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DEVELOPMENT OF VOLTAMMETRIC SENSORS FOR THE ANALYSIS OF NATURAL WATERS

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1. Introduction

The chemical composition of natural water is derived from numerous sources of solutes, involving gases from the atmosphere, weathering and erosion of soil and rocks, solution or precipitation reactions taking places under the terrestrial surface, and products resulting from human activities [1, 2]. The measurements of the natural waters by means of usual chemical analysis is difficult, is time consuming, require expensive equipment and qualified personnel [3]. Therefore, it is becoming necessary to develop analytical small devices that are inexpensive, portable, reliable, selective, easy to use and require few microliters of sample to determine a particular parameter.

2. Experimental

In this work, an innovative type of chemically modified sensors based on conducting polymers has been developed and used for the construction of a multisensory system. Sensors have been obtained by electrosynthesis from the corresponding monomers (3,4-ethylenedioxythiophene and pyrrole) onto platinum disk electrodes using a variety of doping agents with electroactive properties.

3. Results and discussion

The voltammetric response of sensors is sensitive and stable in a wide potential range. These are related to the redox properties of polymers and doping agents, strongly influenced by the chemical compounds from the electrolyte solution. Furthermore, their sensing characteristics can be enhanced by using multicharged anions or electroactive anions as doping agents. Sensors are highly sensitive to the electroactive compounds from the solution, the lowest detection limits being 2.2×10^{-7} M for Fe^{2+}, an important cation related to the polluted water. The sensors presents cross-selectivity, the responses being influenced by the global composition of the samples. Therefore, these sensors could be used for the development of a multisensors system. The multisensors system has been developed using those voltammetric sensors showing the best performance characteristics, stability and cross-sensitivity and cross-selectivity. The sensors array has been used to analyze water samples from the Danube River, collected from five different points near to Galati city. Each voltammetric sensor presents a specific electrochemical signal when exposed to the water samples. Principal Component Analysis and Partial Least Squares-Discriminant Analysis results obtained from the voltammetric signals are able to classify the water samples according to their characteristics. The regression coefficients among sensor responses and the results of the physico-chemical analyses obtained by means of PLS1 regression models are greater than 0.8, validating the multisensors system.

4. Conclusions

The voltammetric sensors as sensing devices or as multisensory system are useful in the analysis of natural waters.

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