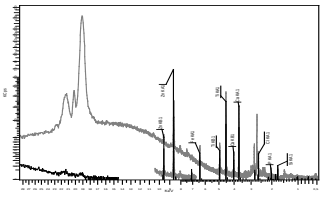

Fig. 16. XRF spectrum for electronic waste LDPE regranulated + 0% powder nanoconductive - M3

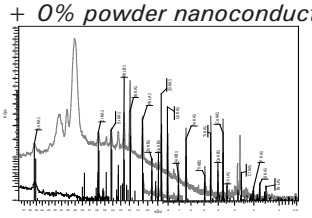

Fig. 17. XRF spectrum for electronic waste regranulated LDPE / 10% powder nanoconductive - M6

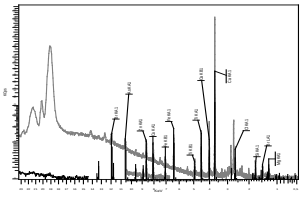

Fig. 18. XRF spectrum for HDPE waste the mill powder electro 0% nanoconductive - M7

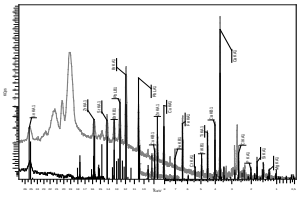

Fig. 19. XRF spectrum for electro waste HDPE 10% the mill powder nanoconductive - M10

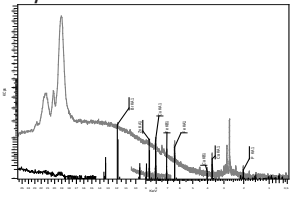

Fig. 20. XRF spectrum for electronic waste HDPE the mill (tanks) - M16

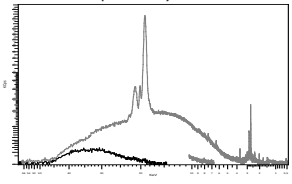

Fig. 21. XRF spectrum for PP natural - M2

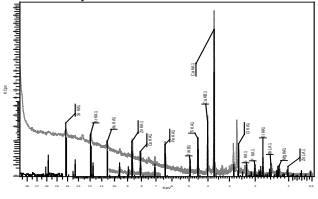

Fig.22. *XRF spectrum for electronic waste PP regranulated 0% powder nanoconductive M11*

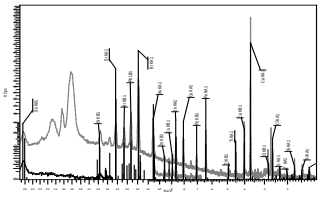

Fig. 23. XRF spectrum for electronic waste regranulated PP + 10% powder nanoconductive - M14

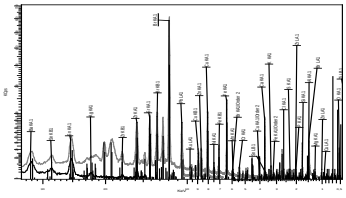

Fig. 24. XRF spectrum for powder nanoconductive - Mo

A statistical analysis of the results observed the following:

- nanoconductive powder used as a filler in all three types of polymer composites (based on -LDPE low density polyethylene, high density polyethylene - HDPE and polypropylene - PP) contains mainly the elements Si, Ca, Fe, Al, Cu, Pb, Ti, Sn, P, Sr (as oxides) and Br element (rest of the elements being found in concentrations of less than 1%);
- the reference materials (LDPE, HDPE and PP) are substantially chemically pure as evidenced only the organic matrix, without any inclusions, impurities or additives in concentrations that are within the detection values of the device (PPM);
- re-granulated polymer composites based on polyethylene of low density (LDPE range) without the addition of powder nanoconductive contain, in addition to the polymeric matrix, mainly the elements Ca, Ti, Si, Fe (as oxides) and the element Br;
- as polymer composites of the mill on the basis of high density polyethylene (HDPE range) without the addition of powder nanoconductive contain, in addition to the polymeric matrix, mainly the elements Ca, Ti, Si (as oxides) and the element Br;
- re-granulated polymer composites based on polypropylene (PP range) without the addition of powder nanoconductive contain, in addition to the polymeric matrix, mainly the elements Ca, Ti, Si, Mg (as oxide) and the element Br;
- In all cases, the addition of powder in a proportion of 10% nanoconductive leads both to an increase in the common elements and powder polymer composites, as well as the appearance of the chemical composition of the specific elements only nanocomposite powder (eg. Sn and Zr) . This indicates an appropriate degree of mixing of polymer composites by powder nanoconductive during the process by injection of samples for testing.

DIFFERENTIAL AND DYNAMIC CALOMETRY THERMOGRAVIMETRIC ANALYSIS (TG-DSC) [8]

- **HDPE polymer matrix material**

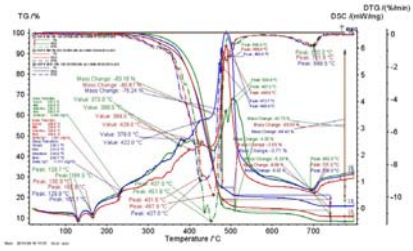

Fig. 25. TG, DSC for the polymer matrix material of the HDPE

- **the polymer matrix material LDPE**

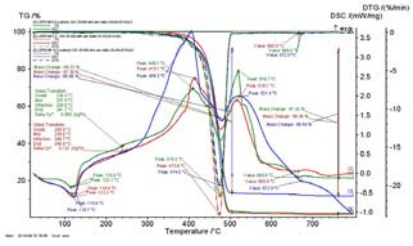

Fig. 26. TG, DSC for the polymer matrix material of the LDPE

- **the polymer matrix material PP**

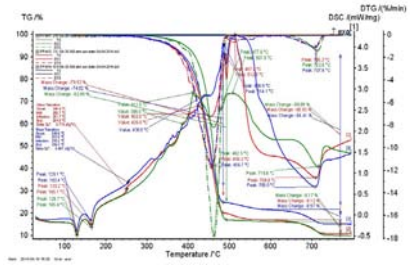

Fig. 27. TG, DSC for the polymer matrix material PP

The materials in this series show a similar behavior due to the polymer matrix of HDPE, LDPE and PP. It boils down to a series of phenomena clearly identified in TG - termopierdere table with their related derivatives DTG. DSC curves are presented showing the heat absorbed or disposed of those materials in dynamic (differential scanning calorimetry).

The I - melting materials. It appears that all of the materials is highlighted melting point, a glass transition of second kind.

- For HDPE and PP shows a split melting phenomenon, which may be due regranulation polymeric material and reinforced additions.
- LDPE is a tendency for all of cleavage melting phenomenon, but without actual evidence - widen the phenomenon.

Process II - Oxidation materials. It notes the start of the oxidation reaction in the temperature range of 300°C, with one or more points. For all samples highlights and weight loss related to TG-DTG.

Process III - Thermo-oxidation. It appears that some materials exhibit and this process highlighted in Table 1; for some materials to reveal the process and TG and DTG curves.

IV decomposition process. It appears that some materials exhibit and this process; for some materials this process is present and has a mass loss shown separately.

For there is a reaction control material consists of a process of melting a glass transition temperature (unless LDPE) and the oxidation - termooxidation.

Compared with control materials, composite materials have a tendency to translational thermal phenomena by higher temperatures. This phenomenon is confirmed by temperature differences identified at the glass transition, where the observed temperature increase start of the process (ex. Natural LDPE (M1) - initial T = 203,9°C to regranulated LDPE (M4) with initial T = 230,4°C), which may be due to both regranulation materials and powder addition nanoconductive.

THERMAL ANALYSIS - DETERMINATION OF THERMAL CONDUCTIVITY

The thermal conductivity was determined according to ASTM E-1461: 2007 [7,8] using the "flash".

The thermal conductivity of the polymer matrix composite material of LDPE

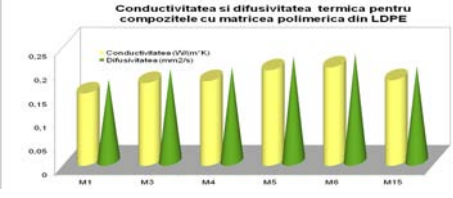

Fig. 28. The variation of the thermal conductivity of the polymer matrix composite material of LDPE

From these values we can conclude that the addition of increasing percentages nanoconductive powder for thermal conductivity values are obtained very similar for all the formulations of LDPE matrix composite material. However, it can be said that the tendency is to increase the conductivity of electronic waste material regranulated LDPE / 10% powder NC - M6, which are of the highest thermal conductivity grade LDPE matrix material.

The thermal conductivity of polymer matrix composite materials HDPE

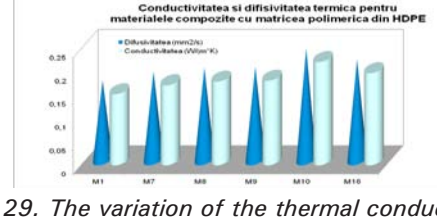

Fig. 29. The variation of the thermal conductivity of polymer matrix composite materials HDPE

From these values we can conclude that the addition of increasing percentages nanoconductive powder for thermal conductivity values are obtained very similar for all the formulations of HDPE matrix composite material. However, it can be said that the trend of increasing conductivity of composite materials is nanoconductive powder for electronic waste material regranulated HDPE / 10% powder NC - M10.

The thermal conductivity of the polymer matrix composite material PP

Fig. 30. The variation of thermal conductivity for composite materials with polymer matrix PP

From these values we can conclude that the addition of increasing percentages nanoconductive powder for thermal conductivity values are obtained very similar for all receipts of PP matrix composite material. However it can be said that the tendency is to increase the conductivity of electronic waste material regranulated PP / 10% powder NC - M14, which are of the highest thermal conductivity of PP matrix material class.

From comparison of conductivities of these materials (Fig. 31), it can be said that the maximum concentration of powder materials nanoconductive have the highest thermal conductivity (M6, M10 and M14) and thermal conductivity of which at most is M14, ie electronic waste regranulated PP / 10% powder NC.

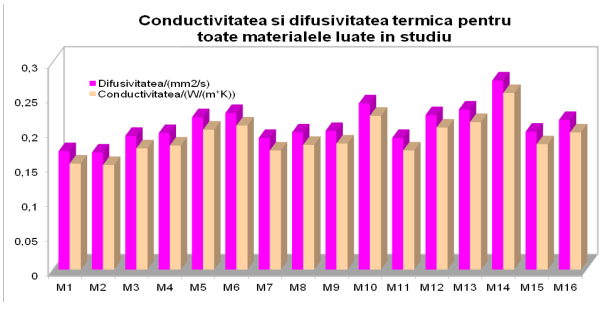

Fig. 31. Variation of thermal conductivity and diffusivity for all materials studied

CONCLUSIONS

In this work were obtained and characterized in terms of mechanical, thermal and structural 16 kinds of polymer composite in which the polymer matrix was composed of LDPE, HDPE and PP repelleted of electronic waste and reinforcing element was a nanoconductive powder.

Raw materials were made traversing the beneficiary, SC ALL GREEN SRL.

REFERENCES

[1] EN ISO 3369: 2010 *Determination of density and PI* - 02/2013

[2] SR EN 13925 to 1.2 / 2003 *Qualitative phase and PI* SR EN 13925/3 -2005 - 04

[3] SR EN ISO: 527-2: 2000 - *Plastics. Determination of tensile properties. Part 2: Test conditions for molding and extrusion plastics*

[4] *Calibration Certificate* no. B-014-10335 / 2011 and ASTM D 785 *Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials*

[5] EN ISO 175/2011 *Plastics. Test methods for determining the effects of immersion in liquid chemicals*

[6] *The internal procedure PI* - 18/2013 manually operating the equipment type S8 TIGER

[7] ASTM E831: 2006 *Thermal Expansion of Solid Materials by Thermomechanical Analysis*

[8] ASTM E-1461: 2007 *Standard Test Method for Thermal diffusivity by the Flash Method*

The research was financed extrabudgetary - service contract with third parties, contract no. 1111/2014 (1079/2014).

Mini-supercapacitors technology, based on hybrid CNT/CNF - electroactive polymer networks

ABSTRACT

The overall objectives of the project are the morphological characterization (SEM) of electroactive hybrid polypyrrole-CNT material electrodes used in hybrid assemblies minisupercapacitor type developed by the consortium partners, the electrochemical behavior determination of the obtained hybrid electrodes, the achievement of the integrated assemblies minisupercapacitor type using an hybrid polypyrrole-CNT electrode and acid or gel type aqueous electrolyte, determining current-voltage (IV) and capacitance-voltage (CV) characteristics for integrated assemblies developed by the consortium partners and the contribution to the economic, technical and impact studies developing with the consortium partners.

INTRODUCTION

The supercapacitors are electrical storage devices and energy conversion for the future. Electrochemical supercapacitors have become an attractive alternative for electrical energy storage devices because of advantages such as: high power density and stable cycle life [1,2]. The development of electrochemical supercapacitors requires the manufacture of advanced electrodes with new materials and techniques. To increase the performance of supercapacitors, electroactive polymers and electroactive polymer/carbon nanotubes networks have a major role, appeared as an immediate consequence of the development of carbon nanotubes and nanocomposite materials prepared based on carbon nanotubes [3,4]. The polymers are particularly attractive materials, due to their low density, ability to cope with heavy loads, higher spectral response. It were carried out polypyrrole depositions using various substrates. The electrolytes used in electrochemical polymerization have a dual role: make electrolyte solution conductive and doping the polymer, allowing one of its ions to couple with the monomer unit [5,6].

Conducting polymers have the following advantages:

- high specific capacitance;
- high conductivity in the charged state, i.e. low equivalent series resistance;
- high power density.

The main disadvantage of the polymers use in supercapacitors is connected to the cycling stability and the occurrence of cracks due to shrinkage and the appearance of cracks during subsequent cycles. This disadvantage can be prevented by the introduction of CNT in the polymer, such composite materials for the electrode having the advantage that the mesoporous network formed by the CNTs in the polymer can adapt to volume changes [7], thereby reducing the risk of cracks and increasing the stability at cycling.

Research staff of the project

PhD. Adela Băra – CS II – head of the project
PhD. Mihai Iordoc – CS
PhD. Paula Priotesa – CS
PhDs. Eng. Aristofan Teișanu – CS III
PhD. Cristina Banciu – CS III
PhDs. Eng. Phys. Virgil Marinescu – CS
PhD. Alina Caramitu – IDT I
PhDs. Eng. Phys. Iulian Iordache – IDT II
PhD. Elena Chițanu – CS
Dorina Vlad – Techn.
Marin Barbu – Techn.

EXPERIMENTAL

We aimed to obtain CNTs grown on a substrate by CVD method and to obtain polypyrrole conductive polymer coatings on various substrates containing CNTs networks, developed by ICPE-CA or received from the project coordinator - CHALMERS, morphological characterization of the developed integrated assemblies of polymer-carbon and determination its adhesion to the metallic substrate.

Polypyrrole coatings were carried out by cyclic voltammetry under the following conditions: 0.2-0.85 V/ESC potential range, at a scan rate of 20 mV/s, pyrrole electrolyte in sulfuric acid, 50 cycles. In this way, there were obtained four kinds of electrodes. To investigate the quality of the obtained coating, the samples were characterized in terms of morpho-structural through scanning electron microscopy.

Also, it was studied the electrochemical activity of the electrodes based on polypyrrole-CNT hybrid coatings resulted from the coating of the 3D CNT studied structures with polypyrrole, produced by ICPE-CA or from CHALMERS.

There have been built 3 types of supercapacitor assemblies as follows:

(1) symmetric supercapacitor with 0.2M H_2SO_4 electrolyte;

(2) symmetric supercapacitor with gel electrolyte;
(3) asymmetric supercapacitor with gel electrolyte.

Supercapacitors assemblies were build using 2 OL304 current collectors with caps role, OL304 electrodes with Fe catalyst, CNT and PPy, the separator membrane of acetyl-cellulose „nonwoven" type soaked in the electrolyte and Perbunan type seal.

RESULTS AND DISCUSSIONS

Structural characterization of 3D CNT structures developed by ICPE-CA and Chalmers, respectively polymer-CNT hybrid assemblies made at ICPE-CA by coating with polypyrrole, by scanning electron microscopy (SEM) was performed using an FESEM/FIB/EDS Auriga installation produced by Carl Zeiss Germany, with minimum resolution of 1 nm at 15 kV and 1.9 nm at 1 kV, acceleration voltage of 1-5 kV, the used detector was SESI type (Combined Secondary Secondary Electron Ion).

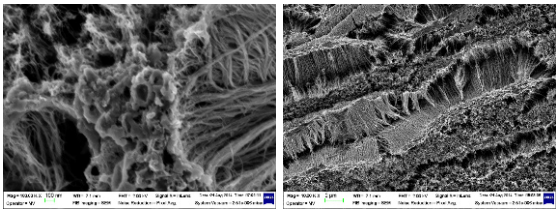

Fig. 1. SEM micrograph representing the morphological appearance of the sample 3D CNT network on OL 304 substrate - Fe catalyst

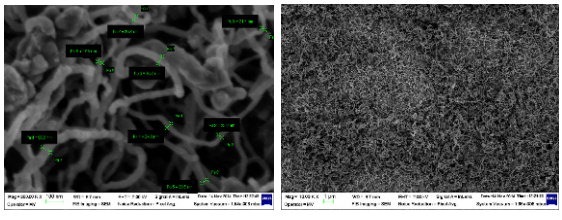

Fig. 2. SEM micrograph representing the morphological appearance of the sample 3D CNT network on Ni substrate

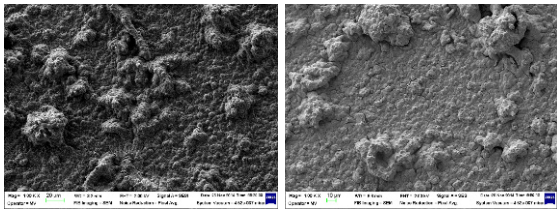

Fig. 3. SEM micrograph representing the morphological appearance of PPy–CNT hybrid samples: a) PPy-3D CNT network on OL 304 substrate - Fe catalyst; b) PPy-3D CNT network on OL 304 substrate - Ni catalyst

It was found that the samples obtained by polypyrrole deposition over the CNT networks grown on Ni substrate, respectively Ta (Chalmers sample), it peels off after drying.

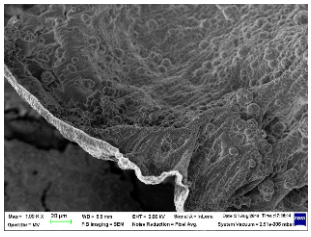

Fig. 4. SEM micrograph representing the morphological appearance of PPy–CNT hybrid samples properly to the sample PPy-3D CNT network on Ni substrate (Chalmers/ICPE-CA sample)

It was determined the linear scratch resistance of PPy-CNT sample corresponding the sample 3D CNT network on OL 304 substrate - Fe catalyst with a equipment of thin layers mechanical characterization (CSM Instruments, Switzerland) equipped with microscratching module with Rockwell diamond head and optical microscope with 5x, 20x, 50x and 100x magnification.

Scratching was done on a test length of 5 mm, with a progressive force of from 0.03 N to 10 N, scratch speed of 6 mm/min, the speed of charging the load of 11.96 N/min, the scanning force 0.03 N and data acquisition frequency of 20 Hz. Critical forces were determined from the curves recorded (coefficient of friction, depth of penetration, acoustic emission, depending on the length of testing and the scratch force), the coefficient of friction sensor, the depth of penetration sensor, acoustic emission sensor with observations from the images acquired by optical analysis using panorama option of data acquisition software of the equipment.

To measure the topographic profile of the samples was performed a prescan with a constant force of 300 mN before the scratch test. Pre-scanning is represented by the surface profile curve before the scratch test, that is the depth of penetration. Pre-scanning is always performed in the same direction as the direction of the scratch test.

To measure the topographic profile of the samples after the scratch test, that is the measuring the depth of the residual penetration by elastic deformation, it took place the samples post-scanning with a constant force of 0.03 N. Post-scanning is the surface profile curve after the scratch test, that is residual penetration depth.

It fiind out the appearance of delamination of the electroactive hybrid layer at a force of 0.51 N and a total peeling of it at an applied force of 4.87 N.

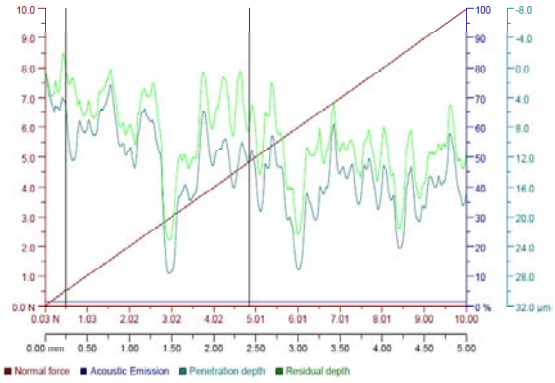

Fig. 5. The curves recorded in the following linear scratches on a test length of 5 mm, with a progressive scratch force of 0.03 N to 10 N

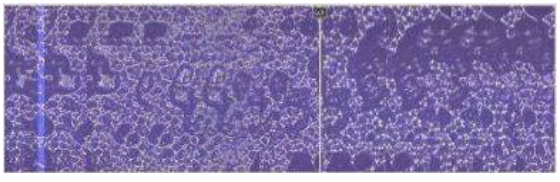

Fig. 6. The optical microscopy image of the sample after scratching, at Lc1 = 0,51 N

The electrochemical activity testing of the electrode made by CNT networks coating with conductive polymers was performed using potentiostat/galvanostat VoltaLab 40 equipment connected to PC by graphic interface VoltaMaster 4. It was used a standard cell with 3 electrodes, respectively an auxiliary platinum electrode, a Ag/AgCl reference electrode and a working electrode that was the tested sample. The measurements were carried out in the electrolytes: 0.2M H_2SO_4 solution; gel electrolyte.

To obtain the gel electrolyte the following raw materials were used: chemically pure phosphoric acid, deionized water, anhydrous polyvinyl alcohol, anhydrous potassium iodide and quinone (p > 99.9%).

All measurements were performed at room temperature (17 ± 3°C) and atmospheric pressure (1005 ± 5 kPa).

Testing of the electrodes was conducted by the following method: electrochemical impedance spectroscopy (frequency range f = 100 kHz ÷ 10 MHz, at an amplitude of 10 mV); potential capacity variation with constant frequency; capacity variation with frequency at constant potential; loss tangent variation with frequency at constant potential; charge-discharge tests.

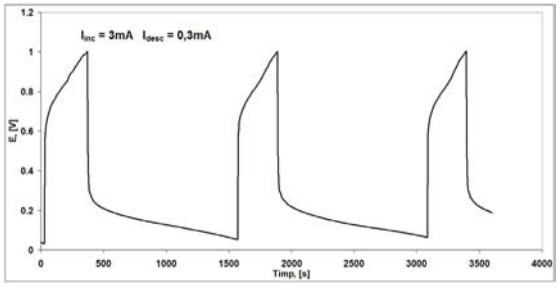

Fig. 7. Example of charging and discharging cycles for asymmetric supercapacitor with gel electrolyte

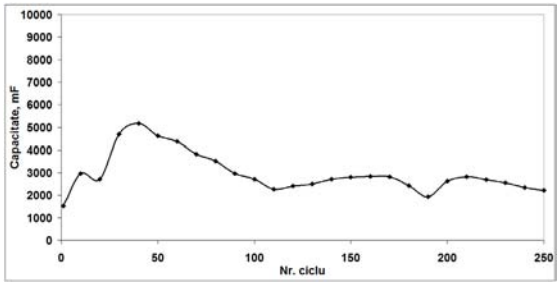

Fig. 8. Variation of the capacity for asymmetric supercapacitors with gel electrolyte

CONCLUSIONS

Samples were carried out by CVD growing the CNT 3D network (ICPE-CA), respectively PECVD (Chalmers), of the carbon nanotubes on the metallic substrate.

The CNT networks thus obtained were characterized morphologically by SEM microscopy and they were coated with PPy to test the electrochemical activity of the resulting hybrid electrodes and it was found as follows:

- Hybrid PPy-CNT samples on OL304 substrate (ICPE-CA samples) have a continuous and uniform layer of polymeric deposit and no deposit peel off after drying;
- Hybrid PPy-CNT samples on Ni substrate (Chalmers/ICPE-CA samples) have a continuous and uniform layer of PPy deposition, but adhesion to the substrate is reduced so that, after drying, partially peel;
- Hybrid PPy-CNT samples on Ta substrate (Chalmers/ICPE-CA samples) could not be investigated morphostructurally, because the hybrid layer is not adhered to the substrate and after drying peel total.

The measurements performed on the half-cell systems shows that the highest values of the electric double layer capacity, determined by circular regression from the electrochemical impedance spectroscopy tests, are obtained for the OL304 electrode with Fe catalyst, CNT and PPy (372,8 mF/cm^2).

Three types of supercapacitor assemblies were built.

Charge-discharge tests done on a full-cell type configuration revealed that asymmetric supercapacitors with gel electrolyte shows the highest values of the capacity determined from loading and unloading curves (the average value being about 3000 mF).

REFERENCES

[1] F. Beguin, E. Frackowiak, *Supercapacitors: Materials, Systems, and Applications*, Wiley-VCH, Weinheim, 2013.

[2] D. Zhao, Y. Wang, Y. Zhang, *Nano-Micro Letters* 3(1) (2011) 62-71.

[3] A.B. Dalton, S. Collins, E. Munoz, J.M. Razal, V.H. Ebron, J.P. Ferraris, J.N. Coleman,B.G. Kim, R.H. Baughman, Nature 423 (2003) 703.

[4] R.H. Baughman, A.A. Zakhidov, H. De, A. Wait, Science 297 (2002) 787–92.

[5] K.H. An, W.S. Kim, Y.S. Park, Y.C. Choi, S.M. Lee, D.C. Chung, et al., Adv. Mater., 13 (2001) 497–500.

[6] M. Hughes, M.S.P. Shaffer, A.C. Renouf, C. Singh, G.Z. Chen, D.J. Fray, et al., Adv. Mater. 14 (2002) 382–385.

[7] Hui Pan, Jianyi Li, Yuan Ping Feng, *Carbon Nanotubes for Supercapacitor, Nanoscale Res Lett.* 5, 654 (2010).

The research was financed by the MNT ERA-NET Programme, contract no. 7-053/2012 (4282/2012).

TRANSNATIONAL COOPERATION PROGRAMME (SEE)

Promotion of financing innovation in South-East Europe – PROFIS

ABSTRACT

The project Promotion of Financing Innovation in South East Europe is funded by the Transnational Cooperation Program South-East Europe. The project objective is to create a transnational framework, at the level of South East Europe to finance businesses that are based on innovative projects in the early stages, when financial needs are high and may not be covered by bank loans.

INTRODUCTION

Starting a business that is based on an innovative idea is made with the high costs caused by prototype construction and testing, followed by implementation of the new product and its market launch. The main goal of the project is to develop new skills and capabilities in financing innovative businesses in the early stages. The project objectives:

- creation of a regional network of public and non-profit actors to facilitate transnational technology transfer and financing of innovative projects;
- creating a transnational network in the South East Europe, and a platform of support innovation providers, to act as a tool for the exchange of ideas, experiences and best practices.

Research staff of the project

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Eng. Gabriela Obreja

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RESULTS AND DISCUSSIONS

One of the objectives of PROFIS project was the development of skills and capabilities of the intermediary organizations in early stage funding of innovative businesses. In this way, the project partners have organized two training sessions about promotion of women inventor / entrepreneur and development of capacity to provide specific services to spin-offs and start-ups in their effort to ensure early stage funding of innovative businesses. The materials of these two training sessions were topics of discussion at two workshops organized by ICPE-CA.

Another direction of activity was the updating of data from the National Report on the financing of innovation. The updated report was validated in a workshop.

PROFIS project had as a final objective to organize a competition of innovative business ideas in the

South East Europe. In this context, each project partner organized in his country / region a contest of innovative business ideas. In Romania this contest was launched on June 2 and was completed on October 20 2014. ICPE-CA has ensured the widest possible dissemination of information relating to this contest, by press releases posted on more than 15 sites. He also identified individuals with skills and entrepreneurial experience to assess innovative business ideas.

In the final phase of the national competition were presented 11 business plans, two of which were considered based on ideas that have a market with growing potential.

In the final competition, which took place in Budapest on December 2, 2014. The international jury, with the participation of an Romanian evaluator, selected by ICPE-CA, had accorded an award of a Romanian competitor. The prize was called "***The best green idea***" and business idea was "***Cloud platform for integration of renewable energies for the next generation of smart grid solutions***".

The research was financed by the Transnational Cooperation Programme SEE, contract SEE/D/0233/1.2/X - PROFIS (4291/2013).

JOINT OPERATIONAL PROGRAMME "BLACK SEA BASIN 2007-2013"

Integrated Hotspots Management and Saving the Living Black Sea Ecosystem HOT BLACK SEA

ABSTRACT

To foster cross-border partnership for the development of harmonised policy and utilization of scientific studies relevant to monitoring and addressing environmental threats in the Black Sea Basin in the field of land-based sources of pollution.

INTRODUCTION

The project contributes to strengthening the regional cooperation in the Black Sea environment protection.

Lead Partner, National Institute for Research and Development in Electrical Engineering ICPE – CA, Romania

Partner 2 – IPA, TUBITAK-Marmara Research Center, Turkey

Partner 3, Foundation Caucasus Environment – FCE, Georgia

Partner 4, Odessa State Environmental University, Ukraine

Partner 5, Burgas Municipality, Bulgaria

Partner 6, NGO for Sustainable Regional Development and Environment Protection – SuRDEP, Bulgaria

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PhDs. Eng. Stoica Victor, IDT III

EXPERIMENTAL

The project contributes to the knowledge of own experience that countries have in combating of the perturbing factors of environment, the most serious issues that they face, identify "hot spots", creating and testing their methodology, solvings and data priorities.

The main activities of the project are grouped as follows:

GA1: Harmonization of Hot Spots policies;

GA2: Identification, evaluation and prioritisation of hot spots;

GA3: Hot Spots Data Base in support of decision-making and investment planning;

GA4: Increasing sector expertise;

GA5: Dissemination of Knowledge and Best Practices, Public Awareness and Visibility;

GA6: Management and coordination of the Action.

RESULTS AND DISCUSSIONS

GA1:

Promotion of the findings of the Gap Analysis and recommendations for harmonization at the level of relevant authorities (by e-mail and during relevant meetings);

Report on gap analysis of rivers monitoring, needs in harmonization of strategies, recommendations for harmonization (elaborated in cooperation with EuropeAid project);

Promotion of market-based instruments for water pollution control based on examination of International experiences in view of their relevance to the Black Sea coastal states.

GA2:

Collection of data in the beneficiary countries, management of data;

Determination of the areas under largest threat of pollution (update of the knowledge);

Testing of the methodology (selected studies);

Update of Hotspots lists in Georgia and Ukraine;

Verification of the updated lists in Romania, Bulgaria and Turkey.

GA3:

Report on availability of data verification, options for sustainable use of the Data Base, development of the ownership of the data base to provide for its sustainable use of the product. Report on the data availability and serious gaps which need urgent attention. Communication of the report at the level of relevant authorities;

Development of the Hot Spots Data Base, testing, further development of ownership, population with data.

GA4:

To organise and carry out one training for project partners;

To organise and carry out one stakeholder consultation meeting.

GA5:

Regular preparation of information for the web portal, and organization of joint events back to back with Black Sea Day, World Water Day and others. Support to the Project web page maintenance. Postings on web portals of networks and on the web page of the project regularly provided;

Cooperation with existing networks like Black Sea NGO Network, Black Sea Economic Cooperation (BSEC), Permanent Secretariat of the Black Sea Commission, Danube Commission (ICPDR), UNEP (GPA), DABLAS, etc.;

Preparation of newsletters and educational materials for enhancing of public participation in hot spots management and awareness at the level of school children and students.

GA6: Management and coordination of the project.

The main results are:

Harmonise river monitoring programmes;

Harmonise of methods for Hot Spots identification and prioritisation;

Update the Lists of Hot Spots based on common Methodology;

Provide data/information management tool to support decision-making in the field of Hot Spots management;

Share competencies to increase capacity in hot spots management embracing the adaptive approach and market-based instruments for pollution control;

Increase public awareness and stakeholders participation in decision-making related to hot spots.

CONCLUSIONS

Promotion of innovation and exchange of good practices in the field of scientific and technical competencies and capacities for environmental protection and conservation;

Harmonization of hot spots identification and prioritization advanced;

Facilities for harmonization of river monitoring programmes;

Providing data/information management tool in support of decision-making in the field of hot spots management provided;

Increasing of expertise in LBS pollution management sector;

Increasing public awareness and stakeholders participation.

The research was financed by Joint Operational Programme "BLACK SEA BASIN 2007-2013", contract MIS-ETC 2303/2013.

ROMANIA-BULGARIA CROSS-BORDER COOPERATION PROGRAMME 2007-2013

Clean Access in Calarasi-Silistra Cross-Border Area

ABSTRACT

The project aims to improve the accessibility in Calarasi-Silistra cross-border area by promoting joint clean and energy-efficient road and river transport systems and to improve cross-border policy coordination among local public administrations. By these means, better transport services for the citizens from cross-border area will be created, and accessibility and mobility of people and goods will be improved. Due to the implementation of innovative technologies within the joint transport system the project objectives will be achieved with minimum effects on the environment.

INTRODUCTION

In order to create the premises of a successful implementation of a clean transport system in Calarasi-Silistra cross-border area, having two components – road and river – it have been elaborated two thorough studies, regarding the possibilities to use renewable energy to create a clean and energy-efficient transport system and ways to increase the energy efficiency by using renewable energy sources. These studies are the bases of the technical design of the tailor made clean transport system for Calarasi-Silistra, the solution being adapted to the specificity of this area.

For the road component of the two cities' transport system, it has been analyzed the existing situation (busses, routes, their length, frequency, number of passengers, maintenance expenses, etc), the existing electric vehicles for public transport, their consumption, autonomy and maintenance costs. Based on this analysis have been crystallized both the proposals regarding possible routes of the public transport suitable for electric vehicles implementation and the types of vehicles to be used and the costs associated to their operation.

Moreover, in order to create the prerequisites for achieving the transport system's river component (linking Calarasi and Silistra cities), based on the new studies, the technical characteristics of the equipment (ecological boat, pontoon) have been reanalyzed.

For the awareness and information of people living within the cross-border area on the effects of the new type of transport system on the environment, an information system will be deployed on each bank of Danube River, its energy being ensured by a wind turbine and photovoltaic panels.

Research staff of the project

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Ec. Ionica Sisu

EXPERIMENTAL

In order to choose the most suitable location for wind turbine deployment in Calarasi, the wind measurements have been repeated in Central Park – Calarasi and a new series of measurements has been carried out in Chiciu, in the proximity of Danube crossing point. Thus, based on this new series of measurements, Chiciu has been selected as the location for deploying the wind turbine.

Fig. 1. Measurements at Călăraşi

Fig. 2. Measurements at Chiciu

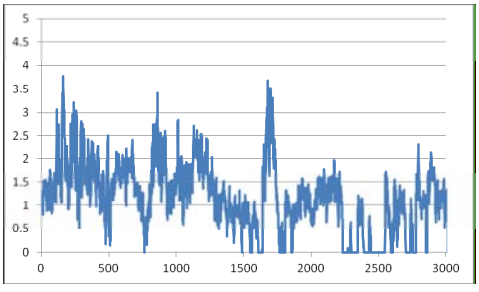

Fig. 3. Registered values at Chiciu

Although the wind potential is relatively low, this location was chosen due to the more constant wind and due to the fact that it is situated in the proximity of the Danube crossing point, ensuring the best premises to increase the public awareness on the positive effects of renewable energy sources use.

RESULTS AND DISCUSSIONS

In order to promote the project and its results, two conferences were organized, to which attended both representatives of the partners involved in the project and representatives of private companies involved in the implementation of electric transport. One conference was held in Silistra on October 8th, 2014 and one in Calarasi on October 9th, 2014. Besides the presentations made during the conferences, demonstrative tests of electric vehicles (electric bicycle and electric car) were also made. These electric vehicles may represent an alternative of the classic transport.

Fig. 4. Images from the conferences

Taking into consideration that the project is also aiming to jointly develop (by both Romanian and Bulgarian sides) a series of documents necessary for the development of clean transport services in Calarasi-Silistra cross-border area, a common strategy for road and river public transport based on electric propulsion was elaborated. The strategy encloses aspects related to the existing transport system and its characteristics, the touristic potential of the area, its main attraction points and suitable areas for eco-tourism, modern solutions for public transport, technologies and solutions recommended for implementation. Moreover, the strategy encloses special sections related to equal opportunities, sustainable development, effects of the classic transport system on environment, climate change.

The developed strategy was debated during a technical workshop held in Silistra, on August 28th, 2014. To this debate participated: members of the previously established Joint Working Group, representatives of partners and of public and private institutions involved in local transport, being also decision makers at local and regional level.

Fig. 5. Opening session of the workshop

Also, for monitoring the solar radiation, wind velocity and air temperature, a monitoring system was deployed in Silistra, on Danube bank, in order to determine the overall efficiency of the wind turbine and of the solar station to be installed. The processed collected data are available at: http://www.sunnyportal.com/Templates/PublicPageOverview.aspx?page=a3fd5b3f-27f4-48d7-b45a-6bb5bc2c5b77&plant=49a9bc6f-5936-4eba-a0f6-a61548fd43b8&splang=en-US

Fig. 6. Images from the workshop

CONCLUSIONS

The project will end during 2015 with two demonstrative ecological boats powered by renewable energy sources. These boats will improve the accessibility in cross-border area, will ensure the access in protected areas and will increase the people awareness regarding new and ecological solutions for an improved life quality, by constituting evidence of innovative technologies implementation in transport services.

The research was financed by Romania-Bulgaria Cross-Border Cooperation Programme 2007-2013, contract MIS-ETC Code 118 (4295/2013).

JOINT SCIENTIFIC COOPERATION ROMANIA - RUSSIA

Study of transparent conductive films of zinc oxide doped with aluminium

ABSTRACT

The project aims is to study the structural and optical properties of ZnO doped with Al - AZO thin films (obtained from not sintered target), textured by wet chemical etching (at room temperature) with potential applications as transparent electrodes in solar cells. In this stage, surface texturing effects were studied on the structural and functional properties of AZO thin films. Surface texturing was carried out with an acid solution of CH_3COOH at room temperature.

INTRODUCTION

In recent years, transparent conductive oxide (TCO) based on ZnO have aroused the interest of researchers because of its remarkable proprieties for applications in optoelectronics. In this studies the research are conducted to obtain thin film with optimal optical and electrical properties for different applications. By doping with group *III A* elements (Al, Ga and In) was observed improve thermal stability and electrical properties.

Transparent conductive oxides, ZnO, have been revealed from research that aimed to replace tin-doped indium oxide (*ITO*) of optoelectronic devices because of its high cost [1-3]. Researching ZnO have attracted attention because of low cost, chemical stability and because it is non-toxic. Have also been taken into consideration the optical and electrical properties of these semiconductors. Although, these materials are studied, there remain significant challenges to improve its properties, including: development of new deposition technique allowing deposition at low temperature (~ 25°C), the processing of large-area flexible substrates but also control the morphology of these films [4].

For this reason research are necessary to improve the technology of preparation of targets, determining the optimum parameters for the deposition but also the texture of the AZO thin films.

Research staff of the project

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PhD. Eng. Magdalena Lungu, Senior Researcher II

EXPERIMENTAL

During this stage, surface texturing effects were studied on the structural and functional properties of *AZO* thin films. *AZO* films were subjected to surface texturing using acid solution at room temperature. For this purpose we used an aqueous solution of a weak acid, acetic acid 5.0% (CH_3COOH) to obtain a high density of craters, sharp form on the surface of *AZO* thin layer. Texturing time was kept constant at 10 seconds. All stages of the texture were performed at room temperature after each immersion the sample was washed with deionised water and dried in stream of nitrogen. *AZO* films as deposited and textured were subjected to characterization in terms of morphological (SEM), the structure by X-ray diffraction, optical spectrophotometric analysis by UV-VIS-NIR, and the film thickness by profilometry.

RESULTS AND DISCUSSIONS

Samples were analyzed to determine the thickness of layers using *VEECO* Profilometer (computer with high sensitivity for surface profiling and determining roughness).Were determined from the analysis the thickness of *AZO* thin films before and after texturing. Following this analysis it was found that the process of texturing reduces the thickness of the films with an average value of 100 nm.

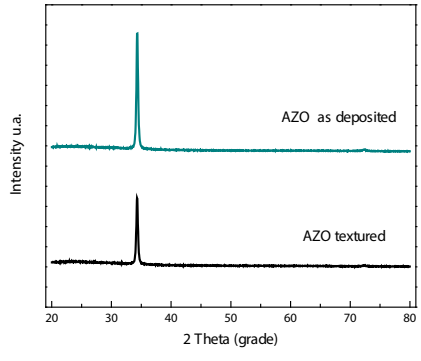

Fig. 1. X-ray diffraction spectra for as deposited and textured AZO thin films

For as deposited and textured *AZO* films was performed X-ray diffraction analysis using Bruker-AXS X diffractometer D8 Advance type. The measurement parameters: X-ray copper anode tube, 40kV/40mA,

kβ Ni filter, 0.04° step, 2s point measurement, measuring range 20-80°. In Figure 1 are presented the X-ray diffraction patterns for as deposited *AZO* thin films and textured with diluted CH_3COOH. For these samples can be observed a peak at 34,4° plan (002) which implies the existence of ZnO hexagonal structure with high crystallinity and c-axis preferentially oriented. Also, there can not be seen peaks for Al_2O_3 or the phase related to that, which means that aluminum replaced zinc in hexagonal structure. It can be seen that the intensity peaks decrease with film texture, which involves the decrease the crystallinity, that is, a reduction in the quality of the *AZO* thin film (appearance of surface defects).

This is because of the appearance of craters which introduce a "disorder" on *AZO* film surface.

Scanning electron microscopy analysis was performed by workstation crossbeam (*SEM-FIB*) - Zeiss Auriga, and the images obtained were performed to a magnification of 25000x, fig. 2.

Following the microscopy analysis, it was observed that the *AZO* thin films shows craters all over textured sample (Fig. 2). Also, it can be seen that the craters do not have symmetry, and the results of different diameters.

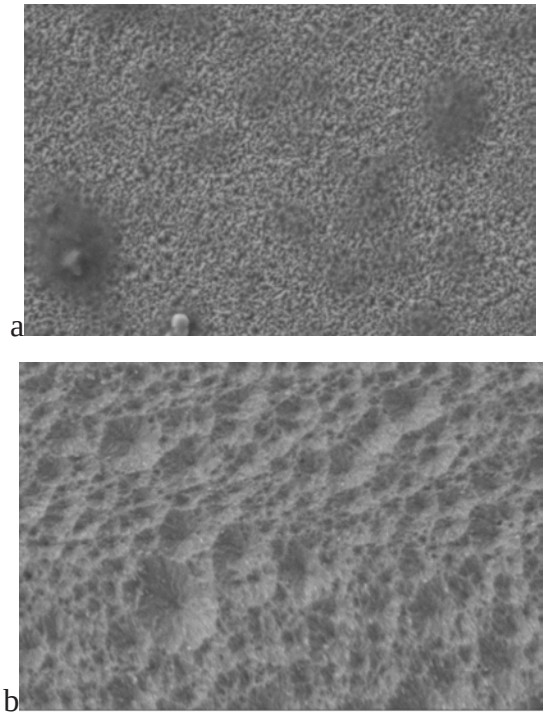

Fig. 2. SEM image of as deposited (a) and texturated (b) AZO thin film

Optical characterization of as deposited and textured *AZO* films was performed with UV-VIS-NIR spectrophotometer JASCO 570. This analysis for plotted optical transmission and reflection spectra was carried out at room temperature for wavelengths between 400-800nm (visible) with a step of 2 nm.

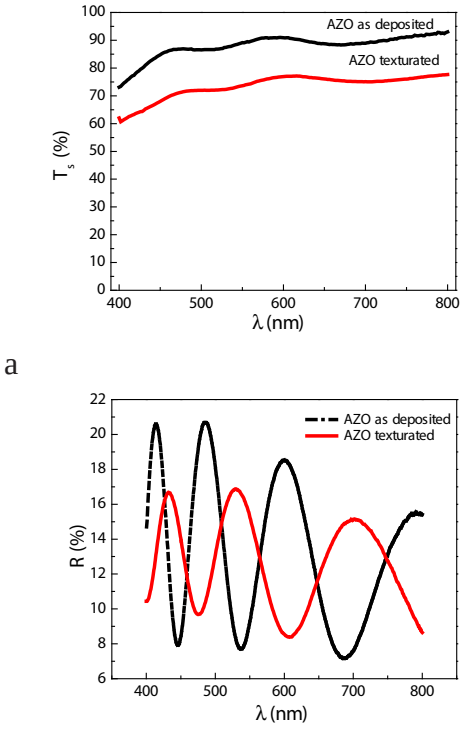

Fig. 3. Optical transmission (a) and reflection (b) for as deposited and textured AZO thin films

The decrease of optical transmission (Figure 3 a) of the *AZO* thin films after texturing is due to increased transmission by diffusion because of the existence of craters, producing regions of different refractive indices. Reflectance spectra of *AZO* thin films before and after texturing, were made in the spectral range 400-800nm. After texturing of the *AZO* thin films results a decrease in reflectivity by 5% (Figure 3 b). This indicating that the *AZO* films textured with CH_3COOH solution is more efficient in trapping light.

CONCLUSIONS

The experimental study was carried out in order to identify the changes in the properties of the *AZO* thin film according to the texturing process with acid solution. *AZO* thin films have been subjected to texturing at room temperature in 5.0% CH_3COOH acid solution for 10 seconds.

Following the study conducted was revealed the following:

- the analysis of *X*-ray diffraction, it was found that textured *AZO* thin film maintained wurtzite structure, but the the crystallinity of the film is decreased;
- according to SEM images, the whole surface of *AZO* film is covered with craters of different diameters;
- the optical properties of the *AZO* film is influenced by the texturing process; the appearances of the craters on the film surface lead to areas with different

refractive indices, resulting a reduction of optical transmission with 15%;

Considering of the foregoing, it is found that the experimental studies for texturing *AZO* thin films have brought important additional information, for developed a process for texturing with acidic solution (CH_3COOH).

REFERENCES

1. E.Fortunato, D.Ginley, H. Hosono, D.C.Paine, *Transparent conducting oxides for photovoltaics*, MRS Bulletin 32(3), p. 242-247 , 2007.

2. B.G.Lewis, D.C.Paine, *Applications and processing of transparent conducting oxides*, MRS Bulletin 25(8), p. 22-27, 2000.

3. E. Fortunato, A. Gonçalves, A. Pimentel, P. Barquinha, G. Gonçalves, L. Pereira, I. Ferreira, R. Martins, *Zinc oxide, a multifunctional material: from material to device applications*, Applied Physics A 96, p. 197–205, 2009.

4. FCT Systeme GmbH, Gewerbepark 11 96528 Rauenstein / Germany (Germania), *Manual cu instrucțiuni de utilizare system SPS*, 2009.

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Study of thin films perovskite type for cathodes IT SOFC

ABSTRACT

The proposed project is based on analyzing the behavior of perovskite materials the cathode for the solid electrolyte fuel cells of intermediate temperature (600 - 800°C) in a cell IT SOFC electrolyte / electrode. In this stage were processed perovskite materials from deposition the thin layers on a support electrolyte.

INTRODUCTION

Solid electrolyte fuel cells (SOFC) are electrochemical systems for direct conversion of chemical energy of a fuel into electrical energy at high temperature. Like any fuel cell, SOFC cell type consists of two separate compartments for continued access of a fuel and oxidant, respectively. In the working operation is the production of electrochemical reaction of a burning the fuel at high temperature. SOFC's that have all components ceramic operating at high temperature 900 –1000° C [1-3].

Current trends aimed at reducing operating temperature of the fuel cell that works at the 600-800°C (IT-SOFC). A decisive factor for the development of these cells is to increase the electrochemical activity of the electrodes, in particular at cathodes [3-6].

The ceramic materials most commonly used for SOFC cathodes are oxide compounds with perovskite phase structure [7-10].

The theme of the project is to provide an electrically conductive ceramic perovskite materials for the cathodes SOFC IT. Objectives execution phase are:

- the cathode materials SOFC processing
- the achievement of targets for thin-layer deposition of the cathode
- the achievement the cathode as a thin layer of electrolyte on substrate by magnetron sputtering; the characterization of complex a the ceramic materials by: X-ray diffraction, scanning electron microscopy; the structural characterization of thin layers of the cathode by the atomic force microscopy and technique of interference fringes with an interferometer.

Research staff of the project

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EXPERIMENTAL

In the project phase we experimented a micro and nanostructured system a type $La_{1-x}Sr_xMnO_3$, (x = 0.2) the composition was calculated in %mole, where the lanthanum was partially replaced with strontium.

➢ **The cathode $La_{0,8}Sr_{0,2}MnO_3$ processing – way of working**

The method of processing the powder of the cathode was achieved starting solid state reactions.

The composition $La_{0,8}Sr_{0,2}MnO_3$ (LS2M) was prepared from the oxides and carbonate (Fluka with 99.8% purity La_2O_3, Fluka with 98% purity $SrCO_3$, Merck with 95 % purity MnO_2).

The raw materials were measured gravimetrically and the sample was homogenized wet in the ratio of

dry material to water balls equal to 1: 2: 2, for 10 h. After drying the material at 105°C for 4 h, the powder was granulated on a 0.8mm and 0,41mm sieve and the powders was briquetted and pre-sintered at 900°C for 2 h. After the pre-sintering the material was wet milled for 16 h in a ball mill and then dried in an oven at 105°C for 4 h.

➢ **Processing cathode targets - way of working**

For processing the cathode target was used $La_{0,8}Sr_{0,2}MnO_3$ (LS2M) powder obtained by solid state reactions. The steps of obtaining the cathode targets were as follows:

1. Preparation of the powder; LS2M powder was mixed with a binder and then granulated on the sieve of 0.8 mm.
2. The pressing; to obtain the target the powders was uniaxially pressed at 140 kg / cm^2 on a hydraulic press at Ø = 60 mm
3. The drying targets; targets obtained was dried in air and then in an oven up to 110°C for 2 h.
4. The sintering targets; the targets were dry was heat-treated in an electric furnace at a temperature of 1150 °C, 1170°C, 1190°C for 2 h at the maximum temperature.
5. The processing targets; to obtain perfectly flat surfaces, the targets were processed by polishing.

➢ **Achieving the cathode layers**

The cathodes in the form of thin layers were made by spray technique with a magnetron sputtering apparatus MAGSPUT 4G2-DC Torr International.Inc.

1. The preparation of substrate

The experimental was used for deposition the silicon wafers LS2M and the discs of electrolyte.

As a substrate electrolyte used was two composition of the electrolyte, $SrO-Y_2O_3-CeO_2$ (E3) şi $CaO-SrO-Y_2O_3-CeO_2$ (E4), with Ø = 43 mm, sintered at 1450°C for 2 hours.

2. The deposition cathode layers

The parameters used during deposition were:

- Working pressure = 2.2 x 10^{-3} mbar;
- Working distance (or the distance between the target and substrate) = 10 cm;
- Gas flow, argon = 450 sscm;
- Substrate temperature 60°C;
- Deposition velocity = 0.3-0.5 A / sec.

The temperature of electrolyte substrate was varied from room temperature to 500°C. The RF power of the equipment was maintained at 37 W, in order to avoid damage to the target. LS2M layers sprayed of the discs E3 and E4 were then sintered at 900°C for 2 h with a heating rate of 10°C / min.

RESULTS AND DISCUSSIONS

Determining the characteristics of structural

The X-ray diffraction analysis resulted in the formation of compounds at the interface of the cathode depositions on the electrolyte E3 and E4 substrate.

Results and discussion:

The diffraction patterns of Figures 1 and 2 for the electrolytes E3 and E4 show the specific lines of a solid solution fluorite type structure which indicates that the calcium and yttrium oxides entered the network cerium dioxide.

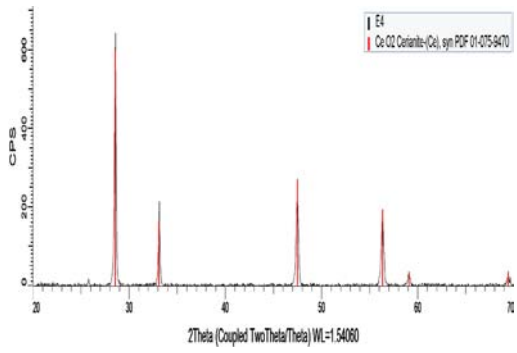


Fig. 1. The diffractogram of the E3 support

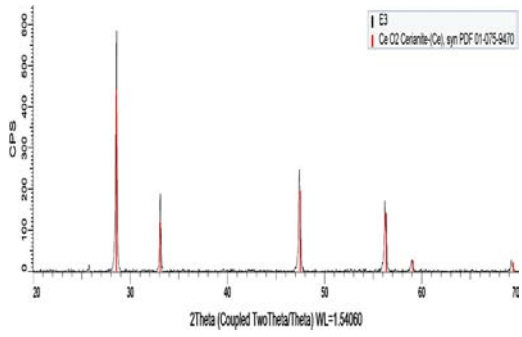


Fig. 2. The diffractogram of the E4 support

The Fig. 3 show the LS2M diffraction, lines for the compound is observed and slight traces of perovskite-type manganese oxide.

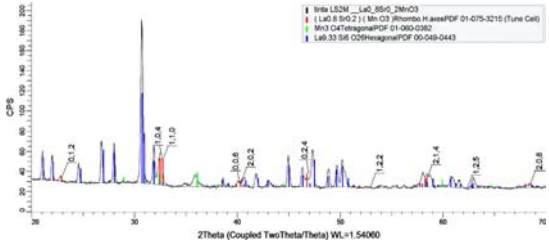


Fig. 3. The diffractogram target cathode for deposition LS2M

The diffractogram LS2M deposit on ceramic substrate is shown fig. 4.

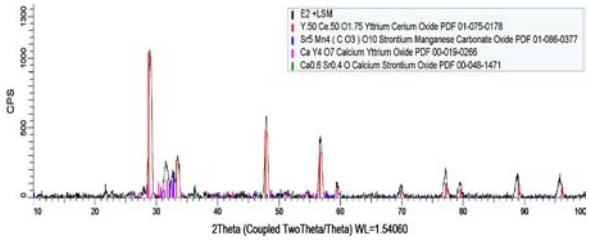


Fig. 4. The diffractogram target cathode for deposition LS2M /E4

Determination of thickness of layers deposited on the electrolyte substrate.

With a device type NT-100 Optical Profiler Vecco based interferometer was determined LS2M thick layer deposited on the cathode electrolyte E3 and E4 substrate. The measurements were carried out at the limit of the difference between the deposit and the substrate. The device is equipped with a microscope Wyco NT1100.

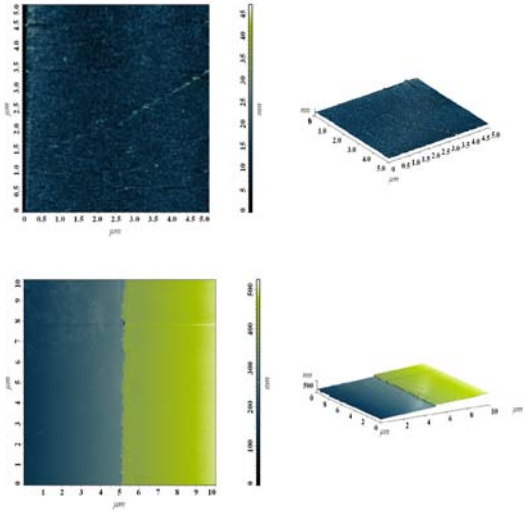
Measurement results:

- deposition LS2M substrate on E3, the average thickness is h = 5,033μm and average roughness is Ra = 1,6μm.

- deposition LS2M substrate on E4, the average thickness is h = 9,24μm and average roughness is Ra = 1,12μm.

The deposits made on silicon wafer were measured using the atomic force microscope instrument type Ntegra Aura (NTMDT Russia).

The results obtained are shown in the following figures:



The thickness of the deposits is approximately 100 nm, and the roughness calculated on the surface of 5μm x5μm: Root Mean Square, Sq = 2.01378 nm.

CONCLUSIONS

The main conclusions drawn from activities carried out in this phase are:

1. by solid state reactions was processed the perovskite cathode composition $\boldsymbol{La_{0,8}Sr_{0,2}MnO_3}$ (LS2M);

2. from the powder were prepared LS2M cathode targets;

3. the cathode targets were characterized physical, structural and microstructural. The specific properties of the composition were performed on LS2M cathode that porosity of 14-34% depending on the sintering temperature and specific perovskite structure.

4. we achieved with thin film deposition on the silicon wafers and the substrate electrolyte by magnetron sputtering. The substrate electrolyte was processed as Ø = 43 mm discs from two electrolyte compositions, SrO-CeO2-Y_2O_3 (E3) and CaO-SrO-CeO2-Y2O3 (E4);

5. the thin layers achieved were characterized by point of view structural and determinations were achieved for the layer thickness and surface roughness. LS2M sample E3 substrate has average thickness a layer a 5,033μm and roughness 1,6μm. LS2M sample E4 substrate has layer thickness average 9.24μm and 1,12μm roughness, this is explained by the longer duration LS2M deposition layer on the support.

6. the project will continue with the deposition of new layers of perovskite cathodes based on lanthanum manganite with dopants such as Co, Sr, Fe

REFERENCES

[1] Mark C. Williams, Joseph P. Strakey, Wayne A. Surdoval, *Solid oxide fuel cell technology development in the U.S*, Solid State Ionics 177, 2006, pp. 2039-2044

[2] EG&G Services Parsons, Inc. Science Applications International Corporation, U.S. Department of Energy Office of Fossil Energy National Energy Technology Laboratory, P.O Box 880 Morgantown, West Virginia 26507-0880, *Fuel Cell Handbook* (Fifth Edition), October 2000, cap. 8.1, pp. 175-198

[3] Devtlev Stover, Hans Peter Buchktemer, Frank Tiez and Norbert H. Menzler, *Solid Oxide Fuel cells (SOFCs) - the everrlansting challenge for high performance ceramics*, 2th International Congress On Ceramics -ICC2 Proceedings Verona, Italy, 2008

[4] N P Brandon, *Materials Engineering for Solid Oxide Fuel cell Technology*, Materials Science Forum, 2007, vols. 539-543, pp. 20-27

[5] B.C.H.Steele and A.Heinzel, *Materials for fuel-cell technologies*, Nature, 2001, 414, pp. 345-352

[6] Mark Wiliams and H.Quedenfeld, *Fuel Cell Handbook*, Seventh Edition by EG&G Services Parsons, Inc. Science Application International Corporation, November 2004

[7] Vladislav V. Kharton, Andrei V. Kovalevsky, Mikhail V. Patrakeev, et al, *Oxygen Nonstoichiometry, Mixed Conductivity, and Mössbauer, Spectra of $Ln_{0.5}A_{0.5}FeO_3$- (LnLa-Sm, A)Sr, Ba), Effects of Cation Size,* Chem. Mater.2008, 20, pp. 6457–6467

[8] V. Thangadurai, W. Weppner, *Development and investigation of perovskite (ABO_3)-type oxides for power generation,* Ionics, 2002, Volume 8, Issue 5-6, pp. 360-371

[9] Mette Juhl Jørgensen, *Lanthanum Manganate Based Cathodes for Solid Oxide Fuel Cells,* Thesis Keele University, UK, July 2001

[10] San Ping Jiang, *Development of lanthanum strontium manganite perovskite cathode materials of solid oxide fuel cells: a review,* J Mater Sci (2008) October 2008 **43**, pp. 6799–6833

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Studies of shape memory alloys by neutron diffraction

ABSTRACT

The aim of the project is to present some investigation of NiTi and NiTiCu shape memory materials obtained at INCDIE ICPE CA in order to identify the precipitates from their microstructure.

The objectives of this project are the microstructural and mechanical characterizations specific to these materials, in order to solve the problems appeared in experimental and theoretical studies from shape memory alloys domain.

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Eng. Alexandra Bratulescu

INTRODUCTION

NiTi and NiTiCu alloys are categorized as shape memory alloys (SMA) and have a widely expected use in the medical industry (the orthopedic implants, surgical tools, including implants inside the blood vessels), automotive (actuators systems safety), aeronautics and space. The chemical composition of this alloy is: 49-51% Ti, Ni rest.

Shape memory alloys have the property to return to their original shape by changes of temperature. Key features of the SMA are: shape memory effect (simple, double and triple effect) and pseudoelasticity (PE). Shape memory effect (SME) is a thermo-mechanical effect, whereas PE is a mechanical effect. Therefore, after applying a mechanical strain on a SMA sample, EMF will be active just in case of acting on the sample with a heat source. Then it will return at its original shape. In case of PE, the SMA sample will have a particular form after applying a mechanic strain. After removing the mechanical strain, the sample returns to its original form.

From the point of view of the material characteristics, its properties are dependent on: the transformation temperatures, the alloying conditions and the alloy microstructure [1-11].

EXPERIMENTATIONS

For reaching the objectives proposed for 2014, were performed the following activities:

♦ It was designed and realized experimental models of NiTi and NiTiCu shape memory materials by: homogenization of powders blending – mechanical milling – pressing-sintering by Spark Plasma Sintering (SPS) at different temperatures and compositions (see table 1), all the processes taking place in controlled atmosphere;

Table 1. Technological parameters for achieving NiTi and NiTiCu samples

Samples code	Composition (wt. %)			Mechanical Alloying (MA) (h)	Sintering temperature (°C)		Holding time (min)
	Ni	Ti	Cu		*only sintering*	*with step sintering*	
A1	56.54	43.46		-	850	-	5
A2	56.54	43.46		-	850	500	5
B1	56.54	43.46	-	15	850	-	5
B2	56.54	43.46	-	15	850	500	5
S1	43.65	44.53	11.82	-	850	-	5
S2	43.65	44.53	11.82	15	850	-	5

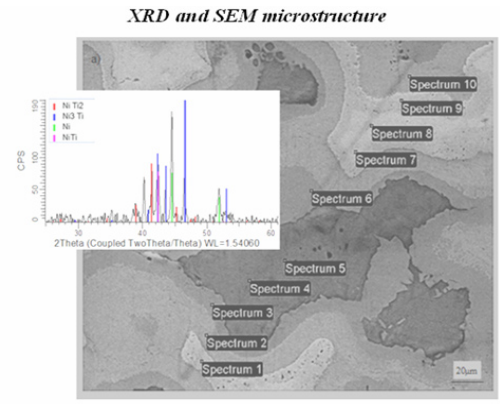
♦ There were characterized the experimental models of NiTi and NiTiCu shape memory materials from the point of view of microstructural and mechanical properties.

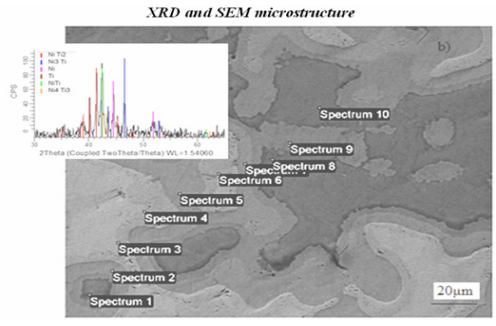
RESULTS AND DISCUSSIONS

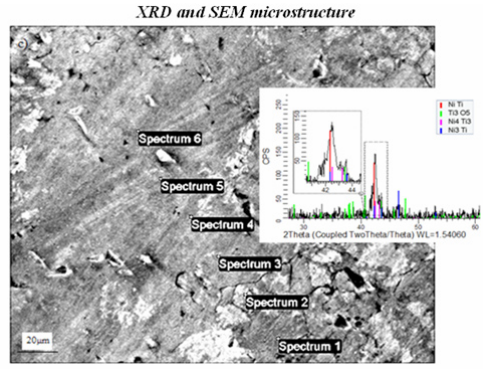
NiTi and NiTiCu shape memory materials:

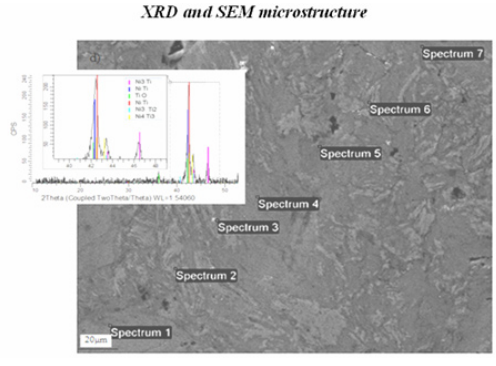
The samples were characterized from microstructural and mechanical point of view by X-rays diffraction, SEM, EDX and nanoindentation, using equipments from the institute.

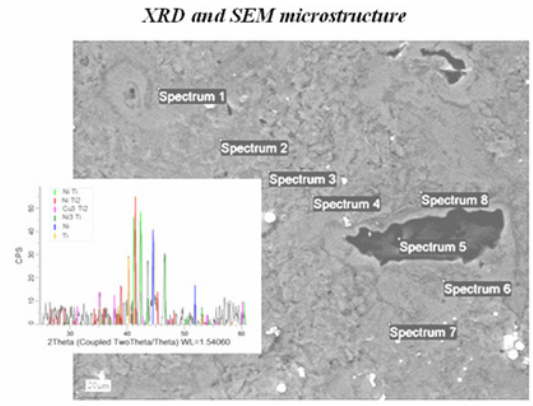
♦ An examination of the X-ray diffraction patterns revealed that in the structure of NiTi and NiTiCu materials, the predominant phase is NiTi cubic (austenitic type) the peak position corresponding to the {110}B2 crystalline plane. Also, the results show that there are many types of precipitates present in the microstructure of all the NiTi and NiTiCu samples like: Ni, Ti, Ni_4Ti_3, $NiTi_2$, Ni_3Ti, (Ni,Cu)Ti, $(Ni,Cu)_3Ti_2$, $(Ni,Cu)Ti_2$. These compounds were also confirmed from EDX analysis.











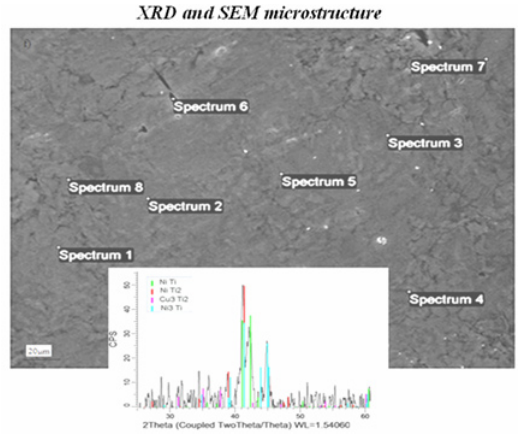


Fig. 1. X-ray diffraction patterns and EDX and SEM analyses

♦ The analysis method of Oliver and Pharr was used [10] to determine Vickers hardness (HV) and Young's modulus (E). Eight measurements were made on each sample and the average results are presented further in table 2.

Table 2. Results obtained for Vickers hardness (HV) and Young's modulus (E)

Sample code	Vickers hardness (HV)	Young's Modulus, E (GPa)
A1	328±21.85	79±1.39
A2	266±14.40	84±3.45
B1	428±21.75	45±3.30
B2	335±25.20	57±2.89
S1	803±17.40	95±4.97
S2	659±31.11	97±3.83

The results obtained are presented in the table above and in figure 2a and 2b are shown the evolutions of the Vickers hardness and Young's modulus. These results are in accordance with other results from the literature (11).

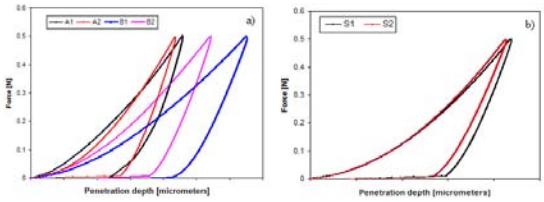


Fig.2. Evolutions of the Vickers hardness and Young's modulus

Some scientific results of the researches conducted within this project were presented as follows:

- Oral presentation at the 3rd International Conference, ADVANCES IN ENGINEERING & MANAGEMENT, ADEM 2014, of the paper ***"Shape memory NiTi and NiTiCu alloys obtained by spark plasma sintering process "***, C. D. Cirstea, M. Lungu, A. M. Balagurov, V. Marinescu, O. Culicov, V. Cirstea.

- Patent application ***Process for the production of semi-finished NiTi shape memory materials,*** authors: C. D. Cirstea, M. Lungu, Ion Ioana, G. Sbârcea, N. Stancu.

CONCLUSIONS

The conclusions are:

- Were used two techniques for processing the mixtures of homogenized powders either mechanically or by mechanical alloying:
  - Pressing and simple spark plasma sintering (SPS) at T = 850°C
  - Pressing and spark plasma sintering in steps at T_1 = 850°C and T_2 = 500°C
- Adding Cu in NiTi alloy led to the increase of hardness
- NiTi and NiTiCu materials can be classified as material of austenitic type.
- Due to the mechanically alloying applied to the NiTi samples (B1 and B2) it was observed that the material revealed improved characteristics from structural and morphologic point of view, as opposed to the other samples A1, A2, S1 and S2.

BIBLIOGRAFY

[1] K. Otsuka and C.M. Wayman, *Shape Memory Materials*, 1st ed., Cambridge University Press, Cambridge, U.K., 1998, p. 27.

[2] Duerig T., Pelton A., Stockel D., *An overview of Nitinol medical applications,* Lausanne: Elsevier Science SA; 1999. p. 149.

[3] C. L. Yeh, W. Y. Sung, *Synthesis of NiTi intermetallics by self propagating combustion*, Journal of Alloys and Compounds, Vol. 376, Issues 1-2, pp. 79-88, Aug. 2004.

[4] M. Bitzer, M. Bram, H. P. Buchkremer, D. Stöver, *Phase Transformation Behavior of Hot Isostatically Pressed NiTi-X (X = Ag, Nb, W) Alloys for Functional Engineering Applications*, Journal of Materials Engineering and Performance, Dec. 2012, Vol. 21, Issue 12, pp 2535-2545

[5] C. Shearwood, Y. Q. Fu, L. Yu, K. A. Khor, *Spark plasma sintering of TiNi nano-powder*, Scripta Materialia, Vol. 52, pp. 455-460, 2005

[6] F. Bernard, S. Le Gallet, N. Spinassou, S. Paris, E. Gaffet, J. N. Woolman, Z. A. Munir, *Dense Nanostructured Materials Obtained by Spark Plasma Sintering and Field Activated Pressure Assisted Synthesis Starting from Mechanically Activated Powder Mixtures*, Science of Sintering, Vol. 36 (2004), pp. 155-164

[7] Mehulkumar S. Patel, thesis *Localized current activated sintering of titanium nickelides*, 2011

[8] M. Omori, *Sintering, consolidation, reaction and crystal growth by the spark plasma system (SPS)*, Mater. Sci. Eng A, Vol. 287 (2000) pp. 183-188

[9]] Ke Chang, Cao Shan-shan, Ma Xiao, Zhang Xin-ping, *Modeling of Ni_4Ti_3 precipitation during stress-free and stress- assisted aging of bi-crystalline NiTi shape memory alloys*, Trans Nonferrous Metals Society of China (2012), Vol. 22, pp. 2578-2585.

[10] G. Fan, Y. Zhou, W. Chen, S. Yang, X. Ren, K. Otsuka, *Precipitation kinetics of Ti_3Ni_4 in polycrystalline Ni-rich TiNi alloys and its, relation to abnormal multi-stage transformation behavior*, Materials Science and Engineering (2006) 622–626

[11] N. Zhou et al.,Acta Materialia 58 (2010) pp 6685–6694

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Investigation of alloyed intermetallic compounds by means of neutron diffraction technique

ABSTRACT

The bilateral cooperation between INCDIE ICPE-CA – Romania and JINR – Dubna – Russia has as purpose the consolidation of scientific cooperation between the both countries and in the frame of this project has as main objective the investigation of alloyed intermetallic compounds using the neutron diffraction technique. The Romanian part was involved in obtaining of material, while the Russian part was involved in their neutron diffraction investigations. It was obtained at micro/nanometric scale the refractory intermetallic compound from the Ti-Ni-X (X = Cu) system by combining the mechanical alloying with the self propagation high temperature syinthesis techniques using the conventional processing routes and plasma sintering techniques

INTRODUCTION

In the Ti-Ni-Cu shape memory alloys with < 10 at% Cu, the martensite transformation is a two stage process which means that the transformation B2-B19 (orthorombic) is followed by the transformation B19-B19', while alloys with more than 10% Cu transform to a B19 martensite by a single stage transformation [1, 2]. These behaviors are of great interests for SMA actuators especially due to their narrow hysteresis which can enhance the response time of such actuation systems. Unfortunately, Cu addition, which exceeds 10 at% spoils the alloy formability, requiring technologies without deformation steps [3].

The lake of plasticity of these alloys was the reason for application of non melting technology in our researches for shape memory alloys manufacturing. In this paper, the obtained results on the synthesized Ni-Ti-Cu alloys starting from elemental powders by combining reactive synthesis and mechanical milling processes, are reported. The manufacturing technologies choose for our materials synthesis were classical powder metallurgy technique and a rapid one, namely SPS. It is expected that this work will bring contributions related with the influence of technological routes and process parameters on the Ni-Ti-Cu SMA properties in order to develop new specific applications.

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Dr. Eng. Magdalena Lungu – MAv Department

Dr. Eng. Diana Cirstea – MAv Department

Dr.Eng. Ioana Ion – MAv Department

Dr.Eng. Andrei Cucoş – DMA Analyses

EXPERIMENTAL

In this phase were made and characterized Ni30Ti50Cu20 type materials using four manufacturing technologies type:

1. Mixtures of 200 grams were weighed according to the chemical composition followed by hand homogenization of the mixture by successive passes on a sieve with a mesh size of 300 micrometres, followed by pressing into a cylindrical die having a diameter of 12 mm at 4 tf/cm^2 pressure and sintering at 870°C for 2 hours in an argon atmosphere of 99.9% purity. Cooling of the samples was performed in furnace and in argon atmosphere.

2. According to the same protocol to obtain powder mixture set to 1, cylindrical samples with a diameter of 40 mm were obtained by plasma sintering at 870°C using Spark Plasma Sintering equipment.

3. The mixture dosed according to paragraph 1 from protocol 1, was placed in a planetary mill and mechanically alloyed for 20 hours at a balls / powder 3/1 ratio of load, and a rotation speed of 250 rot/ min, in an wet grinding environment of petroleum ether and possibilities for change the rotation direction of the mill bowls The mixture thus obtained was subjected to synthesis operations according to the protocol no. 1.

4. The mechanically alloyed mixture according to protocol 3 was subjected to synthesis operations according to protocol 2. We have analyzed the changes in the phase of the Ti50Ni30Cu20 shape memory alloy type, using X-ray diffraction carried out at room temperature. The temperatures of the martensite transformation were studied by differential scanning calorimetry. The martensite transformation evidenced by thermal scanning was discussed in correlation with the relative content of phases in the materials and the process and process parameters used.

RESULTS AND DISCUSSIONS

In the all synthesized materials there are evidenced the reflexions corresponding to the both type of low temperature martensite, namely orthorhombic (B19) and monoclinic (B19'), and an undesirable one, with a

cubic structure of (Ni,Cu)Ti_2 intermetallic compound. Substitution of Cu for Ni has produced a slight change in the lattice parameters of both low temperature phases. This behavior is related with the similarity in atomic radii, ionic radii and electronegativities of Ni and Cu when acting divalently, as have shown by R.H. Bricknell et all. [4]. The type of mixture used for materials processing as well as the processing routes also have a slight influence on the lattice parameters. (Fig. 1). The lattice constants of the monoclinic phase is slightly increase for the all processed materials (Fig. 1 a, and b) when are compared with the 105414-ICSD PDF file.

Conversely, the lattice constants of the orthorhombic phase (Fig. 1c and d) are affected to o very small extent both by the processing route, and by the state of starting materials, showing similarities with the lattice constants from the 99364-ICSD PDF file.

Taking into account the processing routes used for manufacturing of these materials (Fig. 2), it is clear that a reduced time of sintering as is used in spark plasma process, has conducted to the increasing of the amount of the undesirable phase in the sample S which was manufactured starting from the un-milled mixture.

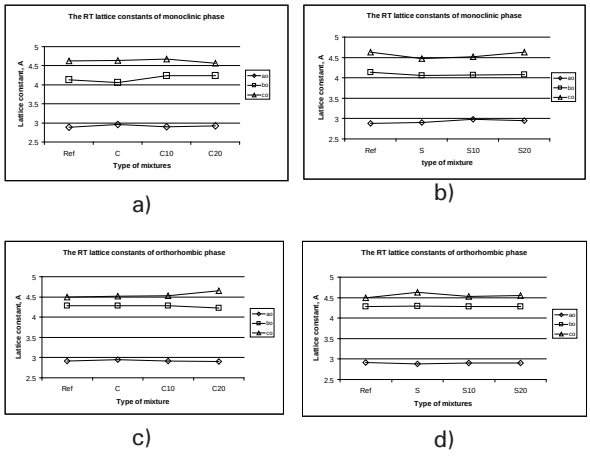


Fig. 1. The room temperature lattice constants of the monoclinic (a, c) and orthorhombic (b,d) phases as a function of the processing route and the state of processed materials (unmilled/milled)

Referring to the (Ni,Cu)Ti_2 non-transformable phase formation, using of activated mixtures for materials synthesis, lead to the increasing of the amount of the non transformable phase in the processed materials, when there are used classical powder metallurgy processes.

When short sintering time are used, as in the spark plasma sintering technology, the activated mixtures contribute to the decreasing of the non-transformable phase amount, producing materials with the highest amount of the phases responsible with the shape memory effect.

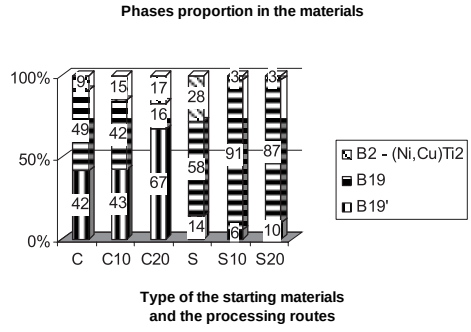


Fig. 2. Phase proportion in the materials as a function of the type of the starting mixture and the processing route

The figure 2 suggests that the processed materials show an inhomogeneous phase distribution, the Cu amount in the transformable phases varying in a large interval. Practically, at room temperature the materials are presented as a mixture of two type of low temperature martensite phases namely B19 and B19' respectively.

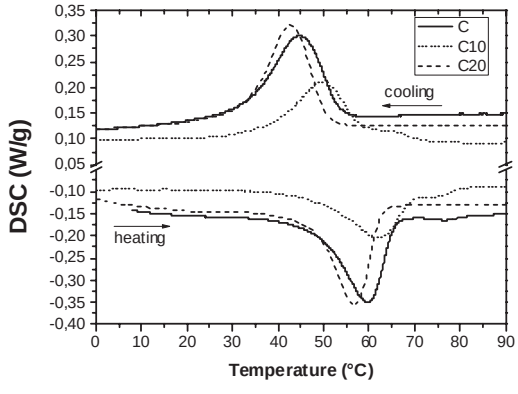


Fig. 3. DSC curves of Ti50Ni30Cu20 alloys classical powder metallurgy processed (C – unmilled, C10 – milled 10 and C20 – milled 20 hours)

The DSC curves obtained upon cooling and heating of processed materials are presented in the Fig.3 for the materials processed using classical powder metallurgy route and in the Fig. 4 for the materials spark plasma processed.

The materials processed via classical powder metallurgy route have exhibited martensitic transformation taking place in one or two steps depending of the type of mixture used for their processing.

Table 1 resume the transformation temperatures, the range of martensite transformation, (Af-Mf), the thermal hysteresis (Af-Ms) as well as the heat of transformation for the materials processed via classical powder metallurgy route. (Samples C).

Table I – Temperatures of martensitic transformation of the materials processed by classical powder metallurgy route

Materials	Ms [°C]	Mf [°C]	As [°C]	Af [°C]	Af-Mf [°C]	Af-Ms [°C]	ΔQ_{A-M} (J/g)	ΔQ_{M-A} (J/g)
C	54	31	46	66	35	12	6.06	-5.838
C10	73	22	33	84	62	11	11.46	-10.71
C20	51	32	47	63	31	12	8.258	-6.629

In the case of materials synthesized using spark plasma sintering route it was observed that by inducing of activation in the materials mixture by mechanical milling, the range of martensite transformation and the all temperatures of martensitic transformation moves to low temperatures, while the thermal hysteresis is kept almost constant, at low values, proper to the cubic to orthorhombic B2-B19 transformation (Fig.4 and table 2).

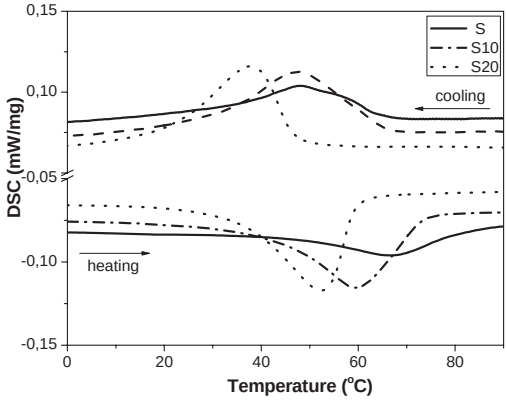


Fig. 4. DSC curves of Ti50Ni30Cu20 alloys spark plasma processed (S –unmilled, S10 – milled 10 and S20 – milled 20 hours)

Table II – Temperatures of martensitic transformation of the materials processed by spark plasma processing route

Materials	Ms [°C]	Mf [°C]	As [°C]	Af [°C]	Af-Mf [°C]	Af-Ms [°C]	ΔQ_{A-M} (J/g)	ΔQ_{M-A} (J/g)
S	64	40	50	80.5	40.5	16.5	2.719	-2.545
S10	65.5	32	45	73	41	7.5	5.283	-5.2
S20	46.5	22	37	59	37	12.5	5.339	-5.403

Although the S type materials have shown a greater quantity of B19, B19′ phases, the heat of transformation is lower than in the case of C samples.

The type of mixture, (un-milled or milled) induces o continuous decreasing of martensite transformation range, while the thermal hysteresis seems to be sensitive to the type and amount of transformable phases.

The thermal behavior of the sintered alloy may also be a consequence of the in- homogeneity of the chemical composition inside of the transformable phases as it was shown by [5]

CONCLUSIONS

The present work shows the influence of the processing route and of type of mixtures on the SMA properties of the NiTiCu materials. The following conclusions can be drawn:

- the mechanical milling technique is a promising alternative procedure to obtain SMA when are used short sintering time route as is spark plasma sintering technology;

- mechanical milling technique assures an improved homogeneity of the mixtures and an appropriate distribution of the elements in the obtained mechano-composite powders which is a guarantee for better material synthesis in the case of spark plasma sintering route adoption;

- during processing of SMA materials via powder metallurgy route, a special attention must given to the working atmosphere in order to reduce the material contamination with oxigen and carbon;

- the both chosen technologies produce a multi-phase type NiTiCu material.

REFERENCES

[1] Madangopal Krishnan, J. B. Singh, *A novel B19′ martensite in nickel titanium shape memory alloys*, Acta mater. 48 (2000), 1325-1344

[2] Young-Hua Li, Li-Jian Rong, Zhong-Tang Wang, Guang-Xia Qi, Cheng-Zhi Wang, *Temperature memory effect of Ti50Ni30Cu20 (at%) alloy*, J. of Alloys and Compounds 400 (2005), 112 – 115

[3] T. Goryczka, J. Van Humbeeck, *NiTiCu shape memory alloy produced by powder technology*, J. of Alloys and Compounds 456 (2008) 194-200

[4] R.H. Bricknell, K.N. Melton, O. Mercier, *The structure of NiTiCu shape memory alloys*, Metallurgical Transactions A, vol. 10A, 1979, 693 – 697

[5] T. Goryczka, *$Ni_{25}Ti_{50}Cu_{25}$ Shape Memory Alloy Produced by Nonconventional Techniques*, published in Shape Memory Alloys – Processing, Characterization and Applications book, edited M. Braz Fernandez, 2013, 53 - 76

The research was financed by the Bilateral Programme Romania – Russia, protocol no. 04-4-1069/2009/2014, contract 28 / 2013

Investigation of crystalline and magnetic properties in micro- and nanostructured systems based granular alloys

INTRODUCTION

The granular magnetic materials have become very attractive for groups of researchers around the world, especially in the current context of search for new magnetic materials for the permanent magnets, without rare earths, based on cheaper and non-deficitary raw materials. In these composites, magnetic fine particles, of the order of a few nanometers, are embedded by specific processing techniques, in a metallic or insulating matrix. Due their microstructure and of the possibility to configurate the properties and the geometrical parameters, these materials possess different properties, and sometimes more performing when compared with their bulk counterparts. The worldwide research efforts focus on identifying new Fe-based alloys, with soft or hard magnetic properties. Another area of study, as important as that mentioned above, dealt with the giant magnetoresistance (GMR) observed in granular nanostructures, many studies being devoted to the investigation of GMR dependence on materials microstructure [1 - 5]. The Fe-Cu and Co-Cu binary systems seem to be promising candidates for the synthesis of granular alloys, with special magnetic properties. The project aims (i) to prepare glass-coated microwires and ribbons based micro- and nanostructured alloys from the Cu-Co, Cu-Co-Ni, Fe-Cu systems and (ii) to study their physical and structural properties.

Research staff of the project

dr. M. M. Codescu – project manager, dr. phys. Otilia Culicov, prof. dr. W. Kappel, dr. eng. E. Manta, dr. eng. phys. D. Pătroi, techn. G. Mărgineanu, techn. F. Oprea, tech. Valerică Albu, techn. Nicolae Vicol

EXPERIMENTAL

The Fe_xCu_{100-x} (x = 0; 10; 20; 30; 40; 50; 60; 70; 80; 90; wt. %) alloys ribbons were prepared by melt-spinning technique, starting from technical pure iron and electrolytic pure Cu. The process parameters were: wheel velocity - 28 m/s, distance between the boron nitride crucible and copper wheel - 0.4 mm, sizes of the boron nitride nuzzle - 10x0.4 (mm), the melting temperature range -1600 – 1650°C and the overpressure of the argon: 0.5 bar. The melt-spun samples were annealed for homogenization at temperatures of 800°C, for 4h, in reducing atmosphere. Structural analysis of the prepared alloys, as-quenched and as annealed ribbons, were performed by X-ray diffraction. For the magnetic measurements, the samples were measured by vibrating sample magnetometer (VSM).

RESULTS AND DISCUSSIONS

The identified phases in the Fe-Cu melt-spun alloys were bcc Fe and fcc Cu (Figure 1), after the homogenization the intensity of peaks increasing for both phases and even appearing new peaks for Fe germs, at $2\theta = 65°$ and $2\theta = 82°$ (Figure 2). The presence of Fe particles in the Cu matrix of the Fe-Cu pseudo alloys determines the distorting of the Cu layer, for all the prepared alloys, with smaller influence in the cases of the alloys with lower Fe amounts (Figures 3 and 4).

The Fe and Cu crystallite sizes increase also during the homogenizing (Figures 5 and 6).

The evolution of crystallite sizes for increasing Fe amounts reveals the levels of Cu layer distortions.

We observe that the both types of crystallites increase after the homogenizing treatment, the sizes of Cu crystallites being situated in the range of 500–700Å, while the Fe crystallite sizes are situated in the range of 435 – 680Å.

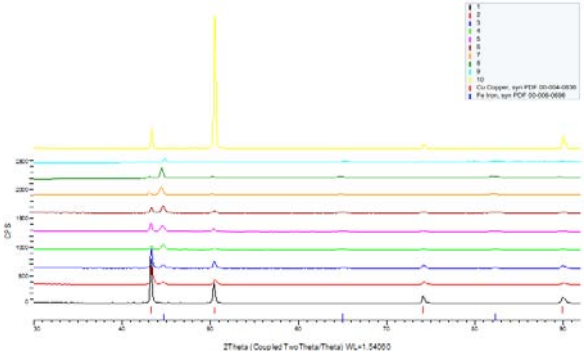


Fig. 1 XRD comparative diffractograms of the Fe – Cu as-quenched melt-spun alloys and of Cu

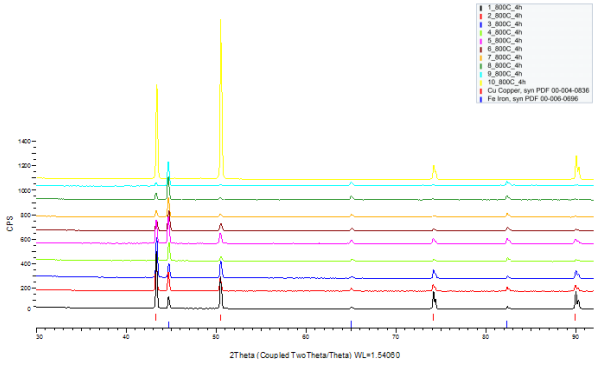


Fig. 2 XRD comparative diffractograms for the Fe-Cu and Cu ribbons, homogenized at 800°C for 4 hours

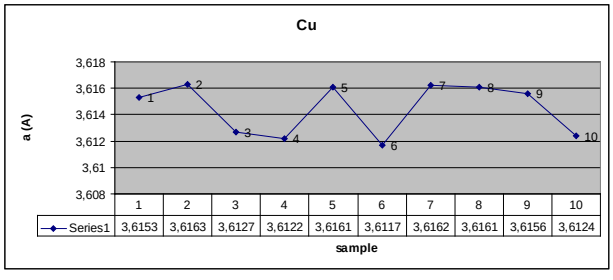


Fig. 3. Evolution of Cu cell parameter, from the Fe-Cu ribbons, after homogenization at 800°C, for 4 hours, in reducing atmosphere

The explanation of their decreasing evolution with the Fe amount increasing (see Figures 5 and 6) consists in fact that a high quantities of Fe (case of the alloys with higher Fe contents) means less distorted Cu layer, so the Cu crystallites sizes will be decreased, in comparison with the value of Cu crystallites existent in the Fe-Cu alloys with lower Fe amounts.

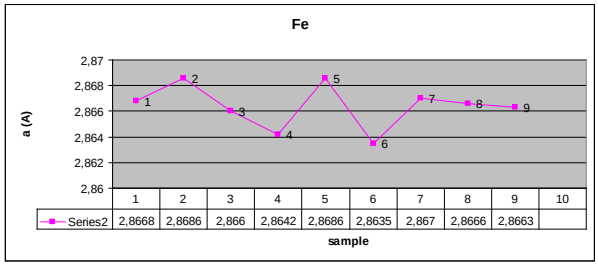


Fig. 4. Evolution of Fe cell parameter, from the Fe-Cu ribbons, after homogenization at 800°C, for 4 hours, in reducing atmosphere

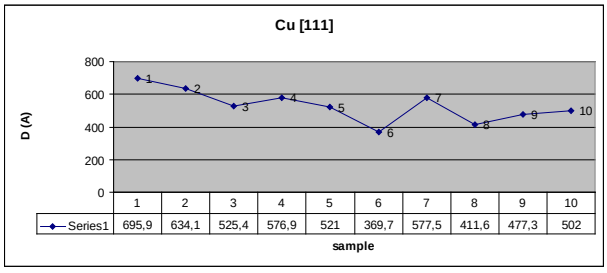


Fig. 5. Evolution of Cu crystallite average size, D_{hkl} of the Fe-Cu ribbons, after homogenization at 800°C, for 4 hours, in reducing atmosphere

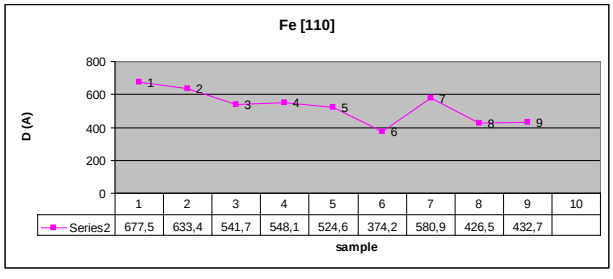


Fig. 6. Evolution of Fe crystallite average size, D_{hkl} of the Fe-Cu ribbons, after homogenization at 800°C, for 4 hours, in reducing atmosphere

The values of the main magnetic characteristics were improved after the homogenization process (Figures 7 and 8).

In order to induce magnetic anisotropy on these homogenized Fe-Cu alloys will be performed, in the next steps of the work, thermo-magnetic treatments.

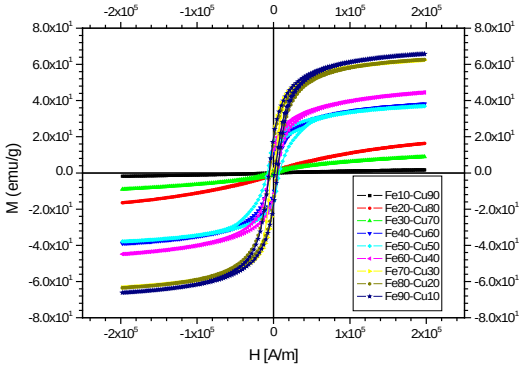


Fig. 7. Comparative hysteresis loops at RT for the Fe-Cu as-quenched melt spun ribbons

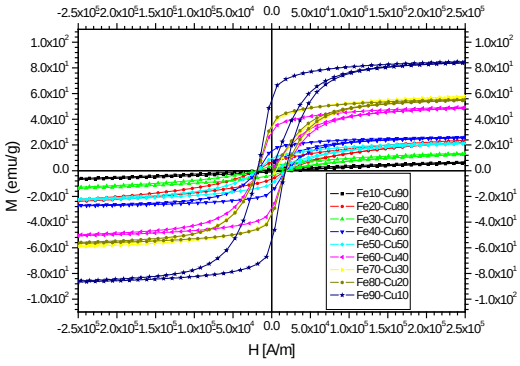


Fig. 8. Comparative hysteresis loops at RT for the Fe-Cu ribbons, homogenized at 800°C for 4 hours

CONCLUSIONS

During this stage of the project have been prepared by melt-spinning techniques Fe-Cu pseudo alloys, with granular structure, which have been structural and magnetic investigated, as-quenched melt spun and after homogenisation treatment, in reducing atmosphere, at 800°C for 4 hours. Have been analysed the evolutions of the cell parameters of Co and Fe and also their crystallite sizes during the processing of the Fe-Cu pseudo alloys.

The homogenising treatment increased the magnetic performances of the studied Fe-Cu alloys.

In order to induce magnetic anisotropy on these homogenized Fe-Cu alloys will be performed, in the next steps of the work, thermo-magnetic treatments.

REFERENCES

[1] **J. Wecker, R. von Helmolt, L. Schultz, K. Samwer**, *Giant magnetoresistance in melt spun Cu Co alloys*, Appl. Phys. Lett. 62, 1985 - 1992 (1993).

[2] **B. Dieny, A. Chamberod, C. Cowache, J. B. Genin, S. R. Teixeira, R. Ferre, B. Barbara,** *Granular alloy type giant magnetoresistance of discontinuous Co/continuous Cu multilayered film*, J. Magn. Magn. Mater. 126, 433 - 438 (1996).

[3] **R. H. Yu, X. X. Zhang, J. Tejada, M. Knobel, P. Tiberto, P. Allia**, *Magnetic properties and giant magnetoresistance in melt-spun Co-Cu alloys*, J. Appl. Phys. 78, (1), 392 - 397 (1995).

[4] **N. Kataoka, H. Endo, K. Fukamichi, Y. Shimada**, *Giant Magnetoresistance in Cu-Co Alloys Produced by Liquid Quenching*, Jpn. J. Appl. Phys. 32, 1969 - 1970 (1993).

[5] **Wuyan Lai**, *Microstructures of magnetic nanoscale metallic multilayer and granular alloys with GMR effects*, Surf. Interface Anal., 36, 135–142 (2004).

The research was financed by National Programme of Bilateral Scientific Cooperation with Joint Institute for Nuclear Research Dubna (Russia), Agreement no. 4247-4-2012/2014, contract No. 32/2013 "Investigation of crystalline and magnetic properties in micro and nanostructured systems based granular alloys" and România – P.R. of China Bilateral Scientific Cooperation Programme, contract No. 633/2012 (4294/2013).

JOINT SCIENTIFIC COOPERATION ROMANIA – CHINA

Prospective studies for assessing the opportunity to develop a bioreactor for energy generation based on organic waste and wastewaters

ABSTRACT

This research project was focused on the completion and extending of several ongoing research activities carried on under the national research programs, where the developing of some communication connections and international collaboration with research institutes with similar targets have been required. In collaboration with the Institute of Biogas China, there have been achieved studies and research on the local potential of organic waste and wastewaters in Avrig, Romania and Guangyuan, China, analysis of the current status on the waste and wastewaters, assessment of the local energy needs, identifying potential beneficiaries, impact analysis of the new technology as well as working visits of the related scientific sites.

INTRODUCTION

The recovery of waste and wastewaters to produce biogas is a technique rather less known in Romania and this is not applied for decentralized level despite the potential of biodegradable biomass and climatic conditions which would makes possible development of such technologies. There are known at national level several research activities for finding technical solutions addressed to exploitation of various organic wastes to biogas. In Avrig and surroundings, there have been valuable agriculture wastes but also energy request for domestic and industrial sectors. In this respect, the implementation of an integrated technology for waste and wastewaters recovery to biogas and ecological fertilizers would be of great interest [2].

China has a rich potential of renewable resources, only the manure-type biomass released from farms amounting to approx. 3 billion tons per year. The subsidiary and support policies were particularly targeted to building of new biogas units but without paying attention to their efficiency or further recovery of the generated valuable products (biogas and fermented slurry). The need to develop biogas technologies has been present in the city Guangyuan as well, where agriculture is an important economic sector [3].

Research staff of the project

Dr. Eng. Carmen Mateescu, CS III – head of the project

Dr. Eng. Corina Alice Băbuţanu, CS

EXPERIMENTAL

Within the project stage 2/2014 entitled "Assessment of the local energy needs, identifying potential beneficiaries; Impact analysis of the new technology; Working visits", the data collection activities at local level in Avrig were focused on the following items:

- Analysis of the local programs aimed to increase the energy efficiency in Avrig and surrounding areas, there have been presented data on electricity suppliers and local initiatives to improve the efficiency of electricity consumption, the introduction of smart meters that allow monitoring of consumption and network operation parameters in real time as well as the automatically transfer of this information to the electricity supplier;
- Analysis of the electricity and natural gas consumption for the municipal estates, residential buildings, public lighting and industrial consumption, data on natural gas and heat supply;
- Analysis of the future local initiatives in launching a strategic project in Avrig as well as the local measures to improve the energy efficiency, analysis of the arguments and proposed solutions towards the development of a biogas reactor;
- The impact analysis of the newly proposed technology, including the legislative framework in support of biogas technologies, presenting of some innovative systems, analysis of the feedstock materials their physical-chemical analysis, recommendations and safety technical measures required for the operation of these systems, assessment the advantages and disadvantages of the proposed technical solutions, recommendations on bioreactor operation, selecting and preparing of optimal mixtures of biomass and determination of the bioreactor loading rate. The impact analysis included the justification for selecting Avrig as a reference location for the use of renewable sources, presenting the measures for the energy efficiency improvement as well as local initiatives in promoting the energy crops and the development policies to implement new technologies based on agricultural residuals at local level [1], [4].

RESULTS AND DISCUSSIONS

The prospective studies carried out within the project and mentioned above represent tangible results

confirming the successful achievement of the objectives undertaken in the project proposal. In addition, for the current year there have been disseminated two papers at symposia organized in Avrig and has elaborated a book entitled *"Methanogenesis in natural and anthropogenic processes"* showing aspects of biochemical and microbiological processes occurring in biogas reactors.

These project results can be used by applying for financing projects aimed to implement the bioreactor for the production of energy based on organic waste and wastewater. The technology selection will be achieved based on data collected on-site as well as on local conditions so that to maximize the economic results which will be reflected in the improvement of environmental quality and decrease costs for local utilities. The proposed technology is intended to be implemented both in Romania and in China through local programs focused on energy efficiency measures in scope of renewable energy production, transmission and distribution of electricity produced from renewable sources and reduce greenhouse gas emissions.

The implementation of the project is supposed to ensure for the related municipalities useful biogas, electricity, heat but also soil fertilizers which can be produced as a by-product from the anaerobic digestion of the various type of biomass.

CONCLUSIONS

This project has provided an experience exchange between specialists from the two institutes in Romania and China, by carrying out activities aimed at promoting clean energy technologies, environmental protection measures and decrease of greenhouse gas emissions. The prospective studies shown that the investments in the use of renewable energy will promote the development of economic and social environment in Avrig and Guangyuan and will help decrease the cost of electricity, heat and natural gas, while contributing to technological progress and the creation of new jobs on the local labor market.

REFERENCES

[1] Local Energy Program, local contribution for fighting against climate changes. Integrated model for energy efficient communities, Avrig, March 2011;

[2] Project Nucleu 0935/2009 „Enhancing the effectiveness of equipments and technological processes for energetically conversion of renewables";

[3] Report on Low-Carbon Development in Guangyuan, publication elaborated by Guangyuan Municipal Development and reform Commission and Guangyuan Municipal Low carbon Development Bureau;

[4] Strategy for Sustainable Development of Avrig city, 2008-2013.

The research was financed by the National Programme of Research, Development and Innovation PNCDI II - Capacități / Modul III – Romania-China bilateral cooperation, contract no. 611/2013 (4296/2013).

JOINT SCIENTIFIC COOPERATION ROMANIA - ITALY

Advanced techniques and interdisciplinary studies for improved assessment of historical parchment documents

ABSTRACT

Optical microscopy and Infrared Spectroscopy with Attenuated Total Reflectance - FTIR/ATR were used for characterization of some parchment documents from Archivio di Stato di Torino. These analyses gave indications concerning the parchment composition and composition of ink used for document writing.

Micro-DSC analyses in water excess were performed for putting in evidence the deterioration of a parchment as a result of its artificial aging by its exposing at 70^{0}C and relative humidity (RH) of 30%.

The obtained results will ground the conservation treatments and the restoration procedures of the investigated documents.

INTRODUCTION

The main objectives of Bilateral cooperation were:

a. The elaboration of some methods of qualitative and quantitative evaluation of the deterioration degree of parchments.

b. Investigation of the degradation of some parchments as a result of action of environmental factors.

Research staff of the project

Dr. Chem. Budrugeac Petru, CS I, Head of the Laboratory for Evaluation of Thermal Behavior of Products and Materials – *head of the project*

Dr. Chem. Cucoş Andrei

Eng. Chiose Ileana Laura

EXPERIMENTAL

Materials

1. It was investigated the following parchment documents from Archivio di Stato di Torino - Italy:

a. Abbazia di Rivalta – 32 notary documents from 1141 to 1236 (274 measurements);

b. Abbazia di Novalesa – 19 notary documents from 1043 to 1151;

c. Bibbia Magna di Novalesa (first half of XIth century), 15 selected pages containing polychromatic illuminations;

d. Various documents under conservation treatment in the Restoration Laboratory of Archivio di Stato.

2. Parchment manufactured from sheep skin, artificially aged at 70^{0}C and 30% RH (duration of aging: 16; 32 and 64 days).

Methods

- *Optical microscopy* applied by using Leica S4E stereomicroscope with magnifying power of (20 – 200)x.
- *FTIR-ATR* measurements were performed using the portable spectrometer Alpha Bruker.
- *Measurements Micro-DSC in water excess* were performed with the calorimeter SETARAM Micro DSC III.

RESULTS OF AND DISCUSSIONS

1. *Optical microscopy*

All parchment documents from Archivio di Stato di Torino – Italy were investigated by optical microscopy. It was obtained information concerning the compositions of parchments and the pigments used in writing.

The images obtained for pages 93 and 151 of Bibbia Magna di Novalesa (first half of XIth century) are shown in Figs. 1 and 2.

Fig. 1. Pattern of page 93 of the book Bibbia Magna di Novalesa

Fig. 2. Image of page 151 of the book Bibbia Magna di Novalesa

Pattern of hair follicle shown in Fig. 1 indicates that the animal used for the parchment was a young calf.

Image shown in Fig. 2 give some information concerning the pigments used for writing.

2. *FTIR-ATR measurements*

All parchment documents from Archivio di Stato di Torino – Italy were investigated by FTIR-ATR spectroscopy. The FTIR-ATR spectra obtained for document 21 (Atto di donazione, Notaio. Theodeericus, 1043) of Abbazia di Novalesa is shown in Fig. 3.

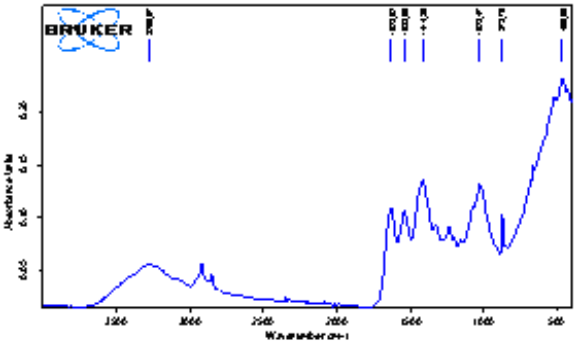


Fig. 3. FTIR-ATR spectra obtained for document 21 (Atto di donazione, Notaio. Theodeericus, 1043) of Abbazia di Novalesa

By such measurements, it was evaluated the deterioration degree of investigated parchments, which is characterized by the following [1]:

- the ratio amide I/amide II (AI/AII) that depends on the degradation by hydrolysis (band for AI is at 3400 cm^{-1}, while the band for AII is at 1650 cm^{-1});

The existence of calcium carbonate on parchment surface could also be determined by FTIR-ATR.

3. *Micro DSC in water excess measurements*

Micro DSC in water excess measurements were performed for putting in evidence the deterioration of the parchment as a result of artificial aging at 70°C and 30% RH. The obtained results are shown in Fig. 4.

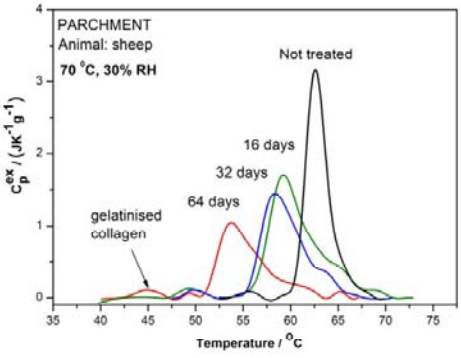


Fig. 4. Micro DSC curves for new sheep parchment and sheep parchment exposed to 70 °C in controlled atmosphere at 30% RH for 16, 32 and 64 days

It results that the artificial aging determines o shift of DSC curves to lower temperatures. This means that the increase oh aging duration determines the decrease of shrinkage temperature, which characterizes the degradation degree of parchment [2, 3]. For duration of aging of 64 days, a partial gelatinization of parchment occurs.

Dissemination of the obtained results

1. E. Badea, L. Miu, C. Carsote, I. Petroviciu, R. Granziero, S. Perona, V. Cachia, B. Pittari, C. Laurora, G. Della Gatta, P. Budrugeac, A. V. Brovarone, Validazione di interventi di recupero conservativo di manufatti in pergamena. In *Lo Stato dell'Arte* 12, XII Congresso Nazionale IGIIC – Volume degli Atti, Nardini Editore, Firenze, 2014, p. 463-470

2. I. Petroviciu, C. Carsote, E. Badea, P. Budrugeac, A. V. Brovarone, *Non-destructive investigation of 11-12th century parchment documents preserved in the State Archives, Turin,* 3rd International Seminar and Workshop on Emerging Technology and Innovation for Cultural Heritage. 2014 Theme: Advanced Technology for Diagnosis, Preservation and Management of Historical and Archaeological Parchment, Leather and Textile Artefacts, 16– 18 Oct. 2014, Sibiu, Romania.

3. A. Cucoş, E. Badea, L. Miu, C. Carsote, I. Petroviciu, P. Budrugeac, *Evaluation of some conservation treatments for parchment artefacts,* 3rd International Seminar and Workshop on Emerging Technology and Innovation for Cultural Heritage. 2014 Theme: Advanced Technology for Diagnosis, Preservation and Management of Historical and Archaeological Parchment, Leather and Textile Artefacts, 16– 18 Oct. 2014, Sibiu, Romania.

CONCLUSIONS

The characterization of some parchment documents from Archivio di Stato di Torino was performed by Optical microscopy and FTIR-ATR. It was obtained

information concerning the parchment composition and composition of ink used for document writing.

Micro-DSC analyses performed in water excess were performed for putting in evidence the deterioration of a parchment as a result of its artificial aging by its exposing at 70^{0}C and relative humidity (RH) of 30%. It was obtained that the increase of exposure duration determines the increase of shrinkage temperature of parchment, which is a quantity tha characterizes its degradation degree.

The obtained results will ground the conservation treatments and the restoration procedures of the investigated documents.

REFERENCES

[1] M. Derrick, *Evaluation of the State of Degradation of Dead Sea Scroll Samples Using FT-IR Spectroscopy*, the book and paper group annual, Getty Conservation Institute, 10, (1992), 49-65

[2] C. Chahine, *Changes in hydrothermal stability of leather and parchment with deterioration: a DSC study*, Thermochim. Acta, 365, 2000, pp. 101-110.

[3] P. Budrugeac, L. Miu L, *The suitability of DSC method for damage*, 9, 2008, 146.

The research project was financed by the Joint Scientific Cooperation Romania – Italy, contract no. 638/2013 (4292 / 2013).

JOINT SCIENTIFIC COOPERATION ROMANIA – FRANCE

Quantitative assessment of environmental impact on collagen-based materials. Research for low-energy climate control in archives and museums

ABSTRACT

Within the framework of bilateral cooperation between Romania and France, it was elaborated „The analytical Protocol of investigation of collagen-based materials (pure collagen, new and old parchments, new and old leathers, artificially aged leathers and parchments) by the following analytical techniques: infrared spectroscopy (ATR/FTIR), Micro Hot Table (MHT), differential scanning calorimetry (DSC)". The contribution of INCDIE ICPE-CA was the elaboration of the part of this Protocol corresponding to the application of the DSC method for the determination of thermodynamic parameters that are characteristic for denaturation in water and for melting of crystalline zone of the collagen-based materials.

INTRODUCTION

It was pointed out [1-5] that DSC method could be used for thermal characterization of the collagen-based materials (pure collagen, new and old parchments, new and old leathers, artificially aged leathers and parchments). In this purpose, two specific DSC methods were applied, namely, DSC analysis of samples immersed in water excess, and DSC analysis of samples in nitrogen flow. The application of these methods needs small amounts of material (1-3 mg/sample), and, therefore, they are suitable for micro-destructive analysis of parchments and leathers from patrimonial objects. It was pointed out [1-5] that the values of thermodynamic parameters of collagen-based materials determined by DSC method could be correlated with their deterioration degree.

The objective of the present project phase was the elaboration of an analytical protocol for the complex characterization of collagen-based materials by the following analytical techniques: infrared spectroscopy (ATR/FTIR), Micro Hot Table (MHT), differential scanning calorimetry (DSC). The contribution of INCDIE ICPE-CA was the elaboration of the protocol part corresponding to the application of DSC method.

Research staff of the project

PhD Chem. Petru Budrugeac, CS I, Head of the Laboratory for Evaluation of Thermal Behavior of Products and Materials – *head of the project*

PhD Chem. Andrei Cucoş

PhD Chem. Carmen Ştefănescu

Eng. Laura Chiose

EXPERIMENTAL

Materials

To check the analytical protocol, the DSC analyses were performed for the following kinds of collagen-based materials: sorts of pure collagen, recent manufactured parchments, historical parchments, recent manufactured leathers, historical leathers, and artificially aged parchments and leathers.

Methods

DSC analysis of samples immersed in water

- DSC 204 F1 Phoenix apparatus produced by Netzsch – Germany;
- the sample (1-3 mg) is immersed in water (35μL deionised water), hermetically sealed in an aluminum pan and stocked for 24 h;
- temperature range: 5 … 90^{0}C;
- atmosphere: nitrogen flow (debit 20 ml.min^{-1});
- protective gas: nitrogen flow (debit 70 ml.min^{-1});
- heating rate: 10 K.min^{-1}.

DSC analysis of samples in nitrogen flow

- DSC 204 F1 Phoenix apparatus produced by Netzsch – Germany;
- sample is introduced in an aluminum pan and is tightening with a lid having three small holes;
- temperature range: 25 … 260^{0}C;
- protective gas: nitrogen flow (debit 70 ml.min^{-1});
- Nitrogen flow (debit 20 ml.min^{-1});
- heating rate: 10 K.min^{-1};
- sample mass: 1 – 3 mg.

RESULTS OF AND DISCUSSIONS

A DSC curve obtained at the analysis of a sample of vegetable tanned leather, immersed in water excess is shown in Fig. 1. Similar thermograms were obtained for all investigated materials.

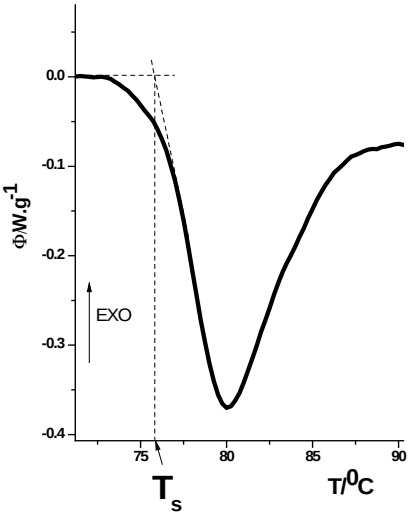


Fig. 1. DSC curve obtained for a sample of vegetable tanned leather, immersed in water excess

The extrapolated temperature for denaturation onset is practically equal with the shrinkage temperature (T_s). T_s value depends on the deterioration degree of the collagen-based material.

A DSC curve obtained at the analysis of a sample of vegetable tanned leather, in nitrogen flow is shown in Fig. 2. Similar thermograms were obtained for all investigated materials. The following two processes occur at the progressive heating of the material:

- 1n initial endothermic process, noted by I, which consists in the loss of water content;
- another endothermic process, noted by II, which consists in the melting of crystalline zone of the collagen-based material.

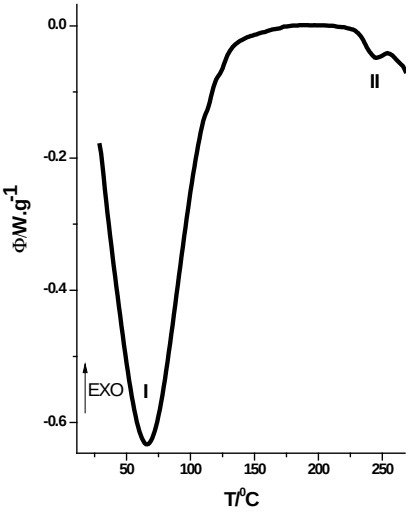


Fig. 2. DSC curve obtained for a sample of vegetable tanned leather, analyzed in nitrogen flow

Temperature corresponding to the minimum of peak II is a measure of the deterioration of the collagen-based material.

The part corresponding to using of DSC method of the analytical protocol for complex characterization of collagen-based materials was elaborated on the basis of the experimental results.

Common activities in Romania

- Working meeting at "Joint Meeting - Bilateral Collaboration Projects", organized in 17 October 2014 at ASTRA Museum Complex, Sibiu-Romania;
- Working visit at ASTRA Museum Complex, Sibiu-Romania;
- participation at 3rd International Seminar and Workshop on Emerging Technology and Innovation for Cultural Heritage (ETICH 2014), *Advanced Technology for Diagnosis, Preservation and Management of Historical and Archaeological Parchment, Leather and Textile Artifacts,* 15 – 18 October 2014;
- Participation at 5th International Conference on Advanced Materials and Systems ICAMS 2014, 23 –25 October 2014, Bucharest - Romania.

CONCLUSIONS

The part corresponding to using of DSC method of the „The analytical Protocol of investigation of collagen-based materials (pure collagen, new and old parchments, new and old leathers, artificially aged leathers and parchments) by the following analytical techniques: infrared spectroscopy (ATR/FTIR), Micro Hot Table (MHT), differential scanning calorimetry (DSC)" was elaborated.

The Common activities in Romania were presented.

REFERENCES

[1] C. Chahine, *Changes in hydrothermal stability of leather and parchment with deterioration: a DSC study*, Thermochim. Acta, 365, 2000, pp. 101-110.

[2] P. Budrugeac, L. Miu L, *The suitability of DSC method for damage assessment and certification of historical leathers and parchments,* J. Cultural Heritage, 9, 2008, 146-153.

[3] V. Plăvan, M. Giurginca, P. Budrugeac, M. Vîlsan, L. Miu, *Evaluation of the physico-chemical characteristics of leather samples of some historical objects from Kiev,* Rev. Chim. (Bucharest), 61, 2010, 627-631.

[4] A. Cucos, P. Budrugeac, L. Miu, S. Mitrea, G. Sbarcea, *Dynamic mechanical analysis (DMA) of new and historical parchments and leathers: Correlations with DSC and XRD,* Thermochim. Acta, 516, 2011, 19–28.

[5] P. Budrugeac, A. Cucoş, Lucreţia Miu, *The use of DSC method for authentication of historical and/ or cultural objects manufactured from leather,* 2nd International Conference Matter and Materials in/ for Heritage Conservation Matcons'2011, Craiova, Romania – 24 – 28 August 2011.

The research was financed by the Joint Scientific Cooperation Romania – France, contract no. 713/01.01.2013 (7110/2014).

JOINT SCIENTIFIC COOPERATION ROMANIA – TURKEY

A comparative characterization study on naturally and artificially aged leathers by using different techniques

ABSTRACT

Differential scanning calorimetry (DSC) and Micro Hot table method were for determination of the shrinkage temperature (T_s) of some recent manufactured leathers, artificially aged leathers and naturally aged leathers (patrimonial leathers). It was suggested a procedure for extrapolation of DSC data obtained at heating rate of 10 K.min^{-1} to the heating rate of 2 K. min^{-1}. The values of shrinkage temperatures resulted by this extrapolation are in good agreement with those obtained by MHT method.

On the basis of the obtained results, it was elaborated an "Analytic protocol for qualitative and quantitative evaluation of tanned leathers by differential scanning calorimetry (DSC) of samples immersed in water".

INTRODUCTION

The shinkage temperature (T_s) of the collagen-based materials (pure collagen, parchments, leathers) characterizes the hydrothermal stability of these materials. Determination of the shrinkage temperature is important for quality control of tanned leathers as well as for evaluation of the deterioration degree of naturally aged leathers (patrimonial leathers) [1 – 4].

The objectives of the present phase of the project were:

- Checking of the micro-destructive methods DSC and MHT used for determination of shrinkage temperature;
- Evaluation of the errors of determination of shrinkage temperature my DSC and MHT methods;
- Elaboration of an investigation protocol, applicable for artificially and naturally aged leathers and establishment of the corresponding methodology;
- Dissemination of the obtained results.

Research staff of the project

PhD Chem. Petru Budrugeac, CS I, Head of the Laboratory for Evaluation of Thermal Behavior of Products and Materials – *head of the project*

PhD Chem. Andrei Cucoş

PhD Chem. Carmen Ştefănescu

Eng. Laura Chiose

EXPERIMENTAL

Materials

- Sorts of leathers: recent manufactured leathers (shhep-mimosa (SM), sheep-quebracho (SQ), calf-quebracho (CQ)); samples of SM artificially aged at 80^{0}C and relative humidity (RH) of 80% for 1, 2, 4 and 8 days; old leathers that take part from Romanian patrimonial leathers („Dogmatică ortodoxă –XVIII century, „Evangheliar Bucureşti" – 1760, „Apostol" – 1784, „Carte religioasa slavă" –XVIII century, „Manuscris slavon" – XVII century I);
- Sorts of pure collagen and recent manufactured parchments (collagen produced by Sigma-Aldricht, collagen produced by Ridel de Haen-AG, recent parchment E manufactured from deer skin and recent parchment F manufactured from deer skin).

Methods

DSC analysis of samples immersed in water

- DSC 204 F1 Phoenix apparatus produced by Netzsch – Germany;
- the sample (1-5 mg) is immersed in water (35μL deionised water), hermetically sealed in an aluminium pan and stocked for 24 h;
- temperature range: 5 … 90^{0}C;
- atmosphere: nitogen flow (debit 20 ml.min^{-1});
- protective gas: nitogen flow (debit 70 ml.min^{-1});
- heating rates: 2 and 10 K.min^{-1}.

MHT analysis

MHT method relies on easy-to-use equipment composed of a stereo microscope (Leica S4E) with a camera and a hot table (Caloris) equipped with a FP90 temperature processor and a home-made software (F.L.T.K. 1.1.X) for temperature regulation and data collection. Magnification used was x40.

Micro-samples (10-15 fibres) from the flesh side were thoroughly wetted and separated in dematerialized water and placed on a microscope slide with a concavity for 10 min. Fibres are then separated as much as possible under a light microscope using a pair of fine needles, and then covered with a cover glass, placed on the hot table and heated. The shrinkage process is digitally recorded under constant heating rate (2°K min^{-1}).

RESULTS OF AND DISCUSSIONS

A typical DSC curve obtained at the analysis of a sample of a collagen-based material (pure collagen, parchments, leathers) immersed in water excess is showns in Fig. 1. Similar thermograms were obtained for all investigated materials.

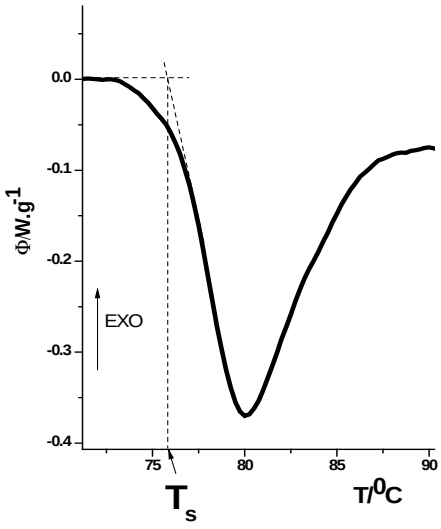


Fig. 1. Typical DSC curve for a sort of collagen-based material immersed in water

The extrapolated temperature for denaturation onset is practically equal with the shrinkage temperature(T_s). T_s value depends on the deterioration degree of the collagen-based material.

The values of shrinkage temperature determined by DSC and MHT methods for some new and old lethars were compared (Table 1). DSC measurements were performed at heating rate of 10 K.min^{-1}, while MHT measurements – at 2 K.min^{-1}.

Table 1. The values of shrinkage temperature determined by DSC and MHT methods

Material	**T_s(DSC-10) ^{0}C**	**T_s(MHT-2) ^{0}C**	ΔT_s ^{0}C	**T_s(DSC-2-corectat) ^{0}C**
SM	**82,3**	**76,4**	5,4	**76,3**
SM_1	**78,9**	**71,9**	7,0	**72,9**
SM_2	**75,5**	**70,6**	4,9	**69,5**
SM_4	**75,5**	**69,2**	6,3	**69,5**
SM_8	**73,1**	**68,1**	5,0	**67,1**
SQ	**86,0**	**80,2**	5,8	**80,0**
CQ	**86,4**	**79,3**	7,1	**80,4**
„Dogmatică ortodoxă - XVIII”	**69,1**	**65,0**	4,1	**63,1**
„Evangheliar București – 1760”	**60,7**	**56,3**	4,4	**54,7**
„Apostol – 1784”	**69,2**	**65,9**	3,3	**63,2**
„Carte religioasă slavă –XVIII”	**60,9**	**55,4**	5,5	**54,9**
„Manuscris slavon – XVIII”	**63,2**	**59,1**	4,1	**57,2**

SM = recently manufactured leather “sheep-mimosa”

SM_x = SM artificially aged at 80^{0}C and RH of 80% for „x” days

SQ = recently manufactured leather “sheep-quebracho”

CQ = recently manufactured leather “calf-quebracho”

T_s(DSC-10) = shrinkage temperature determined by DSC method at the heating rate of de 10 K.min^{-1}

T_s(MHT-2) = shrinkage temperature determined by DSC method at the heating rate of de 2 K.min^{-1}

T_s(DSC-2-corected) = T_s(DSC-10) - ΔT(correction); ΔT(correction) ≈ 6^{0}C;

ΔT_s = T_s(DSC-10)-T_s(MHT-2)

From this Table it results that, for each material, the shrinkage temperature determined by DSC method (T_s(DSC-10)) exhibits a higher value than that determined by MHT method (T_s(DSC-2). The value of ΔT_s = T_s(DSC-10)-T_s(MHT-2) is between 3,3^{0}C and 7^{0}C. This difference could be explained by the fact that the increase of heating rate determines the shifting of DSC curve to higher temperature. In the purpose to extrapolate of the T_s value obtained by DSC method at the heating rate of 10 K.min^{-1} to the heating rate of de 2 K.min^{-1}, it was investigated the dependencies of T_s on the heating rate were investigated for the following collagen-based materials: collagen produced by Sigma-Aldricht , collagen produced by Ridel de Haen-AG, recent parchment E manufactured from deer skin and recent parchment F manufactured from deer skin. It was obtained that the extrapolation of T_s values obtained by DSC method at heating rate of 10 K.min^{-1} to those obtained at heating rate of 2 K. min^{-1} involves a correction of 6^{0}C (T_s(DSC-2) = T_s(DSC-10)-6^{0}C). The application of this correction leads to a good agreement between the T_s values determined by MHT and DSC methods. *Such correction is necessary because the accuracy of DSC measurements is very good for the heating rate of 10 K.min^{-1}, but is relatively lower for the heating rate of 2 K.min^{-1}, which is used for MHT determinations.*

On the basis of the obtained results, it was elaborated an **“Analytic protocol for qualitative and quantitative evaluation of tanned leathers by differential scanning calorimetry (DSC) of samples immersed in water”.**

Dissemination of the obtained results

Communications to international

1. European Chemistry Congress - 5th EuCheMS August 31 - September 4, Istambul 2014

Cristina Carsote, Elena Badea, Fatih Yalçin, Hüseyn Ata Karavana, Petru Budrugeac, Lucretia Miu, *Damage assessment of vegetable-tanned leather artefacts by thermal microscopy and differential scanning calorimetry*

2. ICAMS 2014 – 5th International Conference on Advanced Materials and Systems, București, octombrie 2014

Cristina Carşote, Petru Budrugeac, Lucreţia Miu, Hüseyn Ata Karavana, Elena Badea, *Study of the environmental impact on vegetable tanned leather by thermal analysis*

CONCLUSIONS

The shrinkage temperatures of some recent manufactured leathers, artificially aged leathers and naturally aged leathers were determined by DSC and MHT methods.

On the basis of the obtained results, it was elaborated an "Analytic protocol for qualitative and quantitative evaluation of tanned leathers by differential scanning calorimetry (DSC) of samples immersed in water".

The dissemination of the obtained results was made by 2 communications presented at international Conferences.

REFERENCES

[1] C. Chahine*, Changes in hydrothermal stability of leather and parchment with deterioration: a DSC study*, Thermochim Acta, 365, 2000, 101.

[2] P. Budrugeac, L. Miu L, *The suitability of DSC method for damage assessment and certification of historical leathers and parchments,* J. Cultural Heritage, 9, 2008, 146-153.

[3] V. Plăvan, M. Giurginca, P. Budrugeac, M. Vîlsan, L. Miu, *Evaluation of the physico-chemical characteristics of leather samples of some historical objects from Kiev,* Rev. Chim. (Bucharest), 61, 2010, 627-631.

[4] A. Cucos, P. Budrugeac, L. Miu, S. Mitrea, G. Sbarcea, *Dynamic mechanical analysis (DMA) of new and historical parchments and leathers: Correlations with DSC and XRD,* Thermochim. Acta, 516, 2011, 19–28.

The research was financed by the Joint Scientific Cooperation Romania – Turkey, contract no. 596/2012 (7097/2014)

JOINT SCIENTIFIC COOPERATION ROMANIA – HUNGARY

Assessment and mitigation of impact of climate on library and archival heritage: experience, research, innovation

ABSTRACT

In this bilateral Romanian - Hungarian project, the main approach was the use of very sensitive, micro-invasive thermal analyses techniques, such as TG-MS, Pyrolysis-GC-MS, microDSC, as well as of unilateral NMR non-invasive technique in order to understand the parchment and leather response to the synergistic action of environment factors such as temperature, relative humidity, light and atmospheric pollutants.

New/optimized damage assessment protocols for applications in conservation practice and improving/ optimizing the evaluation and diagnosis software were provided. Also, recommendations for prioritizing the climate factors causing most important damage to documents were drawn.

INTRODUCTION

Evaluation of deterioration degree of historical collagen-based materials is a difficult task due both to the complexity of the material but also to the heterogeneous action of environmental damage, conservation history, the use and manipulation of documents. A complete characterisation of a parchment's degradation must reflect the complexiy and the dinamics of the deterioration processes. In general, the deterioration has a progresive character, caused by environmental factors, such as pollutants, temperature and relative humidity. The degradation processes start from the surface of the parchment (macroscopic level) and advance to internal layers, down to molecular level. The simple visual observation of a parchment object is thus unable to give information about the alterations of the hierarchical structure of collagen, the main component of these materials. An efficient analysis of the deterioration of the historical materials require a study based on the correlation between the physico-chemical and structural properties at all levels : macro- and microscopic (visual examination), mesoscopic, nanoscopic and molecular (investigations through advanced analysis techniques) [1,2].

Research staff of the project

PhD Chem. Petru Budrugeac, CS I, Head of the Laboratory for Evaluation of Thermal Behavior of Products and Materials – *head of the project*

PhD Chem. Andrei Cucoș

PhD Chem. Carmen Ștefănescu

Eng. Laura Chiose

EXPERIMENTAL

Parchment and leather samples manufactured at INCDTP-ICPI were subjected to accelerated ageing procedures. Samples with dimensions of (3 x 1) cm^2 were subjected to thermal treatment (70°C) at 30% controlled relative humidity for 8, 16, 32 and 64 days in absence or presence of visible light radiation (9000/2.0 / (Lux) / (UVA W/m²)). The samples were analysed through ATR/FTIR, DSC, TG/DTG/DSC, TG-MS, Py-GC-MS and unilateral NMR techniques.

RESULTS AND DISCUSSIONS

The DSC technique was used in order to reveal the alterations induced by the ageing and deterioration processes to the parchment structure. Thus, for example, figure 1 illustrates the thermal behavior of a historical parchment. Several collagen populations with different thermal stabilities are present in the material, due to the exposure to environmental factors.

One can consider the thermal stability as a dicrimination criterium for the classification of historical parchments in two classes. Parchments that have more than 50% collagen exhibiting the denaturation temperature (T_d) ≥ 48°C are characterised by a good therma and structural stability. Parchments for which more than 50% collagen exhibiting T_d < 48°C are unstable and exposed to gelatinisation.

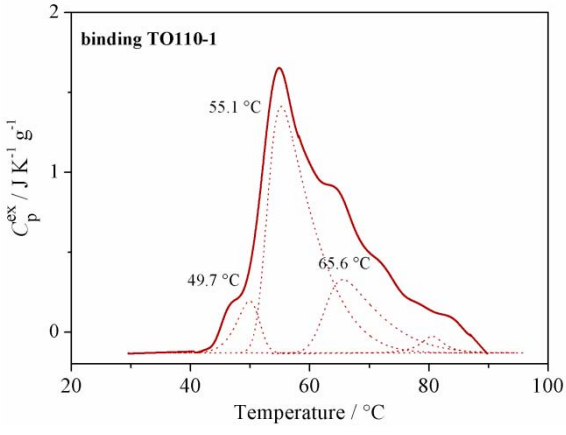


Fig. 1. Separation of collagen populations with different thermal stabilities through mathematical deconvolution

Also, Pyrolysis-GC-MS and TG-MS have been applied for the first time to the study of historical collagen-based materials, e.g. parchment and vegetable-tanned leather. A number of markers which well correlate with natural/artificial ageing as well as with the level of damage have been identified.

Unilateral NMR has been applied for the first time to the study of vegetable tanned leather. Correlations between the longitudinal relaxation time T1 and leather features (e.g. animal origin, tannin type) as well as deterioration mechanism (e.g. acid/basic hydrolysis, thermal dehydration, denaturation) have been found.

The study of artificially aged parchment and leather confirmed our hypothesis on the deterioration pattern induced by the synergistic action of temperature and relative humidity and provided further data for the statistic analysis.

By applying the MHT protocol for the evaluation of damage of parchment samples exposed to NO_x and SO_2 clearly comes out that in presence of pollutants, even when a tight environmental control (T = 25°C and RH = 50%) is provided, the kinetics of degradation process is very high and increases with light and high temperature exposure.

Some recommendations concerning both the temperature and relative humidity intervals allowing for optimizing the balance between long-term conservation and energy use, and NO_x and SO_2 damaging levels, have been drafted to allow for more flexible and informed decisions about the environmental control in the archives, libraries and museums hosting collagen-based documents and artefacts.

CONCLUSIONS

The use of very sensitive, micro-invasive thermal analyses techniques (TG-MS, Pyrolysis-GC-MS, microDSC) as well as of unilateral NMR non-invasive technique was performed in order to understand the parchment and leather response to the synergistic action of environment (temperature, relative humidity, light) and atmospheric pollutants.

New/optimized damage assessment protocols for applications in conservation practice and improving/optimizing the evaluation and diagnosis software were provided.

Recommendations for prioritizing the climate factors causing most important damage to documents were drawn.

REFERENCES

[1] Badea E., Miu L., Budrugeac P., Giurginca M., Mašić A., Badea N., Della Gatta G., *Study of deterioration of historical parchments by various thermal analysis techniques, complemented by SEM, FTIR, UV-vis-NIR and unilateral NMR investigations*, J. Therm. Anal. Calorim. 91, 17-27 (2008).

[2] Della Gatta G., Badea E., Saczuk M., Odlyha M., Larsen R., *Sustainable preservation of historical parchments*, Chimica e Industria, International Journal of the Italian Society of Chemistry, 4, 106-111 (2010).

The research was financed by the Joint Scientific Cooperation Romania – Hungary, contract no. 671/2013 (7111/2014).

BisNet Transylvania - Business and Innovation Support Network for SMEs from Transylvania

ABSTRACT

BisNet Transylvania is a project funded by the European Commission under the Competitiveness and Innovation Programme, which gives the partner institutions in the project the membership in the Enterprise Europe Network. Enterprise Europe Network is a key instrument in the EU strategy to boost SME growth. The network brings together 570 business support organizations in 45 countries whose mission is to support small businesses to take full advantage of business opportunities from the European Union.

INTRODUCTION

Enterprise Europe Network is managed by the Executive agency for Small and Medium sized Enterprises (EASME) and is part of the Competitiveness and Innovation Program (CIP). The Enterprise Europe Network (EEN) [1] is a support network for SMEs in Business and Innovation, with one stop shop for information on EU legislation, opportunities for funding, assistance in finding business and technology partners in EU and help to develop the research and innovation capacity of SMEs. Transylvania BisNet consortium include the developing regions of the northwest and centre of Romania, bringing together seven partner organizations to support SMEs in a macro region 1: Northwest Regional Development Agency from Cluj, Central Regional Development Agency Alba Iulia, Technological and Business Incubator Ecomat ICPE-CA – Branch of Saint George from the National Research and Development Institute for Electrical Engineering ICPE-CA, Technical University of Cluj, Technology Transfer Centre from the National Institute of Research and Development of Optoelectronic - Cluj Napoca.

Research staff of the project

PhD student. Eng. Erdei Remus, Scientific Researcher – head of the project

Dr.Eng. Codescu Mirela – Scientific Researcher I

Dr. Eng. Alecu Georgeta – Scientific Researcher I

Eng. Macamete Elena - IPR Adviser

Ec. Szasz Reka Eva - Economist

Eng. Onica Ciprian - Scientific Researcher

Eng. Alecusan Florin - Assistant Researcher

EXPERIMENTAL

Trough the project was provided support services for SMEs, the main services were:

- consulting services for accessing European funding;
- assistance for finding business partners and technology partners;
- information services on EU law.

RESULTS AND DISCUSSIONS

The services offered by the BisNet Transylvania consortium particularly are addressed to SMEs, the services offered trough the network are free, and there are provide the following main services:

Fig. 1. Logo Enterprise Europe Network

- assistance for SMEs to expand their business in the European Union market by finding a partner for business and technological cooperation;
- information and advice on accessing European funding sources, especially to encourage the participation in research programs;
- partner search for research projects;
- information on European legislation and services regarding intellectual property rights;

INCDIE ICPE-CA as a partner in the consortium BisNet Transylvania has achieved the following results:

- promoting the services offered by Enterprise Europe Network by organizing local events for SMEs development of a website for the inform of SMEs, publishing articles about the Enterprise Europe Network, on the third network websites, realization of a database of potential clients of the central region of

the country, realization of newsletter with topics on EU issues;

- promotion of SMEs on European market through the database of the Enterprise Europe Network by making business cooperation profiles and technology cooperation profiles in order to facilitate finding business partners in the European Union;
- encouragement of the SMEs to access European funding programmes by identifying the right funding call for the SME and advice for filling the forms;
- information regarding the European legislation and advice on industrial property rights for filling and submitting the documentation for patens;

The implementation period of the project was 2013-2014.

Fig. 2. Competitivenes and Innovation Framework Programme Logo

CONCLUSIONS

Over 100 SME's have benefited from the services of the network by which were provided by INCDIE ICPE-CA partner, services such as:

- organizing local events with relevant EU topics for SME's company missions and brokerage events: 220 participants;
- number of meetings during company missions and brokerage events: 117;
- consultancy services for accessing financing programs: 5 SMEs;
- intellectual property service: 14 SMEs;
- business and technologies partnerships agreements: 7 SMEs;
- first company meetings: 62 SMEs;
- feedback activities concerning European law: 25 SMEs participants;
- partnership agreements signed: 2.

REFERENCES

[1]. http://een.ec.europa.eu

The project was financed by the Competitiveness and Innovation Framework Programme, under the agreement no. 225559 / 9.

Sectoral Operational Programme "Increase of Economic Competitiveness", "Investing in your future" SOP-IEC

Infrastructure to promote competitiveness through innovation in electrical engineering for sustainable growth of energy security – acronym PROMETEU

Sectoral Operational Programme "Increase of Economic Competitiveness", "Investing in your future"

Priority axis 2: Research- Development and Innovation for Competitiveness, Operation 2.2.1, Thematic area- Energy

Project co-financed by the European Regional Development Fund

Project responsible: Prof. PhD. Wilhelm Kappel

Total value: 26.836.300 lei

EU contribution: 22.000.000 lei

Start date of the project: March 2014
Completion date of the project: September 2015

General objectives:
- Development of innovative and energy efficient products and technologies;
- Exploring and testing renewable energy sources.

Specific objectives
- Developing a performing infrastructure by completing endowments in the existing laboratories and creating new energy laboratories;
- Strengthening the administrative capacity to support and develop new research activities;
- Purchase of new premises;
- Strengthening human resources in energy sector research.

The establishment of new laboratories:
1. Laboratory of research and testing of photovoltaic panels;
2. Laboratory for electrical testing of intense currents in transient regime for research - development of low-medium and high voltage protection systems;
3. Laboratory of superconductivity applied in electrical engineering;
4. Laboratory of electromagnets and electromagnetic measurements;
5. Laboratory of waste energy recovery - HARVESTING.

Extending and modernizing existing laboratories:
1. Laboratory of electromagnetic compatibility - extending area of research/testing at very high frequencies and 100W RF power;
2. Laboratory of biochemistry and bio-resources;
3. Laboratory of renewable energy sources;
4. Centre of Excellence in radiochemistry;
5. Laboratory of electrical machines dynamics

The main direct results:

- creating 5 new research laboratories in the energy field;
- modernizing 5 existing laboratories by extending research area in the energy field;
- creating 9 new working places;
- purchase of 60 RD equipment;
- purchase of 620 m^2;
- modernizing/rehabilitation of about 1,000 m^2.

Facts and scientific events

Scientific events organized or co-organized by INCDIE ICPE-CA

Eugen Segal Symposium, Romanian Academy, Bucharest, February 14, 2014, organizer: Thermal Analysis and Calorimetry Commission, co-organizer: INCDIE ICPE-CA

The researchers from INCDIE ICPE-CA presented the papers:

- *Thermal Analysis and Calorimetry Conferences - Increasing the number of meetings and participants in our region*, authors: Andrei Rotaru, **Petru Budrugeac**, Crisan Popescu;
- *Study of Crystallization Process of Soda Lead Silicate Glasses by Thermal and Spectroscopic Methods*, authors: Oana Cătălina Mocioiu, Maria Zaharescu, Irina Atkinson, Ana-Maria Mocioiu, Petru Budrugeac;
- *New Zn(II) coordination polymers assembled in the presence of aminoalcohols and polycarboxylic acids. Synthesis, structure, and thermal behavior*, authors: **Carmen Paraschiv, Andrei Cucoș, Cătălin Maxim**, Augustin Madalan, **Virgil Marinescu**;
- *Thermal behaviour of polypropylene/biomass composites materials*, authors: Elena Parparita, Raluca Nicoleta Darie, Carmen-Mihaela Popescu, Manuela Tatiana Nistor, Cristina Popescu, **Traian Zaharescu**, Cornelia Vasile
- *DMA and DSC studies on denaturation in water and in dry state of parchments subjected to accelerated ageing*, authors: **Andrei Cucoș, Petru Budrugeac**, Lucreția Miu;
- *Leather characterization by thermal analysis for improved micro climate conditions*, authors: Cristina Carșote, **Petru Budrugeac**, Irina Petroviciu, Lucreția Miu, Elena Badea

(Drawn up: Eng. Gabriela Obreja, organizer from INCDIE ICPE-CA)

The 12th WEC Central & Eastern Europe Regional Energy (Forumul Regional al Energiei pentru Europa Centrală și de Est) - FOREN 2014, Bucharest, June 22-26, 2014; co-organizer INCDIE ICPE-CA together with Romanian National Committee – World Energy Council CNR-CME, with the main theme "Tomorrow's Energy: From Vision to Reality"; the Workshop Study Session, WSS 1 – Regional Cooperation between Scientific Units and Universities, June 23, 2014, Parliament Palace

(Drawn up: Dr. Eng. Florentina Bunea, organizer from INCDIE ICPE-CA of WSSI – FOREN 2014 Workshop)

ICOHTEC Brașov, July 28 – August 3, 2014

The scientific event took place on July 28 – August 3, 2014, in Brașov, organizers being Transylvania University from Brașov, Brașov County Council, Brașov City Hall and INCDIE ICPE-CA.

The topic of ICOHTEC Symposium was „Tehnology in transition period"; the debates were taken into account finding solutions for the period that many countries going through, de de-industrialization and re-industrialization.

It was presented the paper: "60 Years of Technology Transfer", authors: Georgeta Alecu, Iulian Iordache, Elena Enescu, Wilhelm Kappel.

The 9th International Workshop of Electromagnetic Compatibility CEM 2014, Timișoara, September 2-5, 2014, organizer INCDIE ICPE-CA

This year, under the Ministry of National Education, INCDIE ICPE-CA organized the "*9th International Workshop of Electromagnetic Compatibility – CEM 2014*" on September 3-5, 2014. The host of the event was the city of Timisoara, famous academic center. Together with our institute co-organizer was the "Politehnica" University from Timișoara, Romanian Association for Electromagnetic Compatibility and Academy of Technical Sciences of Romania.

The total number of participants: 79,

Of which:

- from the country: 42,
- from abroad: **37** (Macedonia, Belgium, Germany, Poland, Switzerland, Italy, Serbia, Bulgaria and Croatia).

At the session of invited lectures, moderated by our General Director, Prof. Dr. Wilhelm Kappel, were presented three valuable invited lectures:

- *Aspects regarding naval electromagnetic compatibility* - Octavian Baltag, Terraflux Control Ltd., Romania;
- *Applications of nanocrystalline magnetic materials in EMC* - Andrei Marinescu, ICMET, Craiova, Romania;
- *Signal integrity applications of an EBG surface* - Ladislau Matekovits, Aldo De Sabata, Politehnica din Torino, Italy, respectively "Politehnica" University of Timișoara, Romania.

The programme continued with the **round table** "*Progress in the field of electromagnetic compatibility in Romania*", moderators being Prof.dr. Andrei Marinescu and Prof.dr. Adrian Graur.

At the end of the day, participants were invited to visit the **exhibition** that included 21 exhibits belonging to specialized firms: COMTEST, EM TEST GmbH, KEYSIGHT TECHNOLOGIES, INCDIE ICPE-CA.

The second day of the workshop started with a **plenary** and oral **session**, both held until noon, session chaired by Dr. Gilbert Decat, Expert GD-EMF-Consulting, Hasselt from Belgium and Prof.dr. Andrei Marinescu, ICMET, Craiova, Romania, respectively Prof. dr. Ladislau Matekovits, Politehnica din Torino, Italia and Prof.dr. Nicolae Muntean, "Politehnica" University

of Timişoara, Romania.

This session was presented six invited lectures and 22 oral presentations.

Very discussed was the **poster session** (9), held on the last day of the event, moderated by dr.eng Georgeta Alecu. Each poster was presented by the authors, being fruitful discussions generating ideas for launching future collaborations.

(Drawn up: Dr.Eng. Georgeta Alecu and Dr. Eng. Andreea Voina, organizers from INCDIE ICPE-CA of CEM 2014 Workshop)

Researchers Night 2014,
Bucharest, September 26, 2014, participant: INCDIE ICPE-CA

The event "*Researchers Night 2014*" held Friday, September 26, until 21:00, in Youth Park (Parcul Tineretului), our institute participate at section **"do you speak science"** with the following **"live" experiments:**

- "live" demonstration on high voltage hybrid generator layout;
- experiment on a high voltage device with discharge in rarefied gas;
- experiment on electronically controlled magnetic levitation;
- efficient solution for bussy trafic: the electric drive system of the bike;
- magnetic brake for elevators;
- "live" demonstration on a layout regarding the transforming of kinetic energy of flowing water in electric energy;
- Experiments on magnetic phenomena.

(Drawn up: Eng. Gabriela Obreja and Eng. Ciprian Onică, organizers from INCDIE ICPE-CA of the event)

ICATE 2014 – International Conference on Applied and Theoretical Electricity,
Craiova, October 23-25, 2014, co-organizer INCDIE ICPE-CA

Seminar on the formation of consortia to participate in National R&D&I Programme PNCDI III and HORIZON 2020,
Bucharest, October 28, 2014

At the initiative of our institute, on October 28, a seminar was organized on the formation of consortia for participation in programmes Horizon 2020 and the future National R&D&I Programme. They were presented areas of activity and current concerns of ICPE-CA and ICPE SA from Bucharest, Romania. The debates were held at the Conference Hall of the "ICPE Solar Park"; participants were representatives from the platform ICPE entities and representatives of the Ministry of National Education and other institutes and companies.

(Drawn up: Dr. Eng. Georgeta Alecu, organizer from INCDIE ICPE-CA of this event)

The XV-th edition of INGIMED Conference, Bucharest, December 4, 2014

The XV-th edition of INGIMED Conference was held on December 4, 2014 at INCDIE ICPE CA headquarters.

They were invited around 50 specialists: doctors, engineers, researchers, students involved in the field of medical engineering. Some examples of traditional participants invited to this event regularly: Prof. Radu Negoescu, President of Romanian Association of Medical Engineering, Prof. Sarah Nica – Director of Medical Rehabilitation and Prof. at University of Medicine and Pharmacy «Carol Davila» Bucharest, Dr.Phys. Pierre Hillerin – Director of Research Sports Institute and member of Romanian Olympic Committee, Prof.Alexandru Morega – Politehnica University of Bucharest, Faculty of Electrical Engineering, Prof. Kostrakievici – Politehnica University of Bucharest, Faculty of Medical Engineering, Prof. Florin Teodor Tănăsescu – President of Romanian Committee of Electrical Engineering, Prof. Dr.Ing. Ciprian Racuciu - Titu Maiorescu University.

It is added the participants from Republic of Moldova, from the Medical Engineering Researches Institute of Chisinau.

The papers from INCDIE ICPE-CA were:

- Eng.Christu Ţârdei, *Cranial reconstruction with biomaterials. Preliminary experiments for hydroxyapatite ceramic cranial prostheses manufacturing, and in vitro biocompatibility testing*;
- Dr.Eng. Mircea Ignat, *Aspects on formation of a team in the field of medical engineering research* (*Aspecte privind formarea unei echipe de cercetare in domeniul ingineriei medicale)*;
- Eng. Daniel Lipcinski, *Electrical stimulation device for muscular tissue* (*Aparat de stimulare electrică a ţesuturilor muschiulare)*.

The conference papers were published in **Bulletin of Micro and Nanoelectrotechnologies**, ISSN 2069-1505.

(Drawn up: Dr.Eng. Mircea Ignat, organizer from INCDIE ICPE-CA of this event)

First session of communication of Excellence Centre for Initiation of Young Olympics to Scientific Research (Prima sesiune de comunicări a Centrului de Excelență pentru Inițierea în Cercetare Științifică a Tinerilor Olimpici), September 11, 2014, Bucharest

Excellence Centre for Initiation of Young Olympics to Scientific Research running for more than one year in INCDIE ICPE-CA Bucharest, Romania. The center recruits young elite on few selection criteria, such as: learning results, especially at: mathematics, physics, computer science, chemistry, participation in contests and not least, passion for scientific research.

The creation of this centre was a project developed by its coordinator, Doctor Engineer Mircea Ignat, which had attracted diligent students with school performance.

This centre developed by INCDIE ICPE-CA has already achieved remarkable results through the three teams: Spider, Harvesting and Bionics. Thus, this year the eight future researchers participated in four national and international competitions where they won three gold medals, two silver and four bronze. A remarkable result was exceptional qualifications of Spider team in the international competition finals Intel ISEF 2014.

The elite students have already participated in seminars and competitions with bold projects.

The papers presented by Olympians young were:

- *Software games; Line Follow competition (Jocuri cu soft specific; competiția Line Follow)* - Matei Sarivan, "Tudor Vianu" National College;
- *ADVR – the first isolated protein which is reinforced to impact (ADVR: prima proteină izolabilă ce se rigidizează la impact)* - Ștefan Iov, "Tudor Vianu" National College;
- *Energy Harvesting Cube* (*Sursă harvesting hibridă)* – Andrei Corbeanu, "Tudor Vianu" National College and Luca Florescu, "Sf. Sava" National College;
- *E-commerce Platform for Mobile Terminals (Platforma E-commerce pentru Terminale Mobile)* - Alex Glonțaru and Alex Dragomir, "Tudor Vianu" National College;
- *Architectures for hourses with energy independence (Arhitecturi specifice pentru case cu independență energetică)* - Raluca Turcu, "Tudor Vianu" National College;
- *Graphic motor with applications in scenography (Motor grafic cu aplicații în scenografie)* - Andrei Pangratie, "Tudor Vianu" National College;
- *Stand for experiments of unconventional electromechanical microadrivers (Stand specific experimentelor pentru microacționări electromecanice neconvenționale)* - Călin Mircea Rusu, student at Faculty of Physics and Matei Sarivan, "Tudor Vianu" National College;
- *Approaching the specific software for micro-technologies (Abordarea unor softuri specifice pentru microtehnologii)* - Alex Glonțaru, "Tudor Vianu" National College;
- *Spiru Haret and educational reform: model from contemporary (Spiru Haret și reforma sistemului educațional: model pentru contemporani)* - Tudor Vișan Miu, "Gheorghe Lazăr" National College.

The seminar papers were published in **Bulletin of Micro and Nanoelectrotechnologies**, ISSN 2069-1505.

(Drawn up: Dr. Eng. Mircea Ignat, organizer from INCDIE ICPE-CA of this event)

National and international trade fairs and exhibitions at which INCDIE ICPE-CA attended and results

International trade fairs and exhibitions 2014

No.	International trade fair / exhibition	Results of INCDIE ICPE-CA
1	The **42nd International Exhibition of Inventions**, April 2 – 6, 2014, Geneva - Switzerland **Bronze Medal** for invention ***Plant for superconducting coil active protection at superconductive motors*** **Bronze Medal** for invention ***Inertial electromagnetic microgenerator***	♦ Plant for superconducting coil active protection at superconductive motors *(Instalație pentru protecția activă a bobinei supraconductoare la motoare supraconductoare)* Authors: **Pîslaru-Dănescu Lucian, Dobrin Ion, Stoica Victor,** Lipan Laurențiu C., Pisică Ioana ♦ Inertial electromagnetic microgenerator *(Microgenerator electromagnetic inerțial)* Authors: **Cătănescu Alexandru-Laurențiu, Ignat Mircea, Puflea Ioan, Tinca Ion**
2	The 63rd edition of ***International Salon Brussels – EUREKA,*** November 13 - 15, 2014, Brussels - Belgium **Gold Medal** for invention ***Material for orthopaedic implant*** **Silver Medal** for invention ***Equipment for hydraulic energy conversion from water streams*** **Silver Medal** for invention ***High magnetic field superconducting generator***	♦ Material for orthopaedic implant *(Material pentru implant ortopedic)* Authors: ***Iordoc Mihai, Teișanu Aristofan, Prioteasa Paula, Codescu Mirela*** ♦ Equipment for hydraulic energy conversion from water streams *(Hidroagregat de conversie a energiei hidraulice extrase din cursurile de apă curgătoare)* Authors: ***Mihaiescu Ghe.Mihai, Popescu Mihail, Nicolaie Sergiu, Oprina Gabriela, Chiriță Ionel, Tănase Nicolae, Chihaia Rareș Andrei, Mituleț Lucia Andreea, Nedelcu Adrian*** ♦ High magnetic field superconducting generator *(Generator supraconductor de câmp magnetic intens)* Authors: ***Dobrin Ion, Nedelcu Adrian, Stoica Victor, Tănase Nicolae, Dan Daniel Vasile***

3	**International Innovation Exhibition ARCA 2014**, October 15-18, 2014, Zagreb - Croatia **Silver Medal** for invention ***The plant for active protection of superconducting coil at superconductive motors***	♦ The plant for active protection of superconducting coil at superconductive motors Authors: **Pîslaru-Dănescu Lucian, Dobrin Ion, Stoica Victor**, Lipan Laurențiu Constantin, Pisică Ioana
4	**European Exhibition of Creativity and Innovation EUROINVENT 2014** **(Expoziția Europeană a Creativității și Inovării)** May 22-24, 2014 Iași, Romania **Gold Medal** for invention ***Automated nondestructive examination system for heat exchanger tubes***	♦ Automated nondestructive examination system for heat exchanger tubes Authors: *Nicolae Farbaş, Raimond Grimberg, **Iuliu Popovici***
5	The 21st edition of International Conference and Exhibition of Hydraulics and Pneumatics "HERVEX 2014", Călimănești – Căciulata, November 05 – 07, 2014 	♦ It was presented the paper: "*Improving the efficiency of energy conversion for contrarotating wind generators using innovative electric generators*" and at exhibition was presented the following products: a. Submersible microhidrogenerator with signalling light; b. Wind turbine with double effect and vertical axis.

National trade fairs and exhibitions

No.	National trade fair / exhibition	Results of INCDIE ICPE-CA
1	**INVENTIKA 2014**, Bucharest, October 15-18, 2014 	INCDIE ICPE-CA attended with 10 patents submitted at OSIM to be evaluated: - **Magnetostrictive sonic motor with electronic module drive** (*Motor sonic magnetostrictiv cu modul electronic de acționare*), authors: ***Pîslaru-Dănescu Lucian,*** *Morega Alexandru Mihail, Morega Mihaela, Lipan Laurentiu Constantin,* ***Bunea Florentina;*** - **Procedure for obtaining planar junctions of carbonic material-steel type** (*Procedeu de obținere joncțiuni planare de tip material carbonic-oțel*), authors: ***Lungu Magdalena Valentina, Ion Ioana, Enescu Elena, Lucaci Mariana, Grigore Florentina, Brătulescu Alexandra;*** - **High magnetic field superconducting generator** (*Generator supraconductor de câmp magnetic intens*), authors: ***Dobrin Ion, Nedelcu Adrian, Stoica Victor, Tănase Nicolae, Dan Daniel-Vasile;*** - **Realization procedure for a permanent magnet synchronous motor inductor with self-starting function** (*Procedeu de realizarea unui inductor pentru motor sincron cu magneți permanenți și autopornire*), authors: ***Popescu Mihail, Kappel Wilhelm, Nicolaie Sergiu, Mihaiescu Gheorghe Mihai;*** - **The plant for active protection of superconducting coil at superconducting motors** (*Instalație pentru protecția activă a bobinei supraconductoare la motoare supraconductoare*), authors: ***Pîslaru-Dănescu Lucian, Dobrin Ion, Stoica Victor***, *Lipan Laurențiu Constantin, Pisica Ioana;* - **Inductor-armature structure without ferromagnetic core for electric machines with permanent magnets** (*Structura inductor-indus fără miez magnetic pentru mașini electrice cu magneți permanenți*), authors: ***Kappel Wilhelm, Mihăiescu Gheorghe Mihai, Ilie Cristinel Ioan,*** *Gavrilă Horia Cătălin, Vasile Iulian;* - **Material for hydrogen storage in intermetallic compounds of AB_5 type and procedure for its obtaining** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB_5 și procedeu de obținere*), authors: ***Lucaci Mariana, Enescu Elena, Lungu Magdalena Valentina;*** - **Inertial electromagnetic microgenerator** (*Generator electromagnetic inerțial*), authors: ***Cătanescu Alexandru-Laurentiu, Ignat Mircea, Puflea Ioan, Tincă Ion;*** - **Equipment for hydraulic energy conversion from water streams** (*Hidroagregat de conversie a energiei hidraulice extrase din cursurile de apă curgătoare*), authors: ***Mihaiescu Gheorghe Mihai, Popescu Mihail, Nicolaie Sergiu, Oprina Gabriela, Chiriță Ionel, Tănase Nicolae, Chihaia Rareș-Andrei, Mituleț Lucia-Andreea, Nedelcu Adrian;***

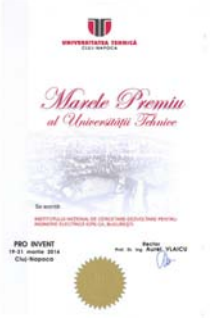
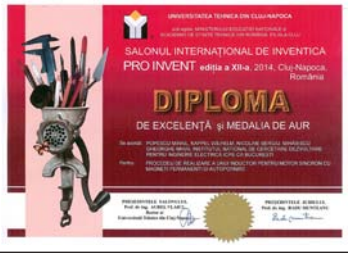
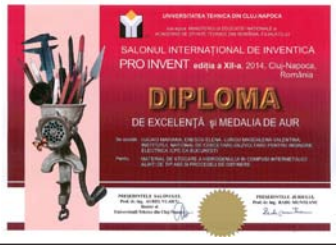
		- **Metallic micro-wire for electromagnetic shields fabric** (*Microfire metalice pentru țesături de ecranare electromagnetică*), authors: ***Pătroi Eros Alexandru, Erdei Remus, Codescu Mirela-Maria, Manta Eugen, Pătroi Delia, Iorga Alexandru, Morari Cristian***, *Loghin Carmen.*
2	**Romanian Research Exhibition 2014**, Bucharest, October 15-18, 2014 DIPLOMĂ se acordă INSTITUTULUI NAȚIONAL DE CERCETARE-DEZVOLTARE PENTRU INGINERIE ELECTRICĂ ICPE-CA BUCUREȘTI cu ocazia SALONULUI CERCETĂRII ROMÂNEȘTI 15 - 18 OCTOMBRIE 2014 | București, România Mihnea COSTOIU Ministru delegat Cătălin TRIFU Director General ROMEXPO S.A. **Medal** and **participation Diploma** at **Romanian Research Exhibition 2014**	Products: - **Composite polymeric nanofibers** (*Nanofibre polimerice composite*) (Băra Adela, Chițanu Felicia); - **Supercapacitors with electrodes of polymer-CNT hybrid electroactive material** (*Supercapacitori cu electrozi din materiale electroactive hibride polimer-CNT*) (Băra Adela); - **Carbon fibers** (*Fibre de carbon*) (Băra Adela); - **Lightweight carbon fibers based composite structure for electronics housing in satellites** (*Structură compozită ușoară pe bază de fibre de carbon pentru incintele de protecție a electronicii în sateliți*) (Băra Adela, Teișanu Aristofan); - **Advanced composite materials of carbonic material - steel type realized by physical-mechanical joining** (*Materiale compozite avansate de tip carbon-oțel realizate prin joncțiuni fizico-mecanice*) (Lungu Magdalena); - **Flexible electromagnetic shields** (*Ecrane flexibile pentru protecție electromagnetică*) (Codescu Mirela); - **Materiale magnetic moi pe baza de nanoparticule $FeNi_3/Al_2O_3$ si $FeCo/Al_2O_3$** (*Materiale magnetic moi pe bază de nanoparticule $FeNi_3/Al_2O_3$ și $FeCo/Al_2O_3$*) (Codescu Mirela); - **Graphite - ceramic junctions** (*Joncțiuni grafit-ceramică*) (Tsakiris Violeta) - **Steel/DLC planar junctions** (*Joncțiuni planare Otel/DLC*) (Lucaci Mariana); - **Bulk metallic glasses (BMG)** (*Sticle metalice amorfe*) (Lucaci Mariana); - **Calcium phosphate porous microspheres for bone healing** (*Microsfere microporoase pe bază de fosfați de calciu pentru reparații osoase*) (Țârdei Christu); - **Granular product based on beta-TCP for bone reconstruction** (*Produs granular pe bază de -TCP pentru reconstrucție osoasă*) (Țârdei Christu); - **Active piezoelectric elements (disks, rings) based on lead zirconate titanate system Pb (Ti, Zr) O3 modified with niobium (Nb)** (*Elemente active (discuri) din material piezoceramic aparținând sistemului titanat-zirconat de plumb Pb (Ti, Zr)O_3 modificat cu niobiu (Nb)*) (Dumitru Alina); - **Ceramic scaffolds based on calcium phosphate** (*Structuri 3D ceramice pe bază de fosfați de calciu*) (Grigore Florentina); - **Functionalized graphene with silver nanoparticles** (*Soluții coloidale de grafene funcționalizate*) (Ion Ioana); - **Colloidal graphene solutions** (*Soluții coloidale de grafene*) (Ion Ioana);

		- **Permanent magnets without rare earths** (*Magneţi permanenţi fără pământuri rare*) (Pătroi Eros); - **NiTi shape memory materials obtained by powder metallurgy** (*Materiale cu memoria formei de tip NiTi realizate prin metalurgia pulberilor*) (Cîrstea Diana); - **Pressure sensor** (*Senzor de presiune*) (Iordache Iulian); - **Nanocomposites based on Ti functionalized with HAP for medical applications** (*Nanocompozite pe bază de Ti funcţionalizate cu HAP pentru aplicaţii medicale*) (Tălpeanu Dorinel); - **Accelerometer** (*Traductor piezoelectric pentru măsurarea vibraţiilor mecanice (Accelerometru)*) (Dumitru Alina); - **Electrical Contacts for low voltage vacuum contactors** (*Contacte electrice pentru contactoare în vid de joasă tensiune*) (Tsakiris Violeta); - **Procedure for obtaining of a composite material based on tungsten for electrical contacts** (*Procedeu de obţinere a unui material compozit pe bază de wolfram pentru contacte electrice*) (Tsakiris Violeta); - **Microsensors matrix for procedures and assessments in medical rehabilitation of the lower limbs and sports** (*Matrici de microsenzori pentru proceduri specifice şi evaluări în domeniul reabilitării medicale a membrelor inferioare şi sportului*) (Ignat Mircea); - **Acceleration transducer** (*Traductor de acceleraţie*) (Popovici Iuliu, Lipcinski Daniel, Dumitru Alina, Ilie Cristinel, Popa Marius); - **Capacitive deionization module** (*Model funcţional - modul de desalinizare*) (Hristea Gabriela); - **Power generation system which uses a double - effect wind turbine in order to ensure the energy autonomy in specific applications** (*Sistem de generare a energiei electrice utilizând turbina eoliană cu dublu efect, pentru asigurarea autonomiei energetice în aplicaţii specifice*) (Nicolaie Sergiu, Popescu Mihail, Mihăiescu Mihai, Chiriţă Ionel, Oprina Gabriela, Mituleţ Andreea, Chihaia Rareş, Nedelcu Adrian); - **Magnetostrictive sonic motor with electronic module drive** (*Motor sonic magnetostrictiv cu modul electronic de acţionare*) (Pîslaru-Dănescu Lucian, Morega Alexandru Mihail, Morega Mihaela, Lipan Laurenţiu Constantin, Bunea Florentina); - **Apparatus for in situ resistivity measuring reinforced concrete structures** (*Aparat destinat măsurării in situ a rezistivităţii betonului din structurile de rezistenţă din beton armat*) (Pîslaru-Dănescu Lucian, Lingvay Iosif, Lingvay Carmen, Velciu Georgeta);

		- **Components and microelectromechanical systems produced by specific technologies with applications in medicine and microfluidic** (*Componente și sisteme microelectromecanice realizate prin tehnologii specifice cu aplicații în medicină și microfluidică*) (Ilie Cristinel, Popa Marius, Tănase Nicolae, Chiriță Ionel, Iordache Iulian, Nedelcu Adrian); - **Permanent magnet AC superconductive electric generator** (*Generator electric supraconductor de c.a. cu magneți permanenți*) (Dobrin Ion, Pîslaru-Dănescu Lucian, Popescu Mihai, Cîrnaru Radu, Popovici Iuliu, Stoica Victor); - **High magnetic field superconductive generator** (*Generator supraconductor de câmp magnetic intens*) (Dobrin Ion, Nedelcu Adrian, Dan Daniel, Popovici Iuliu, Stoica Victor, Tănase Nicolae); - **Light rig for water wells drilling FA 100** (*Instalația ușoară de forat puțuri de apă FA 100*) (Fica Sorin Alexandru, Marin Georgiana).
3	**International Inventions Show PRO INVENT 2014**, 12th edition, Cluj-Napoca, March 19-21, 2014 - **Great Prize** of the **Technical University of Cluj-Napoca, Romania**; - **Diploma of Excellence** and **Gold Medal** for: **Material for hydrogen storage in intermetallic compounds of AB5 type and procedure for its obtaining** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB5 și procedeu de obținere)*; - **Diploma of Excellence** and **Gold Medal** for: **Procedure for a permanent magnet synchronous motor inductor with self-starting function** (*Procedeu de realizare a unui inductor pentru motor sincron cu magneți permanenți și autopornire)*; - **Second Prize** awarded by Politehnica University of Bucharest for: **Material for hydrogen storage in intermetallic compounds of AB5 type and procedure for its obtaining** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB5 și procedeu de obținere)*	**Material for hydrogen storage in intermetallic compounds of AB5 type and procedure for its obtaining** *(Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB5 și procedeu de obținere)* **Procedure for a permanent magnet synchronous motor inductor with self-starting function** (*Procedeu de realizare a unui inductor pentru motor sincron cu magneți permanenți și autopornire)*

National awards (granted by Romanian Academy, National University Research Council CNCSIS, other)

International Awards obtained by a selection process in 2014

No.	Prize	Authority who granted	Authors
1.	**Great Prize of the Technical University of Cluj-Napoca** awarded to INCDIE ICPE-CA for inventions from International Inventions Show **Pro Invent 2014** 	International Inventions Show PRO INVENT Cluj Napoca – Technical University of Cluj-Napoca - Rector	**INCDIE ICPE-CA**
2.	**Diploma of Excellence** and **Gold Medal** at International Inventions Show PRO INVENT 2014, for the invention ***Procedure for a permanent magnet synchronous motor inductor with self-starting function*** *(Procedeu de realizare a unui inductor pentru motor sincron cu magneți permanenți și autopornire)* 	International Inventions Show PRO INVENT Cluj Napoca – International Panel	**Popescu Mihail** **Kappel Wilhelm** **Nicolaie Sergiu** **Mihaiescu Gheorghe** **Mihai**
3.	**Diploma of Excellence** and **Gold Medal** at International Inventions Show PRO INVENT 2014, for the invention ***Material for hydrogen storage in intermetallic compounds of AB5 type and procedure for its obtaining*** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB_5 și procedeu de obținere)* 	International Inventions Show PRO INVENT Cluj Napoca – International Panel	**Lucaci Mariana** **Enescu Elena** **Lungu Magdalena Valentina**

4.	**Gold Medal** at International Inventions Show PRO INVENT 2014, for the invention ***The plant for active protection of superconducting coil at superconducting motors*** (*Instalație pentru protecția activă a bobinei supraconductoare la motoare supraconductoare)*	International Inventions Show PRO INVENT Cluj Napoca – International Panel	**Pîslaru-Dănescu Lucian** **Dobrin Ion** **Stoica Victor**
5.	**Gold Medal** at International Inventions Show PRO INVENT 2014, for the invention ***Inertial electromagnetic microgenerator*** (*Microgenerator electromagnetic inerțial)*	International Inventions Show PRO INVENT Cluj Napoca – International Panel	**Cătănescu Alexandru Laurențiu** **Ignat Mircea** **Puflea Ion** **Tinca Ion**
6.	**Diploma – Second Prize** – awarded by Politehnica University of Bucharest at International Inventions Show PRO INVENT Cluj Napoca 2014, for invention ***Material for hydrogen storage in intermetallic compounds of AB_5 type and procedure for its obtaining*** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB_5 și procedeu de obținere)*	International Inventions Show PRO INVENT Cluj Napoca - Politehnica University of Bucharest	**Lucaci Mariana** **Enescu Elena** **Lungu Magdalena Valentina**
7.	**Bronze Medal** at International Exhibition of Inventions - Geneva 2014, for invention ***The plant for active protection of superconducting coil at superconducting motors*** (*Instalație pentru protecția activă a bobinei supraconductoare la motoare supraconductoare)*	International Exhibition of Inventions - Geneva – International Panel	**Pîslaru-Dănescu Lucian** **Dobrin Ion** **Stoica Victor**
8.	**Bronze Medal** at International Exhibition of Inventions - Geneva 2014, for invention ***Inertial electromagnetic microgenerator*** (*Microgenerator electromagnetic inerțial)*	International Exhibition of Inventions - Geneva – International Panel	**Cătănescu Alexandru Laurențiu** **Ignat Mircea** **Puflea Ion** **Tinca Ion**
9.	**Diploma** and **Gold Medal** at **European Exhibition of Creativity and Innovation Euroinvent** Iași – 2014 for invention ***Automated nondestructive examination system for heat exchanger tubes*** (*Sistem automat de examinare nedistructivă a țevilor din plăci tubulare)*	European Exhibition of Creativity and Innovation, Iași - International Jury	Farbas Nicolae Grimberg Raimond **Popovici Iuliu**
10.	**Gold Medal** at International Salon of Innovations Warsaw - IWIS 2014 awarded to INCDIE IICPE-CA	International Salon of Innovations Warsaw – International Panel	**INCDIE ICPE-CA**
11.	**Diploma** awarded to INCDIE ICPE-CA at Romanian Research Exhibition 2014, October 15-18, 2014 – Bucharest International Technical Fair	Ministry of National Education, Delegate Minister	**INCDIE ICPE-CA**
12.	**Gold Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention **Inductor-armature structure without ferromagnetic core for electric machines with permanent magnets** (*Structură inductor – indus fără miez magnetic pentru mașini electrice cu magneți permanenți)*	Ministry of National Education, Delegate Minister	**Kappel Wilhelm** **Mihaiescu Gheorghe Mihai** **Ilie Cristinel** Gavrilă Horia Cătălin Vasile Iulian

13	**Gold Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Material for hydrogen storage in intermetallic compounds of AB_5 type and procedure for its obtaining*** (*Material de stocare a hidrogenului în compuși intermetalici aliați de tip AB_5 și procedeu de obținere)*	Ministry of National Education, Delegate Minister	**Lucaci Mariana** **Enescu Elena** **Lungu Magdalena Valentina**
14	**Gold Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Equipment for hydraulic energy conversion from water streams*** *(Hidroagregat de conversie a energiei hidraulice extrase din cursurile de apă curgătoare)*	Ministry of National Education, Delegate Minister	**Mihaiescu Gheorghe Mihai** **Popescu Mihail** **Nicolaie Sergiu** **Oprina Gabriela** **Chiriță Ionel** **Tănase Nicolae** **Chihaia Rareș Andrei** **Mituleț Lucia Andreea** **Nedelcu Adrian**
15.	**Gold Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention **Magnetostrictive sonic motor with electronic module drive** (*Motor sonic magnetostrictiv cu modul electronic de acționare)*	Ministry of National Education, Delegate Minister	**Pîslaru Dănescu Lucian** Morega Alexandru Morega Mihaela Lipan Laurențiu Constantin **Bunea Florentina**
16.	**Gold Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***High magnetic field superconducting generator*** (*Generator supraconductor de camp magnetic intens)*	Ministry of National Education, Delegate Minister	**Dobrin Ion** **Nedelcu Adrian** **Stoica Victor** **Tănase Nicolae** **Dan Daniel Vasile**
17.	**Silver Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Procedure for obtaining planar junctions of carbonic material-steel type*** *(Procedeu de obținere joncțiuni planare de tip material carbonic-oțel)*	Ministry of National Education, Delegate Minister	**Lungu Magdalena Valentina** **Ion Ioana** **Tsakiris Violeta** **Enescu Elena** **Lucaci Mariana** **Grigore Florentina** **Brătulescu Alexandra**
18	**Silver Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Procedure for a permanent magnet synchronous motor inductor with self-starting function*** *(Procedeu de realizare a unui inductor pentru motor sincron cu magneți permanenți și autopornire)*	Ministry of National Education, Delegate Minister	**Popescu Mihail** **Kappel Wilhelm** **Nicolaie Sergiu** **Mihaiescu Gheorghe Mihai**
19.	**Silver Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Metallic micro-wire for electromagnetic shields fabric*** *(Microfire metalice pentru țesături de ecranare electromagnetică)*	Ministry of National Education, Delegate Minister	**Pătroi Eros Alexandru** **Erdei Remus** **Codescu Mirela Maria** **Manta Eugen** **Pătroi Delia** **Iorga Alexandru** **Morari Cristian** Loghin Carmen

20.	**Silver Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***The plant for active protection of superconducting coil at superconducting motors*** (*Instalație pentru protecția activă a bobinei supraconductoare la motoare supraconductoare)*	Ministry of National Education, Delegate Minister	**Pîslaru-Dănescu Lucian** **Dobrin Ion** **Stoica Victor** Lipan Laurențiu Constantin Pisică Ioana
21.	**Silver Medal** at Invention and Innovation Show INVENTIKA – TIB, October 15-18, 2014, Bucharest, for invention ***Inertial electromagnetic microgenerator*** (*Generator electromagnetic inerțial)*	Ministry of National Education, Delegate Minister	**Cătănescu Alexandru Laurențiu** **Ignat Mircea** **Puflea Ioan** **Tinca Ion**
22.	**Gold Medal** at International Invention Salon – Brussels 2014, for invention **Material for orthopaedic implant** (*Material pentru implant ortopedic)*	International Salon Brussels – EUREKA – International Panel	**Iordoc Mihai Nicolae** **Codescu Mirela Maria** **Teișanu Aristofan Alexandru** **Prioteasa Paula**
23.	**Silver Medal** at International Invention Salon – Brussels 2014, for invention **Equipment for hydraulic energy conversion from water streams** (*Hidroagregat de conversie a energiei hidraulice extrase din cursurile de apă curgătoare)*	International Salon Brussels – EUREKA – International Panel	**Mihaiescu Gheorghe Mihai** **Popescu Mihail** **Nicolaie Sergiu** **Oprina Gabriela** **Chiriță Ionel** **Tănase Nicolae** **Chihaia Rareș Andrei** **Mituleț Lucia Andreea** **Nedelcu Adrian**
24.	**Silver Medal** at International Invention Salon – Brussels 2014, for invention ***High magnetic field superconducting generator*** (*Generator supraconductor de câmp magnetic intens)*	International Salon Brussels – EUREKA – International Panel	**Dobrin Ion** **Nedelcu Adrian** **Stoica Victor** **Tănase Nicolae** **Dan Daniel Vasile**
25.	**Silver Award** at *12th edition of International Innovation Exhibition ARCA 2014,* October 15-18, 2014, Zagreb – Republic of Croatia 	Union of Croatian Innovators	**Pîslaru-Dănescu Lucian** **Dobrin Ion** **Stoica Victor** Lipan Laurențiu Constantin Pisică Ioana

National Awards (granted by Romanian Academy, National University Research Council CNCSIS, other) in 2014

No.	Prize	Authority who granted	Authors
1.	**Plaquette** awarded by Avrig City – Centre for Renewable Energy	Avrig City Hall	**INCDIE ICPE-CA**
2.	**Diploma of Excellence** awarded to INCDIE ICPE-CA *for supporting activity of RDI-CCIB "Top companies from Bucharest 2013" ("Topul firmelor din București 2013")*, 21st edition, October 2014	Trade and Industry Chamber of Bucharest, Romania (*Camera de Comerț și Industrie a Municipiului București*)	**INCDIE ICPE-CA**

PATENTS SUBMITTED AT STATE OFFICE FOR INVENTIONS AND TRADEMARKS (OSIM) – TO BE EVALUATED – in 2014

No.	*Title of submitted patent / registration no.*	*Inventors / Applicants*
1	*Sensor of CO_2 concentration with sensitive element with organo-siloxanic supramolecular polymer* (Senzor de concentraţie Co_2 cu element sensibil cu polimer supramolecular organo-siloxanic) Registration no. A/00510/2014	**Pîslaru-Dănescu Lucian** **Telipan Gabriela** Racleş Carmenus
2	*Planar junctions with functional gradient and obtaining procedure* (Joncţiuni planare cu gradient funcţional şi procedeu de obţinere) Registration no. A/00581/2014	**Lungu Magdalena Valentina** **Ion Ioana** **Lucaci Mariana** **Tălpeanu Dorinel** **Marinescu Virgil** **Tsakiris Violeta** **Cîrstea Cristiana Diana** **Brătulescu Alexandra**
3	*Composite material for supercapacitors* (Material compozit pentru supercapacitori) Registration no. A/00643/2014	**Băra Adela** **Iordoc Mihai Nicolae** **Prioteasa Paula** **Teişanu Aristofan Alexandru**
4	*Hybrid wind generator with radial magnetic flux and external rotor* (Generator eolian hibrid cu flux magnetic radial şi rotor exterior) Registration no. A/00838/2014	**Nicolaie Sergiu** **Popescu Mihail**
5	*Hybrid wind generator with radial magnetic flux and internal rotor* (*Generator eolian hibrid cu flux magnetic radial şi rotor interior*) Registration no. A/00839/2014	**Nicolaie Sergiu** **Popescu Mihail**
6	*Hybrid wind generator with axial magnetic flux* (Generator eolian hibrid cu flux magnetic axial) Registration no. A/00840/2014	**Nicolaie Sergiu** **Popescu Mihail**
7	*Procedure of obtaining nanostructured Ag based conductive adhesive composition* (Procedeu de obţinere a compoziţiei adezive conductive pe bază de Ag nanostructurat) Registration no. A/008572014	**Mălăeru Teodora** **Neamţu Jenica** **Georgescu Gabriela** **Marinescu Virgil** **Pătroi Delia**

No.	*Title of submitted patent / registration no.*	*Inventors / Applicants*
8	*Magnetostrictive linear motor* (Motor liniar magnetostrictiv) Registration no. A/00879/17.11.2014	**Pîslaru- Danescu Lucian** **Popa Marius** **Bunea Florentina** **Chihaia Rareş Andrei** Morega Alexandru Mihail Morega Mihaela Gabor Dumitriţa Flore Lica Popescu Ionel
9	*Auto–assembled films obtaining procedure* (Procedeu de obţinere filme auto-asamblate) Registration no. A/00929/2014	**Hristea Gabriela** **Iordoc Mihai** **Prioteasa Paula**
10.	*NiTi type shape memory half-finished materials and obtaining procedure* (Materiale semifabricate cu memoria formei de tipul NiTi şi procedeu de obţinere) Registration no. A/00930/2014	**Cîrstea Cristiana Diana** **Lungu Magdalena Valentina** **Ion Ioana** **Sbârcea Beatrice Gabriela** **Stancu Nicolae**
11.	*Electrolytic gel supercapacitor* (Supercapacitor cu electrolit gel) Registration no. A/00931/2014	**Iordoc Mihai Nicolae** **Teişanu Aristofan Alexandru** **Băra Adela** **Prioteasa Paula** **Banciu Cristina**

PATENTS GRANTED / DECISION to grant in INCDIE ICPE-CA in 2014

No.	*Title of patent granted / no. of patent*	*Inventors / Applicants*
1.	*Structure inductor – induced without magnetic core for permanent magnet electrical machines* (Structura inductor-indus fără miez magnetic pentru maşini electrice cu magneţi permanenţi) Patent no. 123604	**Kappel Wilhelm** **Mihaiescu Gheorghe Mihai** **Ilie Cristinel Ioan** Gavrilă Horia Cătălin Vasile Iulian
2.	*Epoxy resin based electroconductive material and conductive fillers for fuel cells* (Material electroconductiv bazat pe răşini epoxidice şi fileri conductivi pentru pile de combustie) Patent no. 127059	**Rîmbu Gimi Aurelian** Borbath Istvan Boros Tiberiu Francisc **Iordache Iulian** **Teişanu Alexandru Aristofan** **Vasilescu Mirea Radu** **Iordoc Mihai** **Băra Adela** **Banciu Cristina**
3.	*Biogas obtaining installation* (Instalaţie de obţinere a biogazului) Patent no. 125902	**Mateescu Carmen** **Chiriţă Ionel** **Stancu Nicolae** **Băbuţanu Corina Alice**
4.	*Perovskit type ceramic material composition* (Compoziţie de material ceramic de tip perovskit) Patent no. 128735	**Velciu Georgeta** Preda Maria Melinescu Alina **Rîmbu Gimi Aurelian** **Dumitru Alina Iulia**
5.	*Doped carbonic xerogel material for fuel cells with polymer membrane* (Material xerogel carbonic dopat pentru pile de combustie cu membrane polimericã) Patent no. 125703	**Hristea Gabriela** Alexandru Elena Camelia

No.	*Title of patent granted / no. of patent*	*Inventors / Applicants*
6.	*Transformer with magnetic nano-fluid as cooling agent* (Transformator cu agent de răcire nanofluid magnetic) *Hotarare de acordare no. 6/11/29.08.2014*	**Pîslaru Dănescu Lucian** **Telipan Gabriela** **Pintea Jana**
7.	*Purging mud treatment procedure for metanogen microorganisms activity stimulation* (Procedeu de tratare a nămolurilor de epurare pentru stimularea activităţii microorganismelor metanogene) Patent no. 126398	**Mateescu Carmen**
8.	*Automated system of nondestructive examination of tube blocks pipes* (Sistem automat de examinare nedistructivă a ţevilor din plăci tubulare) Patent no. 125632	Farbaş Nicolae Grimberg Raimond **Popovici Iuliu**
9.	*Installation for superconducting coil active protection at superconducting motors* (Instalaţie pentru protecţia activă a bobinei supraconductoare la motoare supraconductoare) Patent no. 128881	**Pîslaru Danescu Lucian** **Dobrin Ion** **Stoica Victor** Lipan Laurenţiu Constantin Pisică Ioana
10.	*Procedure of obtaining shape memory material of NiTi alloy intermetallic compound type* (Procedeu de obţinere a materialelor cu memorie a formei de tip compus intermetalic NiTi aliat) Patent no. 126126	**Lucaci Mariana** **Enescu Elena** **Tsakiris Violeta**
11.	*Piezoelectric sensor for dynamic viscosity measurement and measurement circuit* (Senzor piezoelectric de măsurare a vâscozităţii dinamice şi circuit de măsurare) Patent no. 128865	**Pîslaru-Danescu Lucian** **Pintea Jana** **Dumitru Alina Iulia** **Oprina Gabriela** **Băbuţanu Corina Alice** Lipan Laurenţiu Catalin Pisică Ioana
12.	*Polymer based microactuator* (Microactuator pe bază de polimer) Decision to grant no. 6/79/30.07.2014	**Ignat Mircea**
13.	*Epoxy resin based electroconductive material* (Material electroconductiv pe bază de rășini epoxidice) Patent no. 125882	**Teişanu Aristofan Alexandru** **Chiţanu Elena** **Vasilescu Mirea Radu Bujor** Roşu Dorin
14.	*Dispersed structure ceramic in stabilized vitreous phase of SiO_2 for dental technique caster structure* (Ceramică cu structură dispersoidă în fază vitroasă stabilizată de SiO_2 pentru producerea de creuzete pentru tehnica dentară) Patent no.125015	**Şeitan Cristian**
15.	*Humidity microsensor* (Microsenzor de umiditate) Decision to grant no. 6/08/29.08.2014	**Ignat Mircea** **Hristea Gabriela**

No.	*Title of patent granted / no. of patent*	*Inventors / Applicants*
16.	*Carbonic material for water capacitive deionization and obtaining procedure* (Material carbonic pentru deionizare capacitivă a apei şi procedeu de obţinere) Decision to grant no. 3/137/28.11.2014	**Hristea Gabriela** **Leonat Lucia-Nicoleta**

Scientific / technical papers published in specialized ISI quoted journals[1]

year 2014

No.	Title	ISI quoted Journal	Authors	Impact factor of ISI quoted journal in 2013
1	*Study of electrode processes and deposition of cobalt thin films from ionic liquid analogues based on choline chloride*	Journal of Solid State Electrochemistry, dec. 2014 Print ISSN: 1432-8488, Online ISSN: 1433-0768 Doi: 10.1007/s10008-014-2711-9	Cojocaru Anca Mareș Lili Mariana **Prioteasa Paula** Anicăi Liana Vișan Teodor	2.234
2	*Quantum optical lithography from 1 nm resolution to pattern transfer on silicon wafer*	Journal of Optics and Laser Technology, vol. 60, pp. 80-84, august 2014, ISSN 0030-3992 doi:10.1016/j. optlastec.2014.01.016	Pavel E. Jinga S.I. Vasile B.S. Dinescu A. **Marinescu Virgil** Trusca R. Tosa N.	1.649
3	*Chitosan and Chitosan modified with glutaraldehyde microparticles for Pb(II) biosorption I. Microparticles preparation and characterization*	REV. CHIM. (Bucharest), 65, No. 6, p. 627-632, 2014 ISSN 0034-7752	Simonescu Claudia Maria Marin Irina **Țârdei Christu** Marinescu Virgil Oprea Ovidiu Căpățînă Camelia	0.677
4	*Chitosan and Chitosan modified with glutaraldehyde microparticles for Pb(II) biosorption II. Equilibrium and kinetic studies*	REV. CHIM. (Bucharest), 65, No.7, p. 750-756, 2014 ISSN 0034-7752	Simonescu Claudia Maria Marin Irina **Țârdei Christu** Dragne Mioara Căpățînă Camelia	0.677
5	*The influence of doping with transition metal ions on the structure and magnetic properties of zinc oxide thin films*	The Scientific World Journal, Vol. 2014, Feb. 2014; 7 pages ISSN 1537-744X	**Neamțu Jenica** Volmer Marius	1.219
6	*Simultaneous TG/DTG–DSC–FTIR characterization of collagen in inert and oxidative atmospheres*	Journal of Thermal Analysis and Calorimetry, vol. 115, issue 3 (March 2014), pp. 2079–2087 ISSN Print: 1388-6150 ISSN online: 1588-2926	**Cucoș Andrei** **Budrugeac Petru**	2.206
7	*DMA and DSC studies of accelerated aged parchment and vegetable-tanned leather samples*	Thermochimica Acta, vol. 583 (May 2014), pp. 86–93 ISSN 0040-6031	**Cucoș Andrei** **Budrugeac Petru** Miu Lucreția	2.105

[1] 1 indexed by Thomson Scientific (former Institute for Scientific Information-ISI) in Science Citation Index Expanded, Social Sciences Citation Index or Arts & Humanities Citation Index.

No.	Title	ISI quoted Journal	Authors	Impact factor of ISI quoted journal in 2013
8	*Joining of C/SiC materials by spark plasma sintering*	Advanced Materials Research Vol. 1029 (2014) p 200-205, (2014) Trans Tech Publications, Switzerland, web ISSN:1662-8985, ISSN print: 1022-6680 doi:10.4028/www.scientific.net/AMR.1029.200	**Tsakiris Violeta** **Kappel Wilhelm** **Tălpeanu Dorinel** **Albu Florentina** **Pătroi Delia** **Marinescu Virgil**	-
9	*Nanostructured W-Cu electrical contact materials processed by hot isostatic pressing*	Acta Physica Polonica A, Vol 125 (2014), No. 2, p. 348-352, ISSN: [e]1898-794X ; [p]0587-4246	**Tsakiris Violeta** **Lungu Magdalena** **Enescu Elena** Pavelescu Dan Dumitrescu Gheorghe Radulian Alexandru Mocioi Nicolae	0.604
10	*Development of W-Cu-Ni electrical contact materials with enhanced mechanical properties by spark plasma sintering process*	Acta Physica Polonica A, vol. 125, nr. 2, feb. 2014, p. 327-3330 DOI:10.12693/APhysPolA.125.327 ISSN 0587-4246	**Lungu Magdalena** **Tsakiris Violeta** **Enescu Elena** **Pătroi Delia** **Marinescu Virgil** **Tălpeanu Dorinel** Pavelescu Dan Dumitrescu Gheorghe Radulian Alexandru	0.604
11	*Synthesis and characterization of a Ni/Ag nanomaterial*	Revista Română de Materiale (Romanian Journal of Materials), 2014, Volume: 44, Issue: 2, pages: 167-177 ISSN 1583-3186	Stroia Adrian Covaliu Cristina Ileana Căpitănescu Cristian **Georgescu Gabriela** Jitaru Ioana	0.538
12	Synthesis and characterization of solid electrolytes based on CeO_2 for intermediate temperature fuel cells *(Sinteza și caracterizarea unor electroliți solizi pe bază de CeO_2 pentru celule de combustie de temperatură intermediară)*	Romanian Journal of Materials (Revista Română de Materiale), 2014, 44 (2), pg. 131-140 ISSN 1583-3186	**Velciu Georgeta** Melinescu Alina **Marinescu Virgil** Fruth Victor Scurtu Rareș Preda Maria	0.538
13	*Thermal and radiation stability of polyolefins modified with silica nanoparticles*	Journals of Optoelectronics and Advanced Materials, Vol. 16, No. 5-6, p.719-725, 2014 ISSN 1454-4164	**Lungulescu Marius Eduard** **Zaharescu Traian** Pleșa Ilona Podina C.	0.563

No.	Title	ISI quoted Journal	Authors	Impact factor of ISI quoted journal in 2013
14	*Characterization of some therapeutic muds collected from different sites in Romania*	Revue Roumaine de Chimie, 58(7-8), 599-610 ISSN 0035-3930	**Setnescu Tanța** Băncuță I. **Setnescu Radu** Băncuță R. Chilian A. Bumbac M. Chelărescu E.D. **Culicov Otilia** Frontasyeva M.V.	0.393
15	*Study of chromium adsorption onto activated carbon*	Water Air and Soil Pollution 01/2014; 225(3):1889- 1894 ISSN 0049-6979	Zinicovscaia I. Mitina T. Lupașcu T. Duca Gh. Frontasyeva M. V. **Culicov Otilia Ana**	1.685
16	*Nostoc Linckia as biosorbent of Chromium and Nickel from electroplating industry wastewaters*	Journal of Materials Science and Engineering B – Advanced Funtional Solid-State Materials, vol. 4 (8) (2014), pp. 242-247 ISSN 0921-5107	Zinicovscaia I. Cepoi L. Valuta A. Rudi L. **Culicov Otilia Ana** Frontasyeva M.V. Kirkesali E.I. Pavlov S.S. Mitin T.	2.122
17	*System for diagnosis of rolling profiles of the railway vehicles* (Sistem pentru diagnostic de profile de rulare ale vehiculelor feroviare)	Mechanical Systems and Signal Processing, Volumul 48, Aspecte 1-2, 03 octombrie 2014, Pagini 153-161 ISSN 0888-3270	**Medianu Silviu Octavian** **Rîmbu Gimi Aurelian** **Lipcinski Daniel** **Popovici Iuliu** **Strâmbeanu Dumitru**	2.465
18	*Preparation of electromechanically active silicone composites and some evaluations of their suitability for biomedical applications*	Materials Science & Engineering C - Materials For Biological Applications, vol. 43, oct. 2014, pp. 392-402 doi:10.1016/j. msec.2014.07.031 ISSN 0928-4931	Iacob Mihail Bele Adrian Patras Xenia Pasca Sorin Butnaru Maria Alexandru Mihaela **Ovezea Dragoș** Cazacu Maria	2.736
19	*Study on the electromechanical properties of polyimide composites containing TiO_2 nanotubes and carbon nanotubes*	Journal of Polymer Research, vol. 21, issue 8, august 2014 ISSN 1022-9760 (print) ISSN 1572-8935 (online)	**Ignat Mircea** **Ovezea Dragoș** Hamciuc Elena Hamciuc Corneliu Dimitrov Lubomir	1.897
20	*Well-defined silicone-titania composites with good performances in actuation and energy harvesting*	Journal of Composite Materials, col. 48, 13, pp.1533-1545, June 2014 ISSN 0021-9983	Cazacu Maria **Ignat Mircea** Racles Carmen Cristea Mariana Musteață Valentina **Ovezea Dragoș** **Lipcinski Daniel**	1.257

No.	Title	ISI quoted Journal	Authors	Impact factor of ISI quoted journal in 2013
21	*Thermo and electro insulating protective layers with ceramic additives*	Korroziós figyelő, Vol 53. 2. 2013. pp. 50-55 (printed in 2014) ISSN 0133-2546	**Velciu Georgeta** Krammer A. ~~Stancu C.~~ **Lingvay C.** Szatmári I. **Lingvay J.**	0.143
22	*Underground power cables ageing. Case study – results of 5 year monitoring*	Korróziós figyelő, vol. 53, no.3, 2013, pp. 71-80 (printed in 2014) ISSN 0133-2546	**Lingvay J.** Szatmári I. Lingvay M.	0.143
23	*Aspergillus niger filamentous fungi initiated corrosion of S235J2G3 carbon steel*	Korróziós figyel , vol. 54, no.1, 2014, pp. 15-21 ISSN 0133-2546	**Lingvay J.** Szatmári I. **Prioteasa P.** Lingvay M.	0.143
24	*Thermal decomposition kinetics of bis(pyridine)manganese(II) chloride*	Journal of Thermal Analysis and Calorimetry, 115 (2014) 1999-2005 ISSN 1388-6150 (print version) ISSN 1588-2926 (electronic version)	Badea Mihaela **Budrugeac Petru** **Cucoş Andrei** Segal Eugen	2.206
25	*Use of thermal analysis methods to asses the damage in the bookbindings of some religious books from XVIII century, stored in Romanian libraries*	Journal of Thermal Analysis and Calorimetry, 116 (2014) 141-149 ISSN 1388-6150 (print version) ISSN 1588-2926 (electronic version)	**Budrugeac Petru** **Cucoş Andrei** Miu Lucreţia	2.206
26	*Study of crystallization process of soda lead silicate glasses by thermal and spectroscopic methods*	Journal of Thermal Analysis and Calorimetry, 117 (2014) 131-139 ISSN 1388-6150 (print version) ISSN 1588-2926 (electronic version)	Mocioiu Oana Cătălina Zaharescu Maria Atkinson Irina Mocioiu Ana-Maria **Budrugeac Petru**	2.206
27	*International comparison of measurements of hard magnets with the Vibrating Sample Magnetometer*	International Journal of Applied Electromagnetics and Mechanics, Volume 44, Issue 3-4, Pages: 245-252 ISSN print 1383-5416 ISSN online 1875-8800	Fiorillo F. Beatrice C. Son D. Ahlers H. Groessinger R. Albertini F. Liu Y.P. Lin A. **Pătroi Eros Alexandru** Shull R. Thomas. O. Hall M.J.	0.737

No.	Title	ISI quoted Journal	Authors	Impact factor of ISI quoted journal in 2013
28	*The influence of the metal sheet cutting technologies on the energy losses in non-oriented silicon iron alloys*	Revue Roumaine des Sciences Techniques - Serie Electrotechnique et Energetique, Volume 59, Issue 1, January-March 2014, Pages 47-55 ISSN 0035-4066	P Itânea V. P Itânea G. Gavril H. **Pătroi Eros** **Alexandru** Peter I.	0.368
29	*Improvement in the degradation resistance of LDPE for radiochemical processing*	Radiatiation Physics and Chemistry, 94, 151-155 (2014)	**Zaharescu Traian** Pleşa Ilona Jipa Silviu	1.189
30	*Radiation stability of polypropylene/lead zirconate composites*	Radiatiation Physics and Chemistry, 94, 156-160 (2014)	Burnea L. C. **Zaharescu Traian** **Dumitru Alina** Pleşa Ilona Ciuprina F.	1.189
31	*Radiation effects in polyisobutylene succinic anhydride modified with silica and magnetite nanoparticles*	Radiatiation Physics and Chemistry, 105, 22-25 (2014)	**Zaharescu Traian** Borbath I. Vékás L.	1.189
32	*Elemental content of edible oils studies by neutron activation analysis*	*Revue Roumaine de Chimie*, 8/2014	**Culicov Otilia** Zinicovscaia I. **Setnescu Tanţa** **Setnescu Radu** Frontasyeva M.V.	0.393
33	*Evaluation of powdered activated carbon performance for wastewater treatment containing inorganic pollutants*	*Environmental Engineering and Management Journal*, vol. 13, nr. 9, 2014	Matei E. Covaliu C.I. **Georgescu Gabriela** **Mălăeru Teodora** Stoian O.	1.258
Cumulative impact factor of ISI quoted journals				**39.539**

Scientific / technical papers published in ISI conference proceedings/publications

year 2014

No.	Title of scientific paper	ISI conference proceedings/ publications	Authors
1	*Influence of concentration on thermal and mechanical properties of elastomeric polyamide blends for industrial applications*	**Proceeding** THERMAM 2014 – Izmir, Turkey, 3rd Rostocker Symposium on Thermophysical Properties for Technical Thermodynamics, 12-15 iunie 2014, Cesme, Turcia ISBN: 978-605-84726-1-7, Page(s): 279-283	**Caramitu A.R.** **Zaharescu T.** **Tsakiris V.** Avădanei L. **Mitrea S.**
2	*Thermal resistance of EPDM/IIR systems under γ-irradiation*	International Nuclear Chemistry Conference, Maresias, Brazilia, 14-19 sept. 2014	**Zaharescu T.** Cardoso E.C.L. Scagliusi S.R. Zen H.A. Lugão A.B.
3	*Influence of antioxidant loading on the γ-exposure on ethylene-propylene terpolymer*	International Nuclear Chemistry Conference, Maresias, Brazilia, 14-19 sept. 2014	**Zaharescu T.** **Marinescu M.** Zen H.A. Scagliusi S.R. Cardoso E.C.L. Lugão A.B.
4	*Radiation effects in PA6/EPDM blends*	International Nuclear Chemistry Conference, Maresias, Brazilia, 14-19 sept. 2014	**Zaharescu T.** **Lungulescu M. E.** **Caramitu A. R.** **Marinescu V.**
5	*Improvement in the radiation stability of EPDM/incorporated EPDM powder/carbon black compounds*	International Nuclear Chemistry Conference, Maresias, Brazilia, 14-19 sept. 2014	Kayan L.I.P. **Zaharescu** T. Parra D.F. Lugão A. B.
6	*EPDM composite membranes modified with cerium doped lead zirconium titanate*	International Conference on Irradiation of Polymers, Jeju, Coreea de Sud, 5-9 oct. 2014	**Zaharescu T.** **Dumitru A.** **Lungulescu M. E.** **Velciu G.**
7	*Effect of -irradiation on the copolymerization of bis-GMA/ TEGDMA modified with MMT nanoparticles*	International Conference on Irradiation of Polymers, Jeju, Coreea de Sud, 5-9 oct. 2014	Campos L.M.P. **Zaharescu** T. Boaro L.C. Santos L.K.G. Ferreira H.P. Parra D.F.
8	*Influence of ferromagnetic liquids on γ-irradiation behavior of some polymeric materials*	The 11th Meeting of the Ionizing Radiation and Polymers Symposium – IraP, 5-9 Octombrie 2014, Jeju, Coreea de Sud	**Lungulescu Eduard-Marius** **Zaharescu Traian** **Marinescu Mădălina**
9	*Synthesis and characterization of some composite materials obtained from electronic recycling waste, with intersectorial applications*	**Proceeding** volumul 1 The 5th International Conference on Advanced Composite Materials Engineering „COMAT 2014", 16-17 octombrie, 2014, Brașov, Romania Page(s): 24-28, ISBN: 978-606-19-0411-2	**Caramitu A.R.** **Mitrea S.** **Pătroi D.** **Tsakiris V.** **Marinescu V.** Ursan G.A. Tugui C. **Banciu C.**

No.	Title of scientific paper	ISI conference proceedings/ publications	Authors
10	*Hydrogen gas sensors based on silicon carbide (SiC) MOS capacitor structure*	**Proceeding** of E-MRS Fall Meeting, Sept. 15-18, 2014, Varşovia, Polonia	Pascu Răzvan **Neamțu Jenica** Crăciunoiu Florea Brezeanu Gheorghe **Ovezea Dragoș**
11	*Structural and physical properties of semiconductor oxide thin films doped with transition metals*	**Proceeding** of 22th Int. Conf. on Composites/Nano Engineering (ICCE-22), Malta, 13-19 iulie 2014	**Neamțu Jenica**
12	Passive Magnetic Bearings For Flywheel Energy Storage - Numerical Design *(Lagăre magnetice pasive pentru sisteme de stocare a energiei cu volantă – modelare numerică)*	12th International Conference on Applied and Theoretical Electricity, University of Craiova (**IEEE proceedings** for ICATE 2014) 978-1-4799-4161-2/14, 2014 IEEE	**Tănase Nicolae** Morega A.M.
13	*Electrostatic discharge testing of several ESD protective textiles used in electronic Industry*	**Proceedings** of the 2014 International Conference and Exposition on Electrical and Power Engineering, 16-18 octombrie 2014, Iaşi, România, pp. 602-605	**Telipan Gabriela** **Mircea Ignat** **Cătănescu Alexandru-Laurenţiu** Beatrice Moasa
14	*Detection of cavitation vortex in hydraulic turbines using acoustic techniques*	IOP Conf. Series: Earth and Environmental Science, volume 22, Issue 5 (2014) 052007, UK, E-ISSN: 1755-1315, doi:10.1088/1755-1315/22/5/052007, http://iopscience.iop.org/1755-1315/22/5/052007	Candel I. **Bunea F.** Dunca G. Bucur D.M. Ioana C. Reeb B. Ciocan G.D.
15	*Experimental research on dissipative textile structures*	IEEE **Proceedings** 2014, 14th International Conference on Optimization of Electrical and Electronic Equipment OPTIM 2014, 22-24 mai 2014, Braşov, România, 155-160	Moasa Beatrice Helerea Elena **Ignat Mircea** **Telipan Gabriela**
16	*Electrostatic discharge testing of several ESD protective textiles used in electronic industry*	IEEE **Proceedings** of 8th International Conference and Exposition on Electrical and Power Engineering EPE-Iaşi, 16-18 oct. 2014, Iaşi, România, 602-605	**Telipan Gabriela** **Ignat Mircea** **Cătănescu Laurenţiu** Moasa Beatrice
17	*New energy harvesting systems, designed for new piezoelectric transducers, with charging energy management*	8th International Conference and Exposition on Electrical and Power Engineering EPE-Iasi DOI: 10.1109/ICEPE.2014.6969989 Publication Year: 2014 , Page(s): 646 – 651 IEEE CONFERENCE PUBLICATIONS	**Pîslaru-Dănescu Lucian** Lipan L.C. Pisica I. Ilina I. D. **Dumitru Alina**
18	*A conduction cooled high temperature superconductor quadrupolar superferric magnet, design and construction*	Journal of Physics: Conference Series, Volume 507, Issue 3, article ID. 032014 DOI: 10.1088/1742-6596/507/3/032014	**Dobrin Ion** Morega A. M. **Nedelcu Adrian** Morega M. **Neamţu Jenica**

Scientific / technical papers *to be published* in specialized ISI quoted journals

year 2014

No.	Title	Journal	Authors	Impact factor of ISI quoted jorunal in 2013
1	*Study regarding mechanical, thermal and structural properties of some elastomeric polyamide blends for cable insulating* presented at: International Symposium on Fundamentals of Electrical Engineering 2014 (ISFEE 2014), November 28-29, 2014, Bucharest, Romania	Page(s): *IEEE Xplore* (Cat. No.: CFP1493Y-ART) ISBN: 978-1-4799-6821-3	**Caramitu Alina Ruxandra** **Zaharescu Traian** **Mitrea Sorina** **Tsakiris Violeta** **Sbârcea Gabriela** **Pătroi Delia** Avădanei L.	http://ieeexplore.ieee.org
2	*Electropolymerization of conducting polypyrrole on carbon nanotubes / silicon composite for supercapacitor applications*	*Rev. Chim. (Bucharest)* to be published in vol. 66, no. 2 (2015)	**Iordoc Mihai** **Băra Adela** **Prioteasa Paula** **Teișanu Alexandru** **Marinescu Virgil**	0,677
3	*Electrodeposition of polypyrrole on carbon nanotubes/Si in the presence of Fe catalyst for application in supercapacitors*	*Rev. Chim. (Bucharest)* to be published in vol. 66, no. 6 (2015)	**Prioteasa Paula** **Marinescu Virgil** **Băra Adela** **Iordoc Mihai** **Teișanu Alexandru** **Banciu Cristina** Meltzer Viorica	0,677
4	*Synthesis, characterization and gas sensing properties of CeO_2-Y_2O_3 binary oxides*	*IEEE Sensors Journal* (2015)	**Telipan Gabriela** **Pîslaru-Dănescu Lucian** **Marinescu Virgil** **Prioteasa Paula** **Ovezea Dragoș**	1,852
5	*The fabrication of the CO_2 gas sensor based on sensing properties of the CeO_2-Y_2O_3 binary oxides*	*IEEE Sensors Journal*	**Telipan Gabriela** **Pîslaru-Dănescu Lucian** *(autor correspondent)* **Marinescu Virgil** **Prioteasa Paula** **Ionela** **Ovezea Dragoș**	1,852
6	*Studies of antimony-tellurium and copper–tellurium films electrodeposition from choline chloride-containing ionic liquids*	*Journal of Thin Solid Films* (2015)	Cojocaru A. Catrangiu A. S. Sin I. **Prioteasa Paula** Cotarta A. Anicăi Liana Vișan Teodor	1,867

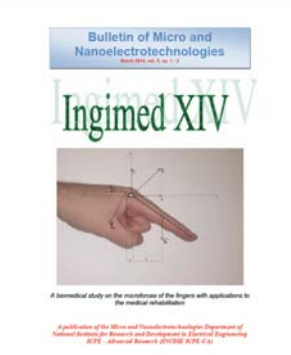
No.	Title	Journal	Authors	Impact factor of ISI quoted jorunal in 2013
7	*Thermal analysis of NdFeB and thin films grown by pulsed laser deposition*	*Journal of Thermal Analysis and Calorimetry*	Constantinescu C. Ion V. **Codescu Mirela Maria** Dinescu M. Rotaru P.	2,206
8	*Improved stability of alkyd resin by modification with TiO_2 nanoparticles*	*Journal of Optoelectronics and Advanced Materials*	**Mitrea Sorina** **Zaharescu Traian** **Caramitu Alina Ruxandra** Borbath Istvan	0,563
9	*Studies on Fe-Cr-Ni-Si-B bulk metallic glass for automotive applications*	*Advanced Materials Research*, vol. 1114 (2015), pp. 68-75	**Lucaci Mariana** **Pătroi Delia** **Tsakiris Violeta** **Lungu V. Magdalena** **Manta Eugen** **Iorga Alexandru**	-
10	*Al/Al_2O_3 + Gr hybrid composite compacting behaviour*	*Advanced Materials Research*, vol. 1114 (2015), pp. 86-91	Matara M.A. Csaki I. **Lucaci Mariana** **Lungu V. Magdalena** Popescu G. Iacob G.	-
11	*Shape memory NiTi and NiTiCu alloys obtained by spark plasma sintering process*	*Advanced Engineering Forum (Periodical)*	**Cîrstea Cristiana Diana** **Lungu Magdalena** Balagurov A. M. **Marinescu Virgil** **Culicov Otilia** **Sbârcea Gabriela** Cîrstea V.	0
12	*$LaCoO_3$ synthesis by intensive mechanical activation (*Sinteza $LaCoO_3$ prin activare mecanică intensivă*)*	*Ceramics International Journal*	**Velciu Georgeta** Melinescu Alina **Marinescu Virgil** Preda Maria	2,086
13	*Wind tunnel testing for a new experimental model of counter-rotating wind turbine*	Un jurnal din platforma Elsevier	**Mituleţ Lucia Andreea** **Oprina Gabriela** **Chihaia Rareş Andrei** **Nicolaie Sergiu** **Nedelcu Adrian** **Popescu Mihai**	–

No.	Title	Journal	Authors	Impact factor of ISI quoted jorunal in 2013
14	*New Zn(II) coordination polymers constructed from amino-alcohols and aromatic dicarboxylic acids: synthesis, structure, photocatalytic properties and solid-state conversion to ZnO*	*Crystal Growth & Design Journal*, 2015, 15(2), pp.799-811 Doi:10.1021/cg501604c	**Paraschiv Carmen** **Cucoș Andrei** Shova Sergiu Madalan M.Augustin Maxim Cătălin Vișinescu Diana Cojocaru Bogdan Pârvulescu I. Vasile Andruh Marius	4,558
15	*Biochemical changes in some cultures of cyanobacteria at the synthesis of silver nanoparticles*	*Canadian Journal of Microbiology*, 2015, Jan, 61(1):13-21	Cepoi L. Rudi L. Chiriac T. Valuta A. Zinicovscaia I. Duca Gh. Kirkesali E. Frontasyeva M.V. **Culicov Otilia** Pavlov S.S. Bobrikov I.	1,182
16	*Determination of eight elements in Moldovian wine using ICP-MS and NAA*	*Ciência e Técnica Vitivinícola / Journal of Viticulture and Enology*	Sturza R. Bilici C. Zinicovscaia I. **Culicov Otilia Ana** Gundorina S.F. Duca Gh.	0,278
17	*Nonpolluting medical technology for environment and patient used in inflammatory diseases monitoring*	*Environmental Engineering and Management Journal* http://omicron.ch.tuiasi.ro/EEMJ/accepted.htm	Bondarciuc Ala Ravariu Cristian Bondarciuc Vlad **Alecu Georgeta**	1,258
18	*Magnetic field distribution inside the aperture of a steerer magtnet prototype*	*Physica Scripta*	**Chiriță Ionel** **Dan Vasile-Daniel** **Tănase Nicolae**	1,296
19	*The influence of hydrostatic pressure on biogas production in anaerobic reactors* (Influența presiunii hidrostatice asupra producției de biogas în reactoarele anaerobe)	*Romanian Biotechnological Letters*	**Mateescu Carmen**	0,351
20	*Phase transitions of a parchment manufactured from deer leather: A calorimetric and kinetic analysis*	*Journal of Thermal Analysis and Calorimetry*	**Budrugeac Petru**	2,206
21	*Characterization of a Byzantine manuscript by infrared spectroscopy and thermal analysis*	*Revue Roumaine de Chimie*	Carșote Cristina **Budrugeac Petru** Decheva Roumiana Haralampiev Nikifor Stefanov Miu Lucreția Badea Elena	0,393

No.	Title	Journal	Authors	Impact factor of ISI quoted jorunal in 2013
22	*Influence of antioxidant loading on the -exposure on ethylene-propylene terpolymer*	*Polymer Bulletin*	**Zaharescu Traian** **Marinescu Mădălina** Zen H.A. Scagliusi S.R. Cardoso E.C.L. Lugão A.B.	1,491
23	*Biomass effect on gamma-irradiation behavior of some polypropylene biocomposites*	*Industrial & Engineering Chemistry Research*	Parparita E. **Zaharescu Traian** Darie R. Vasile C.	2,206
24	*Effect of copper complexes on the stabilization of ethylene-propylene-diene terpolymer*	*Materials and Design*	**Zaharescu Traian** Ilieş D. Roşu T.	3,219
25	*EPDM composite membranes modified with cerium doped lead zirconium titanate*	*Radiation Physics Chemistry*	**Zaharescu Traian** **Dumitru Alina** **Lungulescu Marius Eduard** **Velciu Georgeta**	1,189
26	*Improvement in the radiation stability of EPDM/incorporated EPDM powder/carbon black compounds*	*Radiation Physics Chemistry*	Kayan L.I.P. **Zaharescu Traian** Parra D.F. Lugão A. B.	1,189
27	*Effect of -irradiation on the copolymerization of bis-GMA/TEGDMA modified with MMT nanoparticles*	*Radiation Physics Chemistry*	Campos L.M.P. **Zaharescu Traian** Boaro L.C. Santos L.K.G. Ferreira H.P. Parra D.F.	1,189
28	*Thermal resistance of EPDM/IIR systems under -irradiation*	*Journal of Radioanalytical and Nuclear Chemistry*	**Zaharescu Traian** Cardoso E.C.L. Scagliusi S.R. Zen H.A. Lugão A.B.	1,415

BOOKS / CHAPTERS in PUBLISHED BOOKS

year 2014

No.	Book / chapter title	Publisher, ISBN, year published	Authors
1	**Revista de Istoria Electrotehnicii Românești** *(Journal of Romanian Electrical Engineering History)* 	*INCDIE ICPE-CA Publishing House* *October 2014, Vol. I, No. 1* ISSN 2066-7965	**Honorary Chief Editor** Prof. Florin Teodor Tănăsescu **Chief Editor** Dr.Eng.Mircea Ignat **Editorial staff** Ec. Clara Hender Eng. Cristian Morari Eng. Gabriela Obreja Matilda Gheorghiu
2	**Bulletin of Micro and Nanoelectrotechnologies** 	*A publication of the Department for Micro and Nanoelectrotechnologies from INCDIE ICPE-CA* *INCDIE ICPE-CA Publishing House* March 2014, vol. V, no. 1-2 ISSN 2069-1505	**Executive Staff** Ec. Clara Hender Eng. Cristian Morari Eng. Gabriela Obreja Matilda Gheorghiu **Editor in chief** Dr. Eng. Mircea Ignat, INCDIE ICPE-CA, Dep. MNE, mircea.ignat@icpe-ca.ro
3	**Bulletin of Micro and Nanoelectrotechnologies** 	*A publication of the Department for Micro and Nanoelectrotechnologies from INCDIE ICPE-CA* *INCDIE ICPE-CA Publishing House* December 2014, vol. V, no. 3 - 4 ISSN 2069-1505	**Executive Staff** Ec. Clara Hender Eng. Cristian Morari Eng. Gabriela Obreja Matilda Gheorghiu **Editor in chief** Dr. Eng. Mircea Ignat, INCDIE ICPE-CA, Dep. MNE, mircea.ignat@icpe-ca.ro

No.	Book / chapter title	Publisher, ISBN, year published	Authors
4	**Air pollution and vegetation: ICP Vegetation Annual Report 2013/2014**	Edited by H. Harmens, G. Mills, F. Hayes, K. Sharps, M. Frontasyeva, 09/2014; ICP Vegetation Programme Coordination Centre, Centre for Ecology and Hydrology, Environment Centre, Bangor, Gwynedd, UK, Moss Survey Coordination Centre, Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Moscow, Russia	Harmens H. Norris D. Mills G. Aboal Viñas J. Alber R. Aleksiayenak Y. Baceva K. Barandovski L. Berg T. Blum O. Ocaña A. Carballeira Chilian A. Cucu-Man S.-M. **Culicov O. A.** Dam M. et.al.
5	**Curgerea fluidului real prin canale și conducte** (*The real fluids flow through channels and pipes*)	AGIR *Publishing House*, 2014 ISSN 978-973-720-520-9	**Bunea Florentina** Cazacu Mircea Dimitrie
6	**Metanogeneza în procese naturale și antropice** (*Methanogenesis in natural and anthropic processes*)	Printech *Publishing House*, 2014 ISBN 978-606-23-0295-5	**Mateescu Carmen**
7	**Compatibilitate Electromagnetică** / Cercetări și dezvoltări în domeniul electromagnetic în România – *Materiale compozite bazate pe silicon utilizate pentru ecranare electromagnetică* (**Electromagnetic compatibility** / Electromagnetic field research and development in Romania - *Composite materials based on silicone rubber used for electromagnetic shielding)*	AGIR *Publishing House*, 2014 ISBN 978-973-720-521-6	**Pintea Jana** **Morari Cristian** **Bălan Ionuț** **Chițanu Elena** Stoian Valentina Elena
8	**Compatibilitate Electromagnetică** / Cercetări și dezvoltări în domeniul electromagnetic în România – *Tendințe și aspecte în standardizare cu privire la expunerea la radiațiile electromagnetice în câmp apropiat* (**Electromagnetic compatibility** / Electromagnetic field research and development in Romania - *Current aspects and trends in standardization with reference to general exposure in near field electromagnetic radiation*)	AGIR *Publishing House*, 2014 ISBN 978-973-720-521-6	**Pintea Jana** Marinescu Andrei Morega Mihaela
9	**Electromagnetic compatibility** / Electromagnetic field research and development in Romania – *Shielding effectivness determination for conductive electromagnetic slab*	AGIR *Publishing House*, 2014 ISBN 978-973-720-521-6	**Bădic Mihai**

Scientific / technical papers published in other specialized journals, non-quoted ISI/BDI

year 2014

No.	*Title of scientific / technical papers*	*Journal, non-quoted ISI*	*Authors*
1	Tipologii ale comunicării instituţionale (*Typologies of Institutional Communication*)	Annals of Spiru Haret University, Economic Series 5.1 (2014): 33-40	**Iosif Olguţa Gabriela**
2	Microthermogenerator with semiconductor oxides thermoelectric materials	SPIE Smart Structures/NDE, Technical Summaries, 2014, pg.54	**Telipan Gabriela** **Ovezea Dragoş** **MălăeruTeodora**
3	Coroziunea oţelului carbon în prezenţa mucegaiului Aspergillus niger (*Carbon Steel Corrosion in the Presence of Aspergillus Niger Fungi's*)	EEA – Electrotechnics, Electronics, Automatics (EEA - Electronică, Electrotehnică, Automatizari) vol. 62 (2014), no. 2, pp. 60-65, ISSN 1582-5175	**Prioteasa Paula** Lingvay Monika Szatmari Ilona **Burunţea Nicoleta** **Lingvay Iosif**
4	Studies on biocorrosion of stainless steel and copper in Czapek Dox medium with Aspergillus niger filamentous fungus	U.P.B, Sci.Bull, Series B, volumul 77 (2015) ISSN 1454-2331	Szatmári Ilona Tudosie Liana Mihaiela Cojocaru Anca Lingvay Mónika **Prioteasa Paula** Vişan Teodor
5	Elemente de *Business Intelligence* pentru experţi tehnici şi consultanţi (*Business Intelligence Elements for Technical Experts and Consultants*)	AGIR Bulletin nr. 4/2014	Popa D. R. **Codescu Mirela Maria**
6	Echipament special utilizabil în aeronautică. Risc expertal – studiu de caz *(Special Equipment used in aeronautics. Expertal Risk – Case Study)*	AGIR Bulletin nr. 4/2014	Popa D. R. **Codescu Mirela Maria** Popa A.
7	Profesorul Remus Răduleţ 1904 – 1984 (*Professor Remus Radulet 1904-1984*)	Journal of Romanian Electrical Engineering History (Revista de Istoria Electrotehnicii Româneşti) INCDIE ICPE-CA Publishing House, October 2014, Vol I, no. 1, ISSN 2066-7965	**Ignat Mircea**
8	Ingineria electrică românească în timpul monarhiei 1881-1948 (I) (*Romanian Electrical Engineering during the monarchy 1881 – 1948 (I)*)	Journal of Romanian Electrical Engineering History (Revista de Istoria Electrotehnicii Româneşti) INCDIE ICPE-CA Publishing House, October 2014, Vol I, no. 1, ISSN 2066-7965	**Ignat Mircea**
9	Linear Actuators for the Medical Rehabilitation Procedure	Bulletin of Micro and Nanoelectrotechnologies, INCDIE ICPE-CA Publishing House, March 2014, vol. V, no. 1 – 2, ISSN 2069-1505	**Ignat Mircea**

No.	Title of scientific / technical papers	Journal, non-quoted ISI	Authors
10	Phasing skin factor analysis for oil wells completions	Bulletin of Petroleum-Gas University of Ploieşti, Vol. LXVI, No. 2/2014, pp. 31-37	**Stoianovici Georgeta** Stoianovici Doru Nicolescu Constantin
11	Simulare sistem de lăgăruire radial-axial cu magneţi permanenţi folosit pentru dispozitive de stocare a energiei cu volant (*Simulation of a radial-axial permanent magnetic bearing system used for flywheel energy storage devices*)	Symposium of Electrical Machines SME'14, Oct.2014 ISSN 1843-5912	**Tănase Nicolae** MoregA A.M. **Ilie Cristinel** **Nedelcu Adrian**
12	Theoretical and experimental study of a mixer with bars with application at sludge thickening (*Studiu teoretic şi experimental al amestecătoarelor cu bare, cu aplicaţii la îngroşarea nămolului*)	Energy Technologies Rev., ICEMENERG Pub. House, Issue 47, no. 2/2014, p. 34-38 ISSN 1842-7189	Mândrea L. **Băran Ghe.** **Băbuţanu Corina Alice** **Oprina Gabriela** **Bunea Florentina**
13	Improving of the environmental parameters of Francis turbines	Energetica, vol. 62, no. 5, 2014, p. 181-186 ISSN 1453-2360	**Bunea Florentina** **Baran Gheorghe**
14	Variaţia coeficientului de debit la orificii mici cu vîscozitatea şi tensiunea superficială (*The variation of small orifices discharge with viscosity and superficial tension*)	Science and Engineering Journal (*Revista Ştiinţă şi Inginerie*), vol.25, pp. 423-430 ISSN 2067-7138 e-ISSN 2359-828X	**Oprina Gabriela** **Bunea Florentina** Mandrea L. **Băbuţanu Corina** **Băran Gh.**
15	*Cell Phone and Human Health*	Electromagnetic compatibility / Electromagnetic field Research and development in Romania, pp. 136-139 ISBN: 978-973-720-521-6 AGIR Publishing House, 2014	**Voina Andreea** **Alecu Georgeta** Pantelimon Brânduşa
16	Detecţia gazelor combustibile şi toxice din mediu atmosferic sau industrial *(Combustible and toxic gases detection from atmospheric and industrial environment)*	Automation and Instrumentation under Association for Automation and Instrumentation from Romania (Automatizări şi Instrumentaţie sub egida Asociaţia pentru Automatizări şi Instrumentaţie din România) No.1, January/March 2014 ISSN 1582-3334	**Telipan Gabriela** **Pîslaru-Dănescu Lucian** **Băbuţanu Corina Alice**
17	*Optimizarea unui actuator magnetostrictiv* *(*Optimizing a magnetostrictive actuator*)*	Symposium of Electrical Machines SME'14, Oct.2014 ISSN 1843-5912	**Popa Marius** Morega M. Alexandru Morega Mihaela
18	*Biomasa algala – sursa viabilă de biogas şi biodiesel* *(*Algal biomass – a viable source for biogas and biodiesel*)*	Scientific Annals of the Danube Delta Institute, vol. 20, Section III - Natural resources, socio-economic aspects, pp. 91-94, doi: 10.7427/DDI.20.14	**Mateescu Carmen** **Butoi Nicoleta**

No.	Title of scientific / technical papers	Journal, non-quoted ISI	Authors
19	*Întreţinerea cablurilor de alimentare subterane – biodegradarea mantalelor polimerice externe şi influenţa sa asupra îmbătrânirii izolaţiei (Maintenance of underground power cable – biodegradation of external polymer sheath and its influence on insulation aging)*	JSE (Journal for Sustenable Energy) – indexed BDI - VNCSIS "B+"	**Lingvay Iosif** Szatmári Ilona Lingvay Mónika **Marin Dorian**
20	*New composite textile structure used in electromagneticfield shielding*	Metalurgia Journal, no. 1, 2014	**Rădulescu Florina** **Pătroi Eros Alexandru** **Morari Cristian**

Scientific papers presented to international conferences and workshops

year 2014

No.	Title of scientific paper	International conference and workshop	Authors
1	*Preparation and characterization of electrospun PAN/ZnO composite fiber*	2nd International Conference on Analytical Chemistry „Analytical Chemistry for a better life" RO-ICAC 2014, September 17-21, 2014, Târgovişte, Romania	**Chiţanu Elena** **Băra Adela** **Lungulescu Marius** **Marinescu Virgil** **Codescu Mirela Maria** **Brătulescu Alexandra** **Pătroi Delia** **Albu Florentina**
2	*Synthesis by co-precipitation of Zn-Ni-Fe mixed spinel nanoferrites*	2nd International Conference on Analytical Chemistry „Analytical Chemistry for a better life" RO-ICAC 2014, September 17-21, 2014, Târgovişte, Romania	**Chiţanu Elena** **Codescu Mirela Maria** **Pătroi Delia** **Manta Eugen** **Kappel Wilhelm** **Marinescu Virgil**
3	*Synthesis and characterization of carbon nanotubes by cvd using different types of catalysts*	2nd International Conference on Analytical Chemistry „Analytical Chemistry for a better life" RO-ICAC 2014, September 17-21, 2014, Târgovişte, Romania	**Băra Adela** **Banciu Cristina** **Marinescu Virgil** **Morari Cristian** **Codescu Mirela Maria**
4	*Study of the influence of process parameters on the morphology of electrospun PAN/CNT composite fibers*	2nd International Conference on Analytical Chemistry „Analytical Chemistry for a better life" RO-ICAC 2014, September 17-21, 2014, Târgovişte, Romania	**Băra Adela**
5	*Wind tunnel testing for a new experimental model of counter-rotating wind turbine (Testarea în tunelul de vânt a unui nou model experimental de turbină eoliană contrarotitioare)*	The 25th DAAAM International Symposium Intelligent Manufacturing & Automation: Focus on Sustainability, November 26-29, 2014, Viena, Austria	**Mituleţ Lucia-Andreea** **Oprina Gabriela** **Chihaia Rareş-Andrei** **Nicolaie Sergiu** **Nedelcu Adrian** **Popescu Mihail**

No.	Title of scientific paper	International conference and workshop	Authors
6	*Study regarding the implementation of methods used in order to increase the wind turbines' efficiency (Studiu privind implementarea unor metode de eficientizare a instalaţiilor eoliene)*	The 12th WEC Central & Eastern Europe Regional Energy Forum - FOREN 2014, June 22-26, 2014, Bucharest, Romania	**Mituleţ Lucia-Andreea** **Popescu Mihail** **Nicolaie Sergiu** **Oprina Gabriela** **Chihaia Rareş-Andrei**
7	*Evaluation of powdered activated carbon performance for wastewater treatment containing inorganic pollutants*	6th International Conference „Biomaterials, Tissue Engineering & Medical Devices" BiomMedD'2014, 17-20 Sept.2014, Constanţa, Romania	**Matei E.** **Covaliu C.I.** **Georgescu Gabriela** **Mălăeru Teodora** **Stoian O.**
8	*Alternative approaches for ZnO-graphene nanocomposites designed for supercapacitors*	5th EuCheMS Chemistry Congress 2014, August 31 – September 4, 2014, Istanbul, Turkey	**Hristea Gabriela** **Paraschiv Carmen** **Iordoc Mihai** **Prioteasa Paula**
9	*Studies of antimony-tellurium and copper- tellurium electrodeposition from choline chloride-oxalic acid ionic liquid*	10th European Symposium on Electrochemical Engineering, September 28 – October 2, 2014, Sardinia, Italy	**Sin I.** **Catrangiu A. S.** **Prioteasa Paula** **Cotarta A.** **Cojocaru A.** **Anicăi Liana** **Vişan Teodor**
10	*Studies of antimony-tellurium and copper–tellurium films electrodeposition from choline chloride-containing ionic liquids*	16th International Conference on Thin Films, October 13 – 16, 2014, Dubrovnik, Croatia	**Catrangiu A. S.** **Prioteasa Paula** **Cotarta A.** **Cojocaru A.** **Anicăi Liana** **Vişan Teodor**
11	*Flexible Composites Based on Glass-Coated Microwires for Electromagnetic Shields Materials*	The 9th International Workshop of Electromagnetic Compatibility, CEM 2014, September 2-4, 2014, Timişoara, Romania	**Codescu Mirela Maria** **Kappel Wilhelm** **Chiţanu Elena** **Manta Eugen** **Morari Cristian** **Pătroi Delia** **Pătroi Eros** **Erdei Remus** **Bălan Ionuţ** **Popa D. R.**
12	*Synthesis by co-precipitation of Zn, Ni and Zn0.5Ni0.5 - mixed spinel nanoferrites*	2nd International Conference on Analytical Chemistry „Analytical Chemistry for a better life" RO-ICAC 2014, September 17-21, 2014, Târgovişte, Romania	**Chiţanu Elena** **Codescu Mirela Maria** **Pătroi Delia** **Manta Eugen** **Kappel Wilhelm** **Marinescu Virgil**
13	*Experimental determination of electromagnetic shielding effectiveness of materials*	The 9th International Workshop of Electromagnetic Compatibility, CEM 2014, September 2-4, 2014, Timişoara, Romania	**Morari Cristian** **Bălan Ionuţ** **Popescu O. Mihai**
14	*High voltage anodic plasma: a tool for manufacturing coated organic materials for electromagnetic screening*	International Colloquium 'Physics of Materials' - PM-4, November 13-14, 2014, Bucharest, Romania	**Bădulescu Marius** **Anghel Alexandru** **Surdu-Bob Cristina** **Morari Cristian** **Bădic Mihai** **Bălan Ionuţ**

No.	Title of scientific paper	International conference and workshop	Authors
15	*Studies on Fe-Cr-Ni-Si-B bulk metallic glass for automotive applications*	ROMAT 2014 - 5th International Conference on Materials Science and Technologies, October 15-17, 2014, Bucharest, Romania	**Lucaci Mariana** **Pătroi Delia** **Tsakiris Violeta** **Lungu V. Magdalena** **Manta Eugen** **Iorga Alexandru**
16	*Al/Al2O3 + Gr hybrid composite compacting behaviour*	ROMAT 2014 - 5th International Conference on Materials Science and Technologies, October 15-17, 2014, Bucharest, Romania	**Matara M.A.** **Csaki I.** **Lucaci Mariana** **Lungu V. Magdalena** **Popescu G.** **Iacob G.**
17	*New solutions to store energy into materials*	WEC Central & Eastern Europe Regional Energy Forum – FOREN 2014, June 12-19, 2014, Bucharest, Romania	**Lucaci Mariana** **Kappel Wilhelm** **Enescu Elena**
18	*Nanoporous carbon xerogels for capacitive water desalinationg*	International Chemistry Congress EuCheMS	**Hristea Gabriela** **Paraschiv Carmen** **Cucoş Andrei**
19	*Alternative approaches for ZnO-graphene nanocomposites designed for supercapacitors*	5th International Chemistry Congress EuCheMS,August 31 – September 4, 2014, Istanbul, Turkey	**Hristea Gabriela** **Paraschiv Carmen** **Iordoc Mihai**
20	*Polycarboxylate-assisted synthesis of ZnO nanoparticles*	5th International Chemistry Congress EuCheMS,August 31 – September 4, 2014, Istanbul, Turkey	**Paraschiv Carmen** **Cucoş Andrei** **Hristea Gabriela** **Sbârcea Gabriela** **Pătroi Delia** **Marinescu Virgil**
21	Silver nanoparticles photoinduced ecosynthesis *(Ecosinteza nanoparticulelor de argint fotomediată)*	54th Annual Scientific Communication Workshop – Biology Institute - Romanian Academy, December 20, 2014, Bucharest, Romania	**Cogălniceanu Gina** **Mitoi Monica** **Hristea Gabriela** **Lungu Magdalena**
22	*A new zinc-triethanolamine-isophthalate MOF. Synthesis, crystal structure and photo-catalytic activity*	5th EUCHEMS Chemistry Congress, 31.08– 04.09.2014, Istanbul, Turkey	**Cucoş Andrei** **Paraschiv Carmen** **Shova S.** **Cojocaru B.** **Pârvulescu V.**
23	*Evaluation of some conservation treatments for parchment artefacts*	3nd International Seminar & Workshop on Emerging Technology and Innovation for Cultural Heritage, 15-18.10.2014, Sibiu, Romania	**Cucoş Andrei** **Badea E.** **Miu L.** **Carşote C.** **Petroviciu I.** **Budrugeac Petru**
24	*Joining of C/SiC materials by Spark Plasma Sintering*	TIMA2014, The 7th International Conference Innovative Technologies for Joining Advanced Materials, 19-20.06.2014, Timişoara, Romania	**Tsakiris Violeta** **Kappel Wilhelm** **Tălpeanu Dorinel** **Albu Florentina** **Pătroi Delia** **Marinescu Virgil**
25	*Development of novel aluminum-ceramic nanocomposites and microstructural and mechanical characterization*	International Symposium on Novel and Nano Materials (ISNNM), Krakow, Poland, June 29 - July 4, 2014	**Tsakiris Violeta** **Popescu Ileana Nicoleta** **Bratu Vasile** **Tsakiris Cristian**

No.	Title of scientific paper	International conference and workshop	Authors
26	*The sintering parameters influence on microstructure and physical-chemical properties of novel Al-Cu-SiC composites*	International Symposium on Novel and Nano Materials (ISNNM), Krakow, Poland, June 29 - July 4, 2014	**Popescu Ileana Nicoleta** **Bratu Vasile** **Zamfir Raluca Ioana** **Anghelina Florina Violeta** **Tsakiris Violeta**
27	*Shape memory NiTi and NiTiCu alloys obtained by spark plasma sintering process*	3rd International Conference Advances In Engineering & Management (ADEM 2014), September 11 - 12, 2014, Drobeta Turnu Severin, Romania	**Cîrstea Cristiana Diana** **Lungu Magdalena** **Balagurov A. M.** **Marinescu Virgil** **Culicov Otilia** **Sbârcea Gabriela** **Cîrstea V.**
28	Solutions to reduce heat loss from buildings by covering with thermo insulating and anticorrosion nanostructured material *(Soluții pentru reducerea pierderilor de căldură din clădiri prin acoperiri cu material nanostructurat termoizolant și rezistent la coroziune)*	WEC Central & Eastern Europe Regional Energy Forum – FOREN 2014, June 15-19, 2014, Bucharest, Romania Proceedings Published on USB Flash Drive: ISSN-L 2284-9491, Poster Sp-56	**Velciu Georgeta** **Lingvay Iosif** **Țârdei Christu** **Albu Florentina** **Tsakiris Violeta**
29	Materials for SOFC fuel cells *(Materiale pentru pilele de combustie)*	The 20th Conference of Energy Engineering, CIE 2014, June 05 – 07, 2014, Oradea, Romania Section 2 - Renewable resources of energy. Sustainable energy technologies	**Velciu Georgeta** **Melinescu A.** **Lingvay Iosif** **Pintea Jana** **Dumitru Alina**
30	*Improving the energy conversion efficiency of counter rotating wind turbines by using innovative generators*	Proceedings of 21st edition of *International Conference of Hydraulics, Pneumatics, Tools, Sealing elements, fine mechanics, specific electronic equipment & mechatronics – HERVEX 2014*, November 5th -7th, Călimănești – Căciulata, ISSN 1454-8003, pp. 249-254	**Popescu Mihail** **Nicolaie Sergiu** **Oprina Gabriela** **Cîrnaru Radu** **Mituleț Andreea** **Chihaia Rareș** **Mirea Radu**
31	*Ecological intake for sand-less water solution for river management*	Technical and Scientific International Conference *Current problems of urban and spatial planning*, November 13th -15th, 2014, Chișinău, Moldova ,vol. 2, pp. 149-156, ISBN 978-9975-71-582-9	**Mândrea L.** **Oprina Gabriela** **Băbuțanu Corina** **Voinea Andrei** **Panaitescu V.**
32	*The variation of small orifices discharge with viscosity and superficial tension* *(Variația coeficientului de debit la orificii mici cu vîscozitatea și tensiunea superficială)*	The 14th Multidisciplinary International Conference "Professor Dorin PAVEL – founder of the Romanian hydropower", Sebeș - Alba, June 6th – 7th, 2014, pp. 423-430, ISSN 2067-7138	**Oprina Gabriela** **Bunea Florentina** **Mandrea L.** **Băbuțanu Corina** **Băran Gh.**
33	*Overview of project studies regarding renewable energy sources and their application* *(Prezentare de ansamblu a studiilor privind sursele regenerabile de energie și aplicațiile lor)*	Conference of the Romania-Bulgaria cross-border project *Clean access in Calarasi-Silistra cross-border area*, October 8th, 2014, Silistra, Bulgaria	**Radu Mirea**

No.	Title of scientific paper	International conference and workshop	Authors
34	*Overview of project studies regarding renewable energy sources and their application (Prezentare de ansamblu a studiilor privind sursele regenerabile de energie și aplicațiile lor)*	Conference of the Romania-Bulgaria cross-border project *Clean access in Calarasi-Silistra cross-border area*, October 9th, 2014, Calarasi, Romania	**Radu Mirea**
35	*New Zn(II) coordination polymers assembled in the presence of aminoalcohols and polycarboxylic acids. Synthesis, structure, and thermal behavior*	The 23th Annual Symposium of the Thermal Analysis and Calorimetry Committee of the Romanian Academy, 14 February 2014, Bucharest (oral presentation)	**Paraschiv Carmen** **Cucoș Andrei** **Maxim Cătălin** **Madalan M. Augustin** **Marinescu Virgil**
36	*New Zn(II) coordination polymers with mixed anionic linkers*	5th EUCHEMS Chemistry Congress, 31 august - 4 septembrie 2014, Istanbul, Turcia (poster)	**Paraschiv Carmen** **Cucoș Andrei** **Madalan M. Augustin** **Maxim Cătălin**
37	*Polycarboxylate-assisted synthesis of ZnO nanoparticles*	*5th EUCHEMS Chemistry Congress*, 31st August – 4th September 2014, Istanbul, Turkey (poster)	**Paraschiv Carmen** **Cucoș Andrei** **Sbârcea Gabriela** **Pătroi Delia** **Marinescu Virgil**
38	*Electrostatic discharge testing of several ESD protective textiles used in electronic industry*	8th International Conference and Exposition on Electrical and Power Engineering EPE - Iași, Oct. 16-18, 2014, Iași, Romania	**Telipan Gabriela** **Ignat Mircea** **Cătănescu Alexandru-Laurențiu** **Beatrice Moasa**
39	*Neutron degradation of several polymers subjected to IBR-2 radiation at Dubna*	The 14th International Balkan Workshop on Applied Physics and Materials Science, July 2-4, 2014, Constanța, Romania	**Lungulescu Eduard-Marius** **Setnescu Radu** **Setnescu Tanța** **Marinescu Mădălina** **Culicov Otilia** **Kulikov Sergey**
40	*Thermal resistance of EPDM/IIR systems under -irradiation*	International Nuclear Chemistry Conference, Maresias, Brazil, Sept. 14-19, 2014	**Zaharescu T.** **Cardoso E.C.L.** **Scagliusi S.R.** **Zen H.A.** **Lugão A.B.**
41	*Influence of antioxidant loading on the -exposure on ethylene-propylene terpolymer*	International Nuclear Chemistry Conference, Maresias, Brazil, Sept. 14-19, 2014	**Zaharescu T.** **Marinescu M.** **Zen H.A.** **Scagliusi S.R.** **Cardoso E.C.L.** **Lugão A.B.**
42	*Radiation effects in PA6/EPDM blends*	International Nuclear Chemistry Conference, Maresias, Brazil, Sept. 14-19, 2014	**Zaharescu T.** **Lungulescu M. E.** **Caramitu A. R.** **Marinescu V.**
43	*Improvement in the radiation stability of EPDM/incorporated EPDM powder/carbon black compounds*	International Nuclear Chemistry Conference, Maresias, Brazil, Sept. 14-19, 2014	**Kayan L.I.P.** **Zaharescu T.** **Parra D.F.** **Lugão A. B.**
44	*EPDM composite membranes modified with cerium doped lead zirconium titanate*	International Conference on Irradiation of Polymers, Jeju, South Korea, Oct. 5-9, 2014	**Zaharescu T.** **Dumitru A.** **Lungulescu M. E.** **Velciu G.**

No.	Title of scientific paper	International conference and workshop	Authors
45	*Effect of -irradiation on the copolymerization of bis-GMA/ TEGDMA modified with MMT nanoparticles*	International Conference on Irradiation of Polymers, Jeju, South Korea, Oct. 5-9, 2014	**Campos L.M.P.** **Zaharescu T.** **Boaro L.C.** **Santos L.K.G.** **Ferreira H.P.** **Parra D.F.**
46	*Influence of ferromagnetic liquids on -irradiation behavior of some polymeric materials*	The 11th Meeting of the Ionizing Radiation and Polymers Symposium – IraP, Jeju, South Korea, Oct. 5-9, 2014	**Lungulescu Eduard-Marius** **Zaharescu Traian** **Marinescu Mădălina**
47	*Inhibition of carbon steel in cooling water systems by nicotinamide*	226th ECS Meeting, 5-10 octombrie, 2014, Cancun, Mexico	**Brânzoi F.** **Brânzoi V.** **Iordoc Mihai**
48	*Coin cell-type symmetric supercapacitors*	Workshop on Nanostructured Materials for Energy Storage and Biomedical Applications, Oct. 30-31, 2014, University of Cyprus, Nicosia, Cyprus	**Iordoc Mihai** **Teișanu Alexandru**
49	*Sodium adducts flow battery designed for grid storage integration of renewable energy sources with variable output*	Workshop on Nanostructured Materials for Energy Storage and Biomedical Applications, Oct. 30-31, 2014, University of Cyprus, Nicosia, Cyprus	**Teișanu Alexandru** **Iordoc Mihai**
50	*Epithermal neutron activation analysis of forages from permanent grasslands of North-Eastern Romania*	17th Radiochemical Conference, Marianske Lazne, Czech Republic, May 11-14, 2014	**Culicov O.A.** **Tarcău D.** **Cucu-Man S.M.** **Zinicovscaia I.** **Vintu V.** **Samuil C.** **Frontasyeva M.V.**
51	*Biosorption of chromium and nickel from wastewater by microalgae Nostoc linckia*	17th Radiochemical Conference, Marianske Lazne, Czech Republic, May 11-14, 2014	**Zinicovscaia I.** **Cepoi L.** **Valuta A.** **Rudi L.** **Frontasyeva M.** **Culicov O.** **Gundorina S.** **Mitina T.**
52	*The Geochemistry of the Black Sea Sediments Belonging to the First and to the Second Stratigraphic Units: (I) Major Elements Vertical Profile*	International Seminar on Interaction of Neutrons with Nuclei (ISINN 22), May 27-30, 2014, Dubna, Russia	**Duliu O.G.** **Szabo G.** **Frontasyeva M.V.** **Culicov O.A.** **Oaie G.** **Grădinaru J.**
53	*Biotechnology for wastewater treatment*	5th World Congress on Biotechnology, June 25-27, 2014, Valencia, Spain	**Zinicovscaia I.** **Culicov O.** **Frontasyeva M.V.** **Kirkesali E.I.** **Gundorina S.** **Cepoi L.** **Chiriac T.** **Valuta A.** **Rudi L.** **Mitina T.**

No.	Title of scientific paper	International conference and workshop	Authors
54	*Analytical study of several sewage sludges*	International Conference on Analytical Chemistry - Analytical Chemistry for a Better Life, Sept. 17-21, 2014, Târgoviște, Romania	**Setnescu Tanța** **Gheboianu A. I.** **Setnescu Radu** **Băncuță I.** **Băncuță R.** **Frontasyeva M.V.** **Bumbac M.** **Culicov Otilia** **Frontasyeva M.V.**
55	*Radiation effects of fast neutrons on different organic materials*	International Conference on Analytical Chemistry - Analytical Chemistry for a Better Life, Sept. 17-21, 2014, Târgoviște, Romania	**Setnescu Radu** **Lungulescu Marius** **Setnescu Tanța** **Nicoleta A.** **Dumitru M.** **Culicov O.** **Kulikov S.**
56	*XRF, INAA and TL investigation of the loess and paleo-soil sequences of the Costinesti (Southern Dobrudja, Romania) loess deposit*	International Conference on Analytical Chemistry - Analytical Chemistry for a Better Life, Sept. 17-21, 2014, Târgoviște, Romania	**Duliu O. G.** **Tugulan L.C.** **Culicov O.A.** **Chirosca A.** **Zinikovskaia I.** **Frontasyeva M.V.** **Dumitraș D.G.**
57	*Neutron activation analysis of sewage sludge from Dambovita county*	International Conference on Analytical Chemistry - Analytical Chemistry for a Better Life, Sept. 17-21, 2014, Târgoviște, Romania	**Culicov Otilia** **Setnescu Tanța** **Setnescu Radu** **Zinicovscaia I.** **Frontasyeva M.V.** **Băncuță I.** **Gheboianu A.** **Bumbac M.**
58	*Instruments at IBR-2 modernized reactor – potential applications in microbiology*	2nd International conference on Microbial Biotechnology, Oct. 9-10, 2014, Chișinău, Moldova	**Culicov O.A.** **Chudoba D.M.** **Shvetsov V.N.**
59	*Biosynthesis of selenium and titanium nanoparticles by cyanobacterium Nostoc Linckia*	2nd International conference on Microbial Biotechnology, Oct. 9-10, 2014, Chișinău, Moldova	**Zinicovscaia I.** **Cepoi L.** **Valuta A.** **Rudi L.** **Frontasyeva M.** **Culicov O.**
60	*Characterization of TiO_2 nanoparticles, used in the manufacture of DSSC, by NAA and SEM techniques*	Physics Conference TIM-14, Nov. 20–22, 2014, Timișoara, Romania	**Chilian A.** **Bancuta O.-R., Bancuta I.** **Ion R.-M.** **Setnescu Radu** **Marinescu Virgil** **Setnescu Tanța** **Zinicovscaia I.** **Culicov O.** **Frontasyeva M.** **Stihi C.** **Radulescu C.** **Gheboianu A.** **Popescu I.V.**

No.	Title of scientific paper	International conference and workshop	Authors
61	*On the vortex parameter estimation using wide band signals in active acoustic system*	OCEANS 2014 - TAIPEI, China, April 7-10, 2014, Page(s): 1 – 5, IEEE Conference Publications, Print ISBN: 978-1-4799-3645-8, INSPEC Accession Number 14760894, DOI: 10.1109/OCEANS-TAIPEI.2014.6964552	**Digulescu A.** **Teodor P.** **Candel I.** **Bunea F.** **Dunca G.** **Bucur D.** **Ioana C.**
62	*Aeration solution of water used by hydraulic turbines to respect the environmental policies*	International Conference and Exposition on Electrical and Power Engineering EPE 2014, Oct. 16-18, 2014, Iași, Romania ISSN: 978-1-4799-5848-1 Catalog Number CFP1447S-USB IEE meetings database as conference record #33577	**Bunea F.** **Ciocan G.D.** **Bucur D.M.** **Dunca G.**
63		Electrical and Power Engineering, 2014 International Conference and Exposition on, publisher IEEE, p. 1015-1020 DOI 10.1109/ICEPE.2014.6970062	
64	*Detection of cavitation vortex in hydraulic turbines using acoustic techniques*	Proceeding of 27th IAHR Symposium on Hydraulic Machinery and Systems (CD), sesiunea 5.3, lucrarea 5.3.3, 22-26 septembrie 2014, Montreal, Canada	**Candel I.** **Bunea F.** **Dunca G.** **Bucur D.M.** **Ioana C.** **Reeb B.** **Ciocan G.D.**
65	*Innovative solutions for water aeration in order to meet the environmental policies* *(Soluții inovatoare pentru aerarea apei turbinate, în vederea respectării politicilor de mediu)*	WEC Central and Eastern Europe Energy Forum 12th Edition - FOREN 2014, 15-19 iunie 2014, Romania, Proceedings Published on USB Flash Drive ISSN-L 2284-9491, Poster Sp-37	**Bunea F.** **Ciocan G.D.** **Bucur D.M.** **Dunca G.**
66	*New water aeration techniques in order to increase the dissolved oxygen content* *(Noi tehnici de aerare a apei turbinate în scopul creșterii conținutului de oxigen dizolvat)*	The 8th International Conference of Hydro-Power Engineers in Romania, Section 6 – Engineering and Environment Protection in Hydro-Power Engineering, Bucharest, May 22-23, 2014, Bucharest	**Bunea F.** **Ciocan G.D.** **Bucur D.M.** **Dunca G.**
67	*Analysis of stakeholders in the framework of Hot Black Sea project*	3rd International Symposium on Integrated Coastal Zone Management, Antalya, Turkey, Oct. 14-17, 2014	**Lakovleva Nataliia Grigorievna** **Godin Eugeny** **Kresin Volodymyr** **Alecu Georgeta** **Voina Andreea** **Avaz Gulsen** **Ozer Pembe** **Devidze Devidze**
68	*Interaction with radiations of the electron devices working for telecommunication applications*	9th International Workshop of Electromagnetic Compatibility, CEM 2014, Timișoara, Romania, Sept. 3 – 5, 2014	**Ravariu Cristian** **Alecu Georgeta** **Vladoianu Mihai Laurentiu** **Idu Mihai** **Voina Andreea**

No.	Title of scientific paper	International conference and workshop	Authors
69	*Monitoring system of air quality*	International Conference - New Trends on Sensing- Monitoring- Telediagnosis for Life Sciences- NT-SMT-LS, Braşov, Romania, July 24-26, 2014	**Voina Andreea** **Alecu Georgeta** **Ravariu C.** **Voina C.**
70	*АНАЛИЗ ДЕЯТЕЛЬНОСТИ ОРГАНИЗАЦИЙ РАЗЛИЧНОГО ТИПА В ПРОЕКТЕ HOT BLACK SEA*	«СТАЛИЙ СОЦІАЛЬНО-ЕКОНОМІЧНИЙ ТА ЕКОЛОГІЧНИЙ РОЗВИТОК: ВІД ТЕОРІЇ ДО ПРАКТИКИ», Матеріали міжнародної науково-практичної конференції, Дніпропетровськ, pag. 109- 115, 2014	**Yakovlev NG** **Godin EA** **Alecu Georgeta** **Voina Andreea** **Avaz Gulsen** **Ozer Pembe** **Velikova Violeta** **Devidze Manana**
71	*60 Years of Technology Transfer*	Technology in Times of Transition, 41st ICOHTEC Symposium, July 29 – August 2, 2014, Braşov, Romania	**Alecu Georgeta** **Iordache Iulian** **Enescu Elena** **Kappel Wilhelm**
72	Aspects about the design of a permanent magnet AC superconducting electric generator *(Aspecte privind proiectarea unui generator electric supraconductor de curent alternativ cu magneți permanenți)*	The Symposium of Electrical Machines SME'14, October 2014	**Stoica Victor** **Pîslaru–Dănescu Lucian** **Dobrin Ion**
73	*HTS Superconducting Coils for Applications in Electrical Engineering*	The 4th International Conference "Physics of Materials" PM – 4, Bucharest, Romania, Nov. 13 – 14, 2014	**Stoica Victor** **Dobrin Ion** **Nedelcu Adrian** **Apostol Simona**
74	*Magnetic field distribution inside the aperture of a steerer magtnet prototype*	STORI'14 9th International Conference on Nuclear Physics and Storage Rings, Sept. 28 – Oct. 3, 2014, Sankt Goar, Germany	**Chiriță Ionel** **Dan Vasile-Daniel** **Tănase Nicolae**
75	*Experimental research on dissipative textile structures*	2014 International Conference on Optimization of Electrical and Electronic Equipment, OPTIM 2014, Cheile Grădiștei, Brașov, Romania, May 22-24, 2014	**Moașa Beatrice** **Helerea Elena** **Ignat Mircea** **Telipan Gabriela**
76	*Electrostatic discharge testing of several ESD protective textiles used in electronic industry*	2014 International Conference and Exposition on Electrical and Power Engineering (EPE 2014), Oct .16-18, Iași, Romania	**Telipan Gabriela** **Ignat Mircea** **Cătănescu Laurențiu** **Moașa Beatrice**
77	*The influence of heavy metals composition of soil on the polymeric insulators materials of power cables*	TIM14 Physics Conference - Physics without Frontiers, Nov. 20-22, 2014, Timișoara, Romania	**Popescu I.V.** **Rădulescu C.** **Stihi C.** **Telipan Gabriela** **Dulama I.D.** **Ioniță I.** **Bunghez I.R.**
78	*New Dynamic Balancing System Based on Magnetic Interaction and Software Removal of some Perturbations – cod lucrare 4083*	ISAV 2014 – 4th International Conference on Acoustics and Vibration, Iran University of Science and Technology, Teheran, Iran, Dec. 10-11, 2014	**Ilie Cristinel** **Comeaga Daniel Constantin** **Popa Marius**

No.	Title of scientific paper	International conference and workshop	Authors
79	Energy recovery of the agriculture residuals in descentralized biogas units *(Valorificarea energetică a deșeurilor agrozootehnice în instalații de biogaz descentralizate)*	Symposium „Smart Avrig Region – catalist of the sustainable development", Avrig, 1st July 2014, organized by AGIR and Avrig Municipallity	**Mateescu Carmen**
80	*Assessment of capacitive effect in planar transformers* *(Evaluarea efectului capacitiv in transformatoarele planare)*	9th International Workshop of Electromagnetic Compatibility, CEM 2014, Timișoara, Romania, Sept. 3 – 5, 2014	**Pintea Jana** **Morari Cristian**
81	*Convergences and incongruities of transmission line theory towards S-parameters, respectively EMC - electromagnetic shielding*	9th International Workshop of Electromagnetic Compatibility, CEM 2014, Timișoara, Romania, Sept. 3 – 5, 2014	**Bădic Mihai**
82	*Environmentally friendly products for replacement of insulating mineral oils*	15th International Conference on Energetic-Electrical Engineering, ENELKO 2014, October 9-12, 2014, Odorheiul Secuiesc, Romania pp. 58-63	**Lingvay J.** **Tudosie L.** **Szatmári I.**
83	*Microbial corrosion of S235J2G3 carbon steel*	VEKOR, April 8-10, 2014, Balatonfured, Hungary, CD, paper 34	**Szatmári I.** **Lingvay J.**
84	*Biodegradation of underground power cables*	VEKOR, April 8-10, 2014, Balatonfured, Hungary, CD, paper 28	**Lingvay J.** **Szatmári I.** **Lingvay M.**
85	*Underground power cables maintainability – the biodeterioration of external polymeric jackets and its influence on insulation ageing* *(Întreținerea cablurilor de alimentare subterane – biodegradarea mantalelor polimerice externe și influența sa asupra îmbătrânirii izolației)*	CIE (International Energy COnference) - Energy 2014, June 4-6, 2014, Oradea, Romania	**Lingvay Iosif** **Szatmári Ilona** **Lingvay Monika** **Marin Dorian**
86	*Thermal Analysis and Calorimetry Conferences – Increasing the number of meetings and participants in our region*	Romanian Academy – Division of Chemical Science. Commision of Thermal Analysis and Calorimetry. 23rd edition of Annual Workshop of Scientific Papers – Bucharest, Romania, February 2014	**Rotaru Andrei** **Budrugeac Petru** **Popescu Crisan**
87	*DMA and DSC studies on denaturation in water and in dry state of parchments subjected to accelerated ageing*	Romanian Academy – Division of Chemical Science. Commision of Thermal Analysis and Calorimetry. 23rd edition of Annual Workshop of Scientific Papers – Bucharest, Romania, February 2014	**Cucoș Andrei** **Budrugeac Petru** **Miu Lucreția**
88	*Leather characterization by thermal analysis for improved microclimate conditions*	Romanian Academy – Division of Chemical Science. Commision of Thermal Analysis and Calorimetry. 23rd edition of Annual Workshop of Scientific Papers – Bucharest, Romania, February 2014	**Carșote Cristina** **Budrugeac Petru** **Petroviciu Irina** **Miu Lucreția** **Badea Elena**

No.	Title of scientific paper	International conference and workshop	Authors
89	*Study of crystallization process of soda lead silicate glasses by thermal and spectroscopic methods*	Romanian Academy – Division of Chemical Science. Commision of Thermal Analysis and Calorimetry. 23rd edition of Annual Workshop of Scientific Papers – Bucharest, Romania, February 2014	**Mocioiu Oana Cătălina** **Zaharescu Maria** **Atkinson Irina** **Mocioiu Ana-Maria** **Budrugeac Petru**
90	*Differential Scanning Calorimetry for quantifying damage in artificial aged leather*	Chemistry for Cultural Heritage (ChemCH 2014), Viena, Austria, July 2014	**Carşote Cristina** **Badea Elena** **Miu Lucreţia** **Della Gatta Giuseppe** **Budrugeac Petru**
91	*Phase transitions of a parchment manufactured from deer leather: A calorimetric and kinetic analysis*	The 11th European Symposium on Thermal Analysis and Calorimetry - ESTAC 11, Espoo, Finlanda, August 2014	**Budrugeac Petru**
92	*Differential scanning calorimetry. A valuable technique for characterizing vegetable tanned leather*	International Seminar and Workshop on Emerging Technology and Inovation for Cultural Heritage (ETICH 2014), Sibiu, Romania, October 2014	**Carşote Cristina** **Badea Elena** **Miu Lucreţia** **Della Gatta Giuseppe** **Budrugeac Petru**
93	*Evaluation of some conservation treatments for parchment artifacts*	International Seminar and Workshop on Emerging Technology and Inovation for Cultural Heritage (ETICH 2014), Sibiu, Romania, October 2014	**Cucoş Andrei** **Badea Elena** **Miu Lucreţia** **Carşote Cristina** **Petroviciu Irina** **Budrugeac Petru**
94	*Study of the environmental impact on vegetable tanned leather by thermal analysis*	ICAMS 2014 – 5th International Conference on Advanced Materials and Systems, Bucharest, Romania, October 2014	**Carşote Cristina** **Budrugeac Petru** **Miu Lucreţia** **Karavana Hüseyn Ata** **Badea Elena**
95	*Testing of leather artificially aged in acid rain*	ICAMS 2014 – 5th International Conference on Advanced Materials and Systems, Bucharest, Romania, October 2014	**Wuyong Chen** **Yanping Gao** **Gong Ying** **Ignat Mădălina** **Miu Lucreţia** **Budrugeac Petru**
96	*Composite materials used for electromagnetic shielding*	The 12th National Conference with international participation „Mechatronics, Mechanical Engineering, Microtechnologies and New Materials" MIM-MMN 2014, June 27, 2014, Târgovişte, Romania	**Bălan Ionuţ** **Morari Cristian** **Pătroi Eros Alexandru**
97	*Electromagnetic properties of composite shields*	9th International Workshop of Electromagnetic Compatibility, CEM 2014, Timişoara, Romania, Sept. 3 – 5, 2014	**Bălan Ionuţ** **Morari Cristian** **Popescu O. Mihai**

No.	Title of scientific paper	International conference and workshop	Authors
98	The assessment of the contact pressure developed between the rotor and the stator of the helical pump using the Finite Element Method *(Evaluarea presiunii de contact dezvoltate între rotorul și statorul pompei elicoidale utilizând Metoda Elementelor Finite)*	WEC Central & Eastern Europe Regional Energy Forum – FOREN 2014, June 15-19, 2014, Bucharest, Romania	**Mitrască Nușa, INCDIE-ICPE-CA București – IPCUP Ploiești** **Pupăzescu Alexandru** **Ulmanu Vlad**
99	Abrasive Wear Resistance of the Rotor-Elastomer Couple of Materials Used by Progressive Cavity Pumps *(Rezistența la uzură abrazivă a materialelor cuplei rotor-elastomer utilizată în pompele cu cavități progresive)*	8th International Conference on Tribology Balkantrib'14, October 30 – November 2, 2014, Sinaia, Romania	**Mitrască Nușa, INCDIE-ICPE-CA București – IPCUP Ploiești** **Ulmanu Vlad**

ICPE-CA IN 2014 MEDIA

Coverage of the institute, and therefore the most representative achievements emerged during 2014 by addressing several directions.

On the one hand, weekly press releases were sent. Communications were found in the pages of the largest news agencies such as Agerpres, Mediafax, Promptmedia, Amos News, HotNews, Moldpres, Rador, Deca News, Romanian Global News, Good Agency, RNews.

Information transmitted through press releases were related to national or international projects which involve the institute, the stage and their achievements: "Promotion of Financing Innovation in South-East Europe-PROFIS", "Infrastructure to promote competitiveness through innovation in electrical engineering for sustainable growth of energy security-PROMETEU", "RURALINVEST-TOGETHER FOR A CHANCE TO EMPLOYMENT", "Clean transmission line of 5 km between Silistra (Bulgaria) and Calarasi (Romania)".

Also the information provided through press releases focused on events organized by the institute or activities in which the institute was involved: "International Workshop of Electromagnetic Compatibility CEM 2014", "INGIMED after 14 years: the state of the world", "Romanian-Hungarian meeting clusters in Hungary", "Brokerage event in IT&C field within the Enterprise Europe Network", "Training center for young researchers developed by ICPE-CA", "First communication session of the Excellence Center for Initiation in the Scientific Research of Young Olympics", "ICPE-CA inventions awarded with gold and silver at the INNOVA Salon: a gold and two silver medals", "IPCUP Ploiesti-back in force", "Scientific research is still living in Romania. It is initiated and developed in ICPE-CA".

To increase the impact of media releases, they were posted on well known press releases or news websites. We mention here: ecomunicate.ro, comunicatedepresa.ro, comunicatemedia.ro, comunicate-de-presa.ro, webpr, stiriro.com, fabricadebani.ro, ecomagazin.ro, niuzer.ro, recolta.eu, panoramamedia.ro, bioproduct.ro, stiinta.info, asiiromani.com, stiriro.com, monitorulsb.ro, stiriawzi.ro, rsshunt.ro, roportal.ro, ziare-pe-net.ro, ziare.realitatea.net, ziare.ro, ziarulstiintelor.eu, stiintaazi.ro, asinfo.ro, roportal.ro, agentiadecarte.ro, ziareaz.ro, stiam.ro, cluj-am.ro, ccib.ro, ultimelestiri.com, stiri-financiare.ro, ziarero.antena3.ro, napocanews.ro, e-stireazilei.ro, atitudinea.ro, confluente.ro, discard.ro, newsring.ro, scienceline.ro, braila247.com, stirinoi.com, napocanews, asinfo.ro, rsshunt.ro, haga.mae.ro, scientia.ro, saptamana.com, antena3.ro, viatavalcii.ro, ancs.ro, asinfo.ro, stiri-din-romania.com, ghidelectric.com, promoafaceri.com, ultima-ora.ro, administratie.ro, newsbucovina.ro, afacerilaminut.ro, suceava1.ro, capitalul.ro, agora.ro, stiri.rol.ro, sursadestiri.ro, indexstiri.ro, stirilemedia.ro, ziaregratis.ro, infoziare.ro, paginadestiri.ro, pescurt.ro, 1stiri.ro, bucharestherald.ro, evz.ro, ro-afaceri.ro, scoalaedu.ro, dezvaluiri.ro, ziarebusiness.com, banknews.ro, stirideromania.ro, revistapresei.businessline.ro, allnews4all.ro, financiarul.ro, bursa.ro, revista-presei.com, stiri.astazi.ro, observator.ro, ziarelive.ro, ziuaconstanta.ro, marketingromania.ro, ziar.com, ziarulprofit.ro, scientia.ro, ziarulfaclia.ro, presa-online.ro, presaonline.com, get.ro, infosanatate.ro, stirea.com, money.ro, ziuacargo.ro, instalnews.ro, adevarul.ro, realitatea-ialomiteana.ro, actualitati.net, calificativ.ro, agora.ro, stiriong.ro, stiri-itc.ro, star-storage.ro, digi24.ro, curentul.ro, jurnalul.ro, agir.ro, diacaf.com, stirilepescurt.ro, goldfmromania.ro, enational.ro, curierulnational.ro, jurnalulbucurestiului.ro, infoportal.rtv.net, 008.ro, stiintasitehnica.com, edu.ro, feliciter.net, esimplu.ro, obiectiv.net, opiniagiurgiu.ro, ştirimuntenia.net, giurgiuonline.net, presaonline.eu, index-stiri.ro, ziarullumina.ro, gazetadeagricultura.info, ziarulfermierului.ro, i-ziare.ro, timpromanesc.ro.

On the other hand, in the magazines such as Market Watch, Economistul, Şcoala Edu, Univers Ingineresc, Viaţa Medicală, Ziarul Ştiinţelor were found articles about the institute: „Financing for Innovation and Entrepreneurship","ICPE-CA: Home of applied superconductivity", "ICPE-CA: benchmark of excellence through innovation in the Romanian research", "Electrical Engineering for Black Sea", "ICPE-CA integrates innovative concepts in the crossborder Danube transport", "ICPE-CA prepares the future ambassadors of excellence", "New horizons of research for ICPE-CA through PROMETEU project", "ICPE-CA invests

in the development of an innovative project of biogas", "Romanian entrepreneurs, supported to develop innovative business", "Centre of Excellence in Research for Olympics", "ICPE-CA expands innovation in the management process", "Promotion of Financing Innovation in South-East Europe-PROFIS", "Competition for innovative business ideas", "Electromagnetic Compatibility 2014", "Engineering for Medicine".

Also, in newspaper pages were found news about the institute. Adevărul, Impact, Obiectiv, Bursa, Business Point, Business Adviser, Curentul, EcoMagazin, Financiarul, Curierul Zilei, Curierul Național, Făclia, Monitorul de Sibiu, Viața Vâlcii, Ziua de Constanța, Cultura Valceană, Realitatea Ialomițeană are just a few examples.

In the same time, there have been given more than 15 interviews, broadcasted live on Radio Bucharest FM, Radio România News and most of these were broadcasted on Radio România Cultural in programs like: "Science in the right words", "The explorers of tomorrow world", "Science at home", „Scientific univers".

Certainly, have not been omitted the television appearances. TVR television station, in programs "Time News", "News bulletins" and "Time of the King", presented news and reports about impact projects developed by the institute, such as the Center of Excellence for Initiation in the Scientific Research of Young Olympics or the innovative business ideas competition within PROFIS project.

Also, to increase the visibility of research results, the institute has been involved in the organization of symposiums, conferences, workshops and seminars. We mention "INGIMED after 14 years: the state of the world", "The ninth edition of the International Workshop of Electromagnetic Compatibility CEM 2014", "First session of communication of the Excellence Centre for Initiation in Scientific Research of Young Olympics", "PROFIS-Promotion of Financing Innovation in South-East Europe", "PROFIS-Promotion of the inventor/entrepreneur women", "PROFIS-launching the competition of the innovative business ideas", "PROFIS-Validation the National Report on Financing Innovation", were the institute has enjoyed attention from participants and journalists.

EXCELLENCY CENTRE FOR TRAINING IN SCIENTIFIC RESEARCH OF THE YOUNGS

Coordinator: Dr. Eng. Mircea Ignat,
Department for Micro-Nano-Electrotechnologies, INCDIE ICPE-CA

Nu am nici un talent anume.Sunt doar extraordinar de curios.
Cea mai frumoasă şi profundă trăire omenească este misterul.
Albert Einstein

The prizes and the medals of the Excellency Centre members in 2014

INFOMATRIX Buchares, march 2014, National Fase
GOLD MEDAL – HARVESTING CUBE - project, Team: Luca Florescu, Andrei Corbeanu
SILVER MEDAL – SPIDER ADHESIVE - project, Team: Ştefan Iov, Alex Glonţaru
BRONZE MEDALS - GRAPHIC MOTOR - project, Author: Andrei Pangratie
- INSECT ARM - project, Team: Matei Sarivan, Călin Rusu

INFOMATRIX INTERNATIONAL COMPETITION Bucharest, May 2014
BRONZE MEDALS - HARVESTING CUBE - project, team: Luca Florescu, Andrei Corbeanu
- LINE FOLLOWER - project, team: Matei Sarivan
– SUMMO - project, team: Andrei Corbeanu
ROSEF Suceava, June 2014
Prize II - GRAPHIC MOTOR WITH APPLICATIONS ON SCENOGRAPHY - project, team: Andrei Pangratie

Prize III - E-COMMERCE PLATFORM - project, team: Cristian Dragomir, Alex Glonţaru
Prize III - HARVESTING CUBE - project, team: Luca Florescu, Andrei Corbeanu
OLYMPIAD of YOUNG INNOVATOR, Tbilisi - Georgia, May 2014
Gold Medal - E-COMMERCE PLATFORM project, team: Cristian Dragomir, Alex Glonţaru
PARTICIPATION TO ISEF-INTELL 2014 - FINALS, Los Angeles - USA, May 2014
SPIDER ADHESIVE - project, team: Ştefan Iov, Alex Glonţaru
QUALIFICATION TO ISEF-INTELL - FINALS, Pittsburgh - USA, May 2015
HARVESTING CUBE - project, team: Luca Florescu, Andrei Corbeanu
E-COMMERCE PLATFORM - project, team: Cristian Dragomir, Alex Glonţaru

GRAPHIC MOTOR WITH APPLICATIONS ON SCENOGRAPHY project

Author: Andrei Pangratie

Abstract. This project represents an interdisciplinary researches and include: graphic soft elements, specific libraries, theatrical and scenographic elements on the idea that the research project is a game but not an entertainment.

The aim of this project represent also, the creation a method for the aproach the scenography with different variants on theater, cinematography, or opera.

- A case study was the Karamazov brothers by Dostoievsky.

THE ENERGY - HARVESTING CUBE project

Team : Luca Florescu - Sf.Sava Colegium, Andrei Corbeanu - Iulia Hasdeu Colegium, Excellency Centre for Young Olympics, part of INCDIE ICPE-CA

Coordinating: Dr.Eng. Mircea Ignat - Excellency Centre for Young Olympics, part of INCDIE ICPE-CA

Abstract. The research team of the Centre proposes a theoretical and experimental study to the harvesting field, which is concretized in an energy harvesting cube structure. The harvesting energy cube is a demonstrator to evidence the energy retrieve of the environment and can be a good didactic and educational procedure.

SPECIFIC STAND TO THE EXPERIMENTAL STUDY OF THE INSECT LEGS WITH MICROACTUATOR AND UNCONVENTIONAL MICROELECTROMECHANICAL DRIVER APPLICATIONS

Team: Matei Sarivan, Tudor Vianu Colegium - Excellency Centre for Young Olympics, part of INCDIE ICPE-CA; Calin Rusu, Grigore Moisil Colegium - Excellency Centre for Young Olympics, part of INCDIE ICPE-CA

Coordinating: Dr.Eng. Mircea Ignat - Excellency Centre for Young Olympics, part of INCDIE ICPE-CA

Abstract. The paper makes a short presentation on the Bionics team preoccupation on the project of motility study of the microinsect legs with electromechanical applications.

E- COOMERCE PLATFORM project

Team: Cristian Dragomir, Alex Glonţaru - Excellency Centre for Young Olympics, part of INCDIE ICPE-CA ("Tudor Vianu" Colegium)

Abstract.The aim of this project is to determine in minimum time , an optimum product, with different criterions.The team members has a soft platform , with products and producers libraries and data bases which can be easy used to a cellular.

PARTNERSHIP

Romanian Committee of Electrical Engineering
CER

General Association of the Engineers in Romania
AGIR

Avrig Town Hall, Sibiu county

Romanian Association of Electronics and Software – Bucharest
ARIES

Romanian Society of Magnetic Materials
SRMM

Professional Association of New Energy Sources
SUNE

Romanian Association for Technology Transfer and Innovation

National Network for Innovation and Technology Transfer

National Institute for R&D in Mine Safety and Protection to Explosion
INCD INSEMEX Petrosani

National Institute for R&D in Chemistry and Petrochemistry
ICECHIM

National Institute for R&D in Microtechnologies
IMT Bucharest

SC IPA CIFATT Craiova

National Institute of R&D for Machines and Installations Designed to Agriculture and Food Industry
INMA

Research, Development and Testing National Institute for Electrical Engineering
ICMET Craiova

Mechanical Engineering and Research Institute
SC ICTCM SA

Energy Research and Modernizing Institute
ICEMENERG

The Romanian Academy

Academy of Technical Sciences of Romania
ASTR

Chamber of Commerce and Industry of Romania

National Council of Scientific Research in Higher Education
CNCSIS

SC INTERPLAST SA

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National Institute for Laser, Plasma and Radiation Physics INFLPR

National Institute of R&D in Mechatronics and Measurement Technique INCDMTM

SC ROSEAL SA

SC HOFIGAL EXPORT-IMPORT SA

SC ROFEP SA Urziceni

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ROMEXPO SA

World Energy Council - Romanian National Committee

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Executive Unit for Financing Higher Education, Research, Development and Innovation UEFISCDI

National Research Council CNCS

National Authority for Scientific Research ANCS

China Association for Science &Technology

National Centre for Programme Management

Romanian EMC Association

Technical University of Civil Engineering Bucharest

Institute of Atomic Physics
IFA Magurele

National Institute for R&D in Electrochemistry and Condensed Matter
INCEMC Timisoara

Electrical Research Institute
ICPE SA

SC ICPE-ACTEL SA

ICPE SAERP SA

Research Institute for Electrical Machines
ICPE-ME SA

Electric Products Certification Independent Body
OICPE

National Institute for Earth Physics
INCDFP Bucharest

National Institute for R&D of Isotopic and Molecular Technologies
INCD TIM Cluj Napoca

Romanian R&D Institute for Gas Turbines
COMOTI

National Institute of Materials Physics
INCDFM Bucharest

"Victor Babes" National R&D Institute

The Leather and Footwear Institute
ICPI

National Institute for Chemical Pharmaceutical R&D
ICCF Bucharest

National R&D Institute for Cryogenic and Isotope Technologies
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