PARTNERSHIPS IN PRIORITY AREAS

Collaborative Applied Research Projects (PCCA);
PN-II-PCCA Project No. 204/2012;

"Environmental toxic and flammable gas detector based on silicon carbide MOS sensor array"

Acronym: **SIC-GAS**;
Consortium:
Coordinator: National Institute for Research& Development in Electrical Engineering, INCDIE ICPE-CA
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Project summary.
There is a high need for gas microsensors in many areas of the industry. Some applications request sensors that can operate in high temperature and chemically reactive environments.
The objective of our project is to develop a silicon carbide (SiC) MOS capacitor sensor which can detect environmental toxic and flammable gases. This type of sensor is well suited for such application because it has high selectivity and sensitivity, fast response, short recovery time and low power consumption. The use of silicon carbide is a key feature that allows the sensor to function at high temperatures.
Several innovative material and structures will be developed that will increase the performances of the present SiC MOS capacitor sensors. Every structure will be highly sensitive to a certain type of gas. Structures with different characteristics will be integrated in an array in order to increase the range of gases that can be detected precisely. A drive circuit will be developed. Its purpose is to measure the output of the gas sensor and transmit it to a PC. On the PC a custom software application will be developed. This application receives the measured values from the drive circuit and analyzes them in order to determine the concentration and type of the detected gas.
The sensors and drive circuit will first be designed and simulated. Then the SiC MOS structures will be characterized using a semiconductor characterization system and a controlled environment chamber. C-V characteristics will be plotted for all the structures in different gas mixtures environments. Then, the sensors and the drive circuits will be fabricated and the custom software application will be developed. The prototype will be tested in the controlled environment chamber and in real applications and the necessary adjustment will be performed.
Stage I: Theoretical& conceptual models of environmental toxic and flammable gas detector based on silicon carbide MOS sensor array; Identify sources of toxic and flammable gas emissions from building materials industry; Studies of technological process for fabrication of the MOSiC gas sensors; Studies and preliminary

experimentations of thin film technological compatible with SiC substrate. (07-12. 2012).

Stage II: Industrial research: Design and simulation of different SiC MOS sensor structures; Experiments for solubility of the interest gases in different metal electrodes; Experiments for the optimal technological parameters for oxide layer ; Experiments for fabrication M/O/on SiC substrate; Designing experimental model; Designing masks, Designing the equipment for testing the gases detector; Design of subassemblies. (01-12. 2013)

Stage III: Industrial research: Elaboration of the experimental model; Fabrication of masks batch; Advanced simulation of functional model; Subassembly of gas sensors testing equipment elaboration; Making the equipment for testing gas sensors in a controlled environment chamber from low to high concentrations; Optimizing the structure and the technological process; Designing a novel fully electrically isolated package for high temperature sensors; (01-12. 2014)

Stage IV: Industrial research: Experiments of detector; Utility& functionality of model demonstrate; Design and implementation of the sensor drive circuit, connection between the circuit, computer and the sensor array; development of the custom software application; Characterization, testing and calibration of the entire assembly; Demonstration of functionality and reliability of the SiC MOS detectors in the real conditions from industrial plants. (01-07. 2015)