Modified carbon surface as a new material for electrochemical measurements

Abstract

The use of electrochemical sensors in analytical chemistry is an extremely useful and relatively simple way to identify bioanalytes and environmental analytes. Among materials used for sensors designing, growing nterest is observed for boron doped diamond electrodes (BDD). The choice of a BDD electrode for a potential modification platform is associated with its outstanding electrochemical properties. Main advantages of the material are high chemical and electrochemical stability, low and stable background current, wide potential window, poor ability of adsorption of impurities and easy functionalization of its surface.

BDD electrodes used for modification and for electrochemical measurements were produced by Robert Bogdanowicz, PhD. Eng. team from the Faculty of Electronics, Telecommunications and Informatics at the Gdansk University of Technology. Electrodes were modified with prop-2-ene-1-amine (allylamine), poly-L-lysine and 2,4,6-triamine-1,3,5-triazine (melamine). Plasma-assisted surface modification as well as surface synthesis using electrochemical deposition process allows to form polymer layer on the electrode. The bond formed between the outer surface of the electrode and the organic structure has high chemical and electrochemical stability.

Obtained modified carbon surfaces were used as a part of a measurement system to detect selected analytes. Applied technique – the differential pulse voltammetry, allowed the study of the oxidation processes of chosen compounds in a wide range of concentrations, and to determine the limit of quantification and the limit of detection of selected compounds. The determined quantification limits are often lower than indicated in the literature. Obtained results were verified by performing analogous tests on unmodified BDD layers. The results clearly indicate that the functionalization increases the sensitivity of the detections.