Abstract

Boron-doped diamond (BDD) electrodes represent a unique material with exceptional physical and electrochemical properties, making them highly attractive for applications in various areas of electrochemistry. However, a comprehensive characterization and comparison of polycrystalline unpolished also known as as-grown and chemically-mechanically (CM) polished BDD electrodes with different degrees of boron doping is still underrepresented in the literature. In the first part of this thesis, as-grown and CM polished BDD electrodes with varying boron doping levels were comprehensively characterized and compared. It was confirmed that CM polishing causes morphological changes to the surface of the BDD electrodes, resulting in a more uniform distribution of conductivity across the electrode surface, faster heterogeneous electron transfer kinetics for inner-sphere redox markers, and higher double-layer capacitance values compared to as-grown BDD electrodes. Subsequently, the influence of the surface sp^2/sp^3 carbon ratio on electrochemical properties was investigated on selected as-grown and CM polished BDD electrodes. It was revealed that boron incorporation enhances the absorption of infrared radiation, which reduces the required laser fluence for the conversion of sp^3 to sp^2 carbon. It was further found that when the sp^2/sp^3 conversion ratio is higher than 10%, the electrochemical parameters of all tested BDD electrodes are affected. These findings highlight the advantages of CM polished BDD electrodes over as-grown BDD electrodes. The precise lateral distribution of sp^2 carbon on the surface of BDD electrodes suggests potential future applications of these hybrid sp^2/sp^3 electrodes in biotechnological research.