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Habilitation thesis "Disposable sensors with applications in electroanalysis" ABSTRACT

The habilitation thesis entitled "Disposable sensors with applications in electroanalysis" presents the scientific research activity carried out after the defense of the doctoral thesis in 2003, providing an overview of the academic and scientific developments according to the current standards. Taking into account the impressive progress of the electroanalysis and its growing impact on analytical chemistry, the research activity has been directed towards the development of disposable electrochemical sensors based on sensitive materials for the analysis of electroactive compounds of biological, ecological, pharmaceutical and medical importance from complex samples. The aim of the thesis is to provide some perspectives regarding the choice of electrode materials, electrode surface modification procedures and electrochemical techniques applied for the analyte detection, as well as some practical aspects.

The habilitation thesis is structured in three sections, based on 10 representative scientific papers of the 65 ISI indexed articles published during the post-doctoral period, 25 of which as first author and/or corresponding author.

Section A of the habilitation thesis highlights the main professional, academic and scientific achievements, respectively the current scientific context regarding the importance of the addressed research areas.

At the beginning, some important aspects concerning the electrochemical techniques, especially voltammetric ones, are presented, taking into account their advantages for monitoring of important compounds in different area of interest, as well as for obtaining valuable information on the electrochemical behavior, kinetics and concentration of the chemical species. The challenges of electrochemical sensor development (types of electrode materials, simultaneous analysis of structurally similar compounds, selectivity of voltammetric determinations, etc.) are also considered.

Disposable electrodes, such as screen-printed electrodes (SPEs) and pencil graphite electrodes (PGEs), have been widely used in the development of portable electroanalytical devices, their application in rapid diagnosis and *in situ* monitoring being revolutionary in different areas, but also challenging. This electrode property of being disposable is often associated with important features such as portability, low cost, ease of use, and mass production, which have led to radical transformations in the design and applicability of electrochemical sensors and biosensors, significantly changing materials, fabrication methods, and design technologies. Through the screen-

printing process, a large production of devices with good reproducibility is possible, but the availability and cost effectiveness of graphite mines, as well as their uniform composition, resulted in a considerable increase in PGE applications. Currently, thanks to disposable sensors, it is possible to monitor blood glucose, detect alcohol and drugs or determine pollutants directly at the pollution source.

The scientific contribution in this research direction is represented by the development of electroanalytical systems based on such disposable electrochemical sensors for the determination of electroactive compounds. Thus, at this point of the research, electrochemical methods were developed for the determination of some analytes of pharmaceutical and medical importance (kojic acid, captopril, quinine, chloramphenicol, lamotrigine) or ecological significance (4-nonylphenol). An aspect that is worth mentioning is the simultaneous detection, in some cases for the first time, of compounds with similar structure (e.g., the dihydroxybenzene isomers hydroquinone, catechol and resorcinol, the catecholamine neurotransmitters epinephrine and norepinephrine, the phenyl-urea herbicides linuron and monolinuron) or of active ingredients found together in pharmaceutical preparations (e.g., levodopa and benserazide; paracetamol, phenylephrine and guaifenesin; B vitamins). The selective determination of these compounds was possible using SPE and PGE, in some cases their chemical and/or electrochemical modification leading to the improvement of the kinetics of the reactions occurring at the electrode surface and providing better selectivity and sensitivity to the electrochemical detection. The modified sensors were structurally and electrochemically characterized to demonstrate these electrode features.

Special attention has been paid to ensuring the reliability of the proposed electrochemical methods, this mixed property being based on other major performance characteristics such as the selectivity, accuracy, precision or sensitivity of the developed analytical procedures. Thus, after optimizing the experimental parameters that influence the processes at the surface of the working electrode (such as the nature and composition of the electrode, the nature, composition and pH of the electrolyte solution) or the instrumental parameters specific to the used techniques (for example, the scan rate, potential waveform, etc.) the validation parameters of the analytical methods were evaluated. Emphasis was placed on comparing the results obtained by the electrochemical methods with those obtained by other techniques such as spectrometric (absorption or molecular fluorescence) or liquid-chromatographic with UV detection or by relating to the content declared by the manufacturers of the pharmaceutical products. The applicability of the proposed electrochemical methods was also demonstrated through of the analysis of real samples with complex matrices, mainly pharmaceutical preparations, environmental and food samples.

Section B of the habilitation thesis contains the development plan for the academic, professional and research career, and section C is represented by the list of 147 references.