New Multifunctional Sensors Based on Nanostructured Carbon for Environment-Life-Health Applications

Goal of the project:
The project aim was to develop electrodes based on carbon nanostructures to create sensors and intelligent microelectrodes array behaviour according to the individual and selective/simultaneous detection of some persistent organic pollutants (POPs) target analytes from water, as a solution to the urgent needs of providing enhanced timely monitoring of POPs.

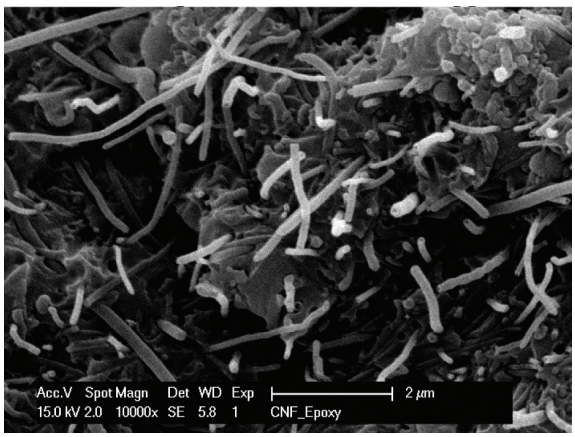
Short description of the project:
This project addresses the urgent needs for providing enhanced timely monitoring of POPs in water through the development of new sensors based on carbon nanostructures with their customization (modification with transition metals functionalized zeolites), integrating these composite based sensors as microelectrodes arrays in order to obtain an intelligent sensor for simultaneous/ selective detection of oxidable pollutants from water. The electroanalytical parameters for POPs detection, i.e. sensitivity, selectivity, detection limits, stability, and short response time were studied in detail. Also, the study of these sensors for application in other complementary fields, i.e., clinical analysis, pharmaceutical and food products analysis, revealed the possibility of elaboration/ development of non-invasive innovative analysis techniques. These new sensors should give an advance for the monitoring of persistent pollutants and should have an important impact on water quality control, as well as on life and health quality.

Implementation period:
05.08.2010-27.07.2012

Research Centre for Environmental Science and Engineering

Project implemented by:
The Faculty of Industrial Chemistry and Environmental Engineering from UPT.

Main activities:
Two new composite electrodes types based on carbon nanotubes / carbon nanofibers one unmodified, and the other modified with functionalized zeolite have been developed. Functionalized zeolite and carbon nano-structures were trapped in the epoxy matrix. After composite electrodes elaboration, specific techniques for the structural and electrochemical characterization and detection experiments have been applied.



The electrochemical techniques optimal conditions for analysis have been established, and the behaviour of obtained sensors as microelectrodes network has been tested. Then, the degree of recovery for each proposed optimal detection method on real waters, and enriched with known quantities of pollutant has been assessed. The accuracy of the proposed detection methods has been evaluated relative to the conventional ones. The adaptation availability of these sensors for detection of some compounds of interest in medicine, pharmacy and food products has also been accomplished.

"Few scientists acquainted with the chemistry of biological systems at the molecular level can avoid being inspired."

Donald Cram

Results:
•Development of new transition metals (Ag/Cu) functionalized zeolite modified composite electrodes based on carbon nanomaterials;
•Established interferences and optimal conditions of the new sensors for individual detection of target POPs from waters;
• Exploiting the multiple pulse amperometry characteristics to enhance the detection electroanalytical performances;
•Establishing of selectivity, specificity, detection limit, concentrations range, measurements accuracy, interferences and fouling/defouling conditions of electrodes for simultaneous detection of organic pollutants from real waters;
•Correlation between amperometric signal and conventional parameters for real waters.

For increasing of the Romanian research international visibility, all the scientific results has been communicated and published in prestigious journals in mainstream publications of the field. The quantifiable contributions are: 10 papers published in ISI Web of Knowledge indexed journals, one published book chapter and one submitted patent application.

Fields of interest:
The main fields of interest related to project applicability and implementation are: control system for the POPs in the environment and noninvasive quantitative evaluation of some compounds of interest in fields such medicine, pharmacy and food industry.

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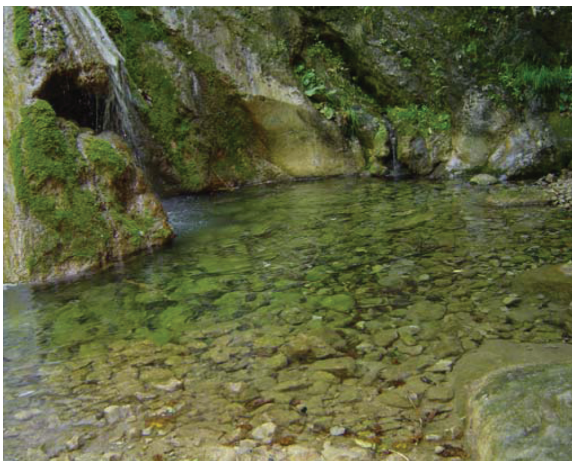
Research team:
Dr. Eng. Aniela POP

Applicability and transferability of the results:
Benefits of this pollution detection way allow the improvement of water quality management, with on-site organics monitoring, reducing response time and avoiding water sampling and conditioning. The potential beneficiaries of these types of sensors are: analysis and research laboratories, environmental protection agencies (especial for on-site pollutants monitoring, water quality control, risk assessment), pilot plants and plants for wastewater treatment.

Contact information:
Dr. Eng. Aniela POP
Address: B-dul Vasile Parvan, no 6, 300223, Timişoara, Romania
Tel./Fax.: (0040) 256 403 069
Mob.: (0040) 723 528 667
E-mail: anielapop@yahoo.com
aniela.pop@chim.upt.ro



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