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IT-13-P-2704 Focused ion beam patterning of boron-doped diamond electrodes: Influence of patterning parameters on the heterogeneous electron transfer behavior

Eifert A.[1], Langenwalter P.[1], Higl J.[2], Lindén M.[2], Nebel C.[3], Mizaikoff B.[1], Kranz C.[1]

[1]Institute of Analytical and Bioanalytical Chemistry, University of Ulm, Ulm, Germany, [2]Institute of Inorganic Chemistry II, University of Ulm, Ulm, Germany, [3]Fraunhofer Institute for Applied Solid State Physics, Freiburg, Germany

Email of the presenting author: alexander.eifert@uni-ulm.de

Diamond with its large band gap of 5.49 eV can be transformed into a metallic-like semiconductor by doping with very high boron concentrations. This new electrode material outmatches many common electrode materials concerning potential window, chemical inertness and signal-to-noise-ratio. The superior chemical and physical properties in combination with the possibility to fabricate microelectrodes or microelectrode arrays for example with FIB [1, 2], renders them highly suitable for bioanalytical applications. The electrochemical behavior of BDD electrodes depend on a variety of parameters, such as doping level, defects, carbon impurities, crystal orientation, surface termination/modification and grain boundaries [3]. Patterning of BDD with FIB technology leads to damages due to the ion bombardment such as amorphization and hence changes the overall electrochemical behavior.
In this contribution we present the influence of different FIB patterning parameters on the electrochemical properties such as heterogeneous electron transfer rate constant and peak separation of the obtained BDD microelectrode arrays. Post fabrication electrochemical treatments will restore to a certain extent the electrochemical properties. Next to electrochemistry also Raman spectroscopy was applied to characterize the ion irradiated sample, which will also be presented.

References

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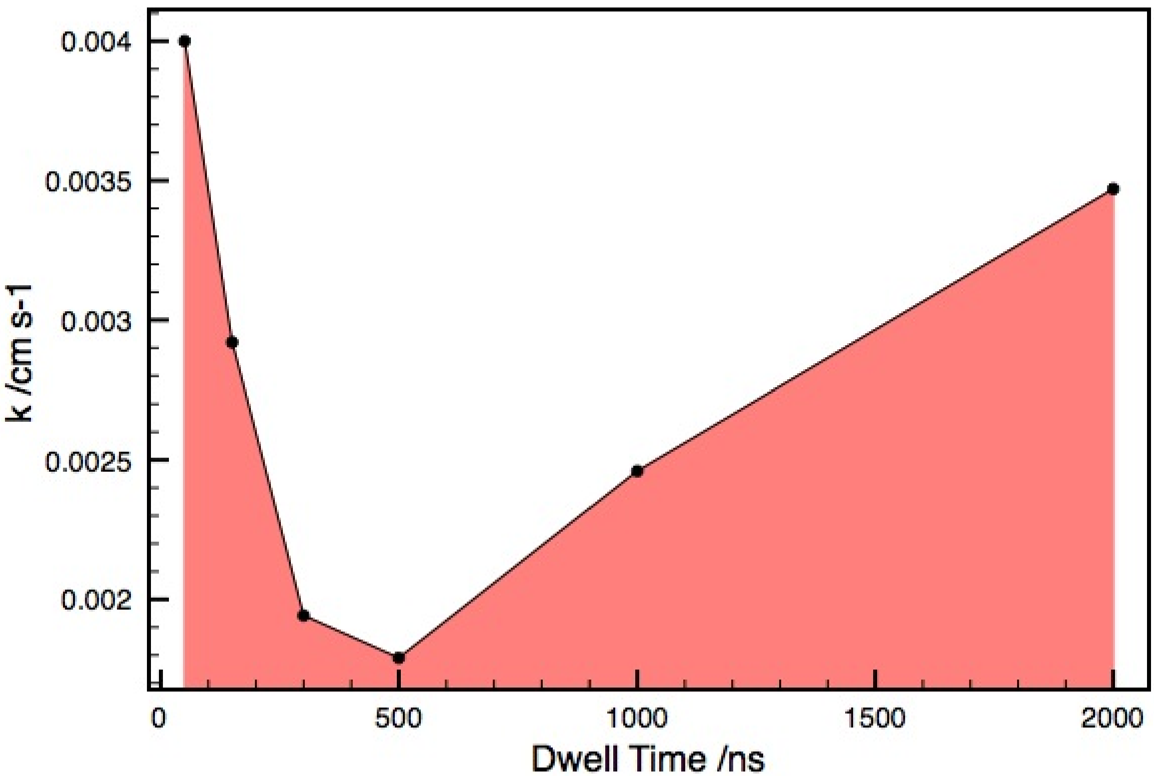

Fig. 1: Rate constants calculated from recorded CVs after electrochemical treatment. Electrochemical measurements were recorded in a solution containing 10 mmol/l $K_4[Fe(CN)_6]$, 0.016 mol/l Tween 20 and 0.1 mol/l KCl. The influence of dwell time dependency was investigated at an accelerating voltage of 30 kV and a beam current of 15 nA.

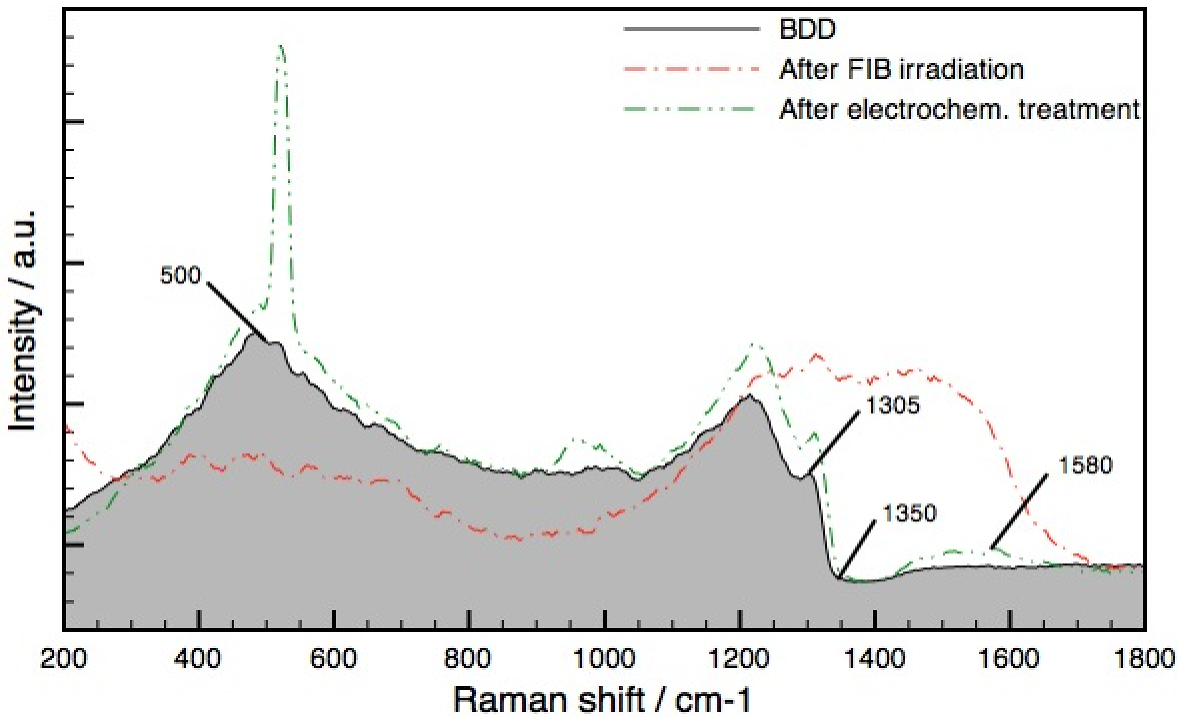

Fig. 2: Raman spectra recorded after different fabrication steps of the microelectrode arrays. Raman spectra were acquired using an excitation laser with 532 nm and 10 mW power. For detection a 100x objective with a 0.9 numerical aperture was used.