# Electrochemical Behavior of Boron-Doped Diamond Films on Metal Substrates

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In recent years, there has been an increasing interest in the electrochemical properties of boron-doped diamond (BDD) coated substrates in large part due to the manner in which water and organic chemicals interact with the BDD (1-6). For aqueous electrolytes, there is a wide potential window before water breaks down. This is a particularly important property for detecting and/or identifying species in solution since oxygen and hydrogen evolution do not interfere with the analysis. Some organic chemicals, such as phenol, interact with metallic electrodes in a way that prevents the surface from being electrochemically active. Diamond electrodes do not appear to have this limitation. Thus boron-doped diamond electrodes can be used in electrolytes where metallic electrodes cannot be used.

Silicon has been the predominate substrate used for diamond deposition. However, the conductivity of the silicon substrate is not sufficient for it to be used in higher current applications. This makes the use of metal wires or meshes as substrate materials highly desirable because of the increased conductivity and the possibility of increased surface areas. This paper will discuss the electrochemical behavior of BDD and chemically modified BDD films deposited on metals.

Electrochemically active diamond coatings were deposited on metal substrates ranging from wires to high surface area meshes to produce the coated electrodes. The boron-doped, polycrystalline diamond films were grown by hot-filament chemical vapor deposition (HFCVD). Two advantages of using HFCVD instead of microwave systems for preparing these types of electrodes are the resulting heavier boron concentrations incorporated in the films and the easier capability of conformal growth on non-planar substrates. Procedures were developed to produce coherent, heavily conductive diamond film coatings onto metal, wire and mesh substrates, including tungsten and tantalum substrates. The electrochemical behavior of these electrodes was examined in a number of electrolytes.

Cyclic voltammetry experiments were run on a group of BDD samples with different surface terminations. Using a series of redox couples, including the $Fe(CN)^{-3}_6$ /$Fe(CN)^{-4}_6$ couple, the effects of the surface terminations on electrochemical properties were investigated. These results and the electrochemical behavior of the BDD films and chemically modified BDD films will be discussed.

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**References**

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