Abstract

This dissertation thesis presents newly developed electrode materials based on porous boron-doped diamond (BDD_{porous}) and their potential applications in electroanalysis. Particularly, these novel BDD_{porous} electrodes (twelve in total) were thoroughly electrochemically characterised and compared, and the ones with the most promising properties were selected to develop reliable voltammetric methods for detecting the neurotransmitter dopamine.

Initially, the impact of selected fabrication parameters on the final properties and electrochemical behaviour of novel BDD_{porous} electrodes was clarified; the following factors were specifically studied: (1) deposition template used, (2) boron-doping level, (3) growth time of the individual layers (*i.e.*, porosity), (4) number of deposited layers (*i.e.*, thickness), and (5) content of non-diamond (sp^2) carbon impurities. Alterations in deposition conditions naturally resulted in BDD_{porous} electrodes with diverse (i) structural and morphological features, which were investigated by scanning electron microscopy and Raman spectroscopy, and (ii) physical and electrochemical characteristics, examined by cyclic voltammetry.

Besides, to assess the suitability of selected BDD_{porous} electrodes for dopamine detection, other parameters, such as susceptibility to adsorption and response stability, sensitivity, and selectivity, were evaluated using developed square-wave voltammetric procedure. For electrochemical sensing applications, mainly targeting dopamine, a SiO_2 nanofibers-based BDD_{porous} electrode with five deposited porous layers (while each layer grew for 5 hours), boron doping level of 4000 ppm and higher sp^2 content, was identified as the most suitable. Also, a platform based on BDD_{porous} material combining neuron growth and recording of released neurochemicals can be envisioned. For this reason, a designed BDD_{porous} electrode with desired analytical performance toward dopamine was subjected, either bare or modified with a neuron adhesion-promoting poly-L-lysine layer, to further experiments in complex bio-mimicking environments. As a result, behaviour of the developed BDD_{porous} electrode was clarified under conditions required for successful culturing of the neural cells.