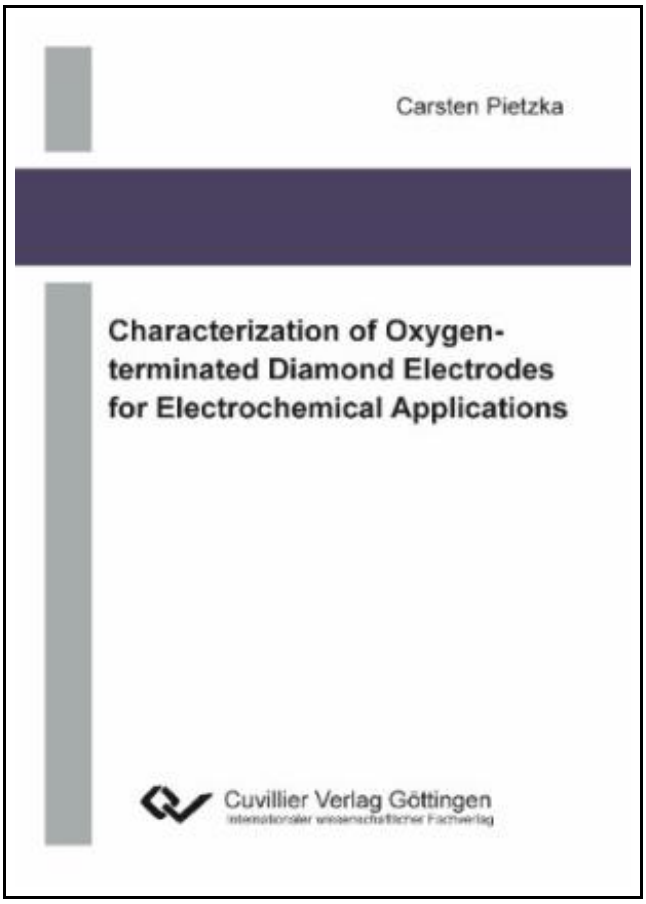
Characterization of Oxygen-terminated Diamond Electrodes for Electrochemical Applications



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CHARACTERIZATION OF OXYGEN-TERMINATED DIAMOND ELECTRODES FOR ELECTROCHEMICAL APPLICATIONS

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Cuvillier Verlag Apr 2011, 2011. Taschenbuch. Book Condition: Neu. 211x147x12 mm. Neuware - The topic of this thesis is the electrochemical characterization of oxygen-terminated single-crystal- and nanocrystalline diamond electrodes. Diamond is a very attractive material for bio- and electrochemical applications due to its exceptional stability, its biocompatibility, and its electrochemical properties like wide potential window of water dissociation and low background current. Therefore, diamond electrodes can operate even in harsh environments and under strongly oxidizing conditions, where electrochemical devices based on silicon or metals are corroded. Such applications can be e.g. pH sensing in strong acids and bases or the detection of organic molecules.However, the electrochemical characterisitcs of oxygen-terminated diamond electrodes are dependent on the surface oxidation treatment. This issue was investigated within this thesis using electrochemical measurement techniques like cyclic voltammetry or electrochemical impedance spectroscopy. The results were be correlated with the analysis of X-ray photoemission (XPS) measurements.The XPS measurements showed that different oxidation treatments induced different carbon-oxygen surface groups on the diamond surface. Besides, plasma oxidation treatments could induce a significant amount of non-diamond phases in the surface-near region.The electrochemcial measurements showed typical behaviour of oxygen-terminated diamond electrodes like a potential window of 3.0 - 3.5 V and low background currents within this window both for single-crystal and nanocrystalline diamond. However, the adsorption characterisitcs in cyclic voltammetry and the value of the electronic surface barrier in contact to the electrolyte were dependent on the chose of the oxidation treatment. The electronic surface barrier ranged from approx. 1.0 eV to 1.8 eV depending on the carbon-oxygen bonds and the amount of sp2-like defects. In addition, a severe plasma treatment including argon bombardement induced a non-diamond layer of several monolayers on the electrode surface. This layer could be removed by annealing in hydrogen plasma at approx. 700 °C, as shown...

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