

Abstract

Recently, innovative and environmentally friendly working electrodes for trace analysis of biologically active compounds were introduced. Mercury electrodes, despite their amazing electrochemical properties, lose their significance due to the harmfulness of mercury. Therefore, carbon-based electrodes have become an excellent alternative.

In this dissertation, the application of various carbon-based materials in electroanalysis has been discussed. Well-known carbon allotropes such as graphite, diamond, graphene, fullerenes and carbon nanotubes are used in electrochemistry as the electrode material or as a modifier of other electrodes. Carbon-based materials possess many advantages when used as a working electrode, e.g. high electrical conductivity, wide electrochemical potential window, low background current, chemical stability, chemical inertness and low cost.

In this study, six carbon-based electrodes were used as the working electrodes: graphite flake paste electrode (GFPE), multilayer graphene paste electrode (MLGPE), glassy carbon electrode (GCE), edge-plane pyrolytic graphite electrode (EPPGE), basal-plane pyrolytic graphite electrode (BPPGE) and boron-doped diamond electrode (BDDE). The voltammetric performance of these types of electrodes was compared using $K_4[Fe(CN)_6] / K_3[Fe(CN)_6]$ as a model redox system. Using carbon-based electrodes, the procedures for voltammetric determination of five biologically active compounds were developed. Among the determined compounds, there were two painkillers (acemetacin – ACM and acetaminophen – AC), two anticoagulants (rivaroxaban – RIV and dabigatran etexilate – DAB) and one pesticide (mandipropamid – MAN). For each compound, the calibration curve, limit of detection, limit of quantification, sensitivity and selectivity were investigated using SWV or SWSV techniques. The usefulness of the developed procedures were checked by their determination in pharmaceuticals or spiked samples. Cyclic voltammetry was conducted to understand the mechanism underlying the electrodes processes of AC, RIV, DAB and MAN.