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“Voltammetric analysis of drugs at various carbon-based electrodes”

abstract

The presented Ph.D. thesis entitled “Voltammetric analysis of drugs at various carbon-based electrodes” is focused on the application of carbon-based electrodes such as boron-doped diamond electrode (BDDE) and edge-plane pyrolytic graphite electrode (EPPGE) in the voltammetric study of selected biologically active compounds (drugs). The developed analytical procedures could allow using voltammetric techniques for drugs determination in the routine control of pharmaceutical preparations. The application of voltammetric techniques enables in many cases reduce the time needed to perform the analysis, reduce the volume of organic solvents used what is important in terms of cost and environmental impact.

Boron-doped diamond electrode (BDD) and edge-plane pyrolytic graphite electrode (EPPG) are environmentally friendly and perspective carbon-based electrode materials. These electrode materials open new possibilities of electrochemical investigations due to their excellent electrochemical properties. BDDE is characterized by a very wide potential window in both aqueous and non-aqueous solutions, very low and stable background current, long-term stability, resistance to electrode fouling, low sensitivity to dissolved oxygen, and perfectly polarizable surface. Moreover, BDDE has weak adsorption properties, and high resistance to deactivation and contamination. In turn, EGPPE is characterized by a relatively wide potential window in aqueous solutions, fast kinetics and strong adsorption properties.

In this doctoral dissertation, the voltammetric analysis of selected drugs such as imatinib, teriflunomide, and bithionol was carried out. The voltammetric analysis of the above-mentioned drugs was possible thanks to the presence of electrochemically active functional groups in their structure. Electrochemical techniques such as differential pulse voltammetry, square-wave voltammetry, and square-wave adsorptive stripping voltammetry were successfully applied for the determination of drugs. The optimization of supporting electrolyte and its pH, as well as voltammetric technique parameters, was performed. The validation of the developed procedures for each compound was also performed. In each case, relatively low limits of detection and quantification were achieved. Furthermore, the applicability of the developed voltammetric procedures was checked by quantitative analysis of the spiked human urine samples with satisfactory recoveries. Finally, the impact of potential interfering agents co-existing in the human urine such as some inorganic ions and organic biological molecules was investigated, and relatively good selectivity of the procedures was reported. Additionally, in order to understand the electrode mechanism, cyclic voltammetry was applied. In the case of bithionol, in order to explain the electrode mechanism, the adsorption studies were conducted using alternating current impedance spectroscopy. Moreover, the EPPGE and BDDE surfaces were characterized using atomic force microscopy and scanning electron microscopy.