Electrochemical Detection of Boron-doped Diamond Electrode For Bio Sensor

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BDD has several superior electrochemical properties that are significantly different from those of other carbon allotropes, e.g., glassy carbon (GC), pyrolytic graphite (PG), and highly oriented pyrolytic graphite (HOPG), which have been widely used as electrode materials for many years. Diamond electrodes have recently been found to show high resistance to deactivation, via fouling, and insensitivity to dissolved oxygen. Here, Two kinds of experiments were carried out to show the excellent properties of BDD films as an electrode in electrochemical system.

Firstly, Boron-doped conductive diamond(BDD) electrodes were used as an working electrode for detection of serotonin(5-hydroxytryptamine) in the presence of ascorbic acid(AA) in human blood. A serotonin is a kind of indolamines, which secreted from adrenal marrow cells. The serious problem to detection of serotonin is the interference phenomena of electroactive constituent, including AA. In this study, electrochemical treatment on BDD was carried out to discriminate between serotonin and AA responses. And nano-scale of serotonin compound was detected by various modified BDD electrodes. The oxidation peak of AA shifted to the positive direction.

Secondly, selective, stable determination of epinephrine (adrenalin) was achieved in cyclic voltammetric measurement carried out at electrochemically treated conductive boron-doped diamond electrode. Epinephrine, which is a component of neural transmission medium, takes effect on the transmission of nerve impulse. Many life phenomena are related to the concentration of epinephrine in blood. Previous techniques for the determination of epinephrine have been primarily based upon cation exchange, HPLC, CE, FIA, fluorimetry and sensors. However, the previous techniques suffered either tedious process or low sensitivity. In detecting epinephrine, a serious source of interference is the presence of electroactive constituent, including ascorbic acid at a typical concentration of 10^{-4}M. In this work, we have found that it is possible to achieve selectivity for epinephrine in the presence of ascorbic acid solution after a simple electrochemical pretreatment of the diamond electrode.

BDD was used as an working electrode, Pt was used as the count electrode and A saturated calomel electrode (SCE) was used as the reference electrode. Electrochemical pretreatment was carried out by strong oxidation of BDD electrode. The voltammograms of epinephrine and AA before pretreat. the anodic peak(Ep,a) of epinephrine was +0.8±0.01V vs. SCE and Ep,a of ascorbic acid was 1.03±0.01V vs. SCE. These two peaks are overlapped after mixing of two chemicals owing to interference of AA. However, after simple pretreatment of BDD electrode, the peaks are separated originated epinephrine and AA respectively. These results were considered that oxidized diamond surface acquires surface dipoles as a result of introducing oxygen-containing functional groups, which then electrostatically repel both anions and neutral molecules with strong dipoles; AA is negatively charged ion.

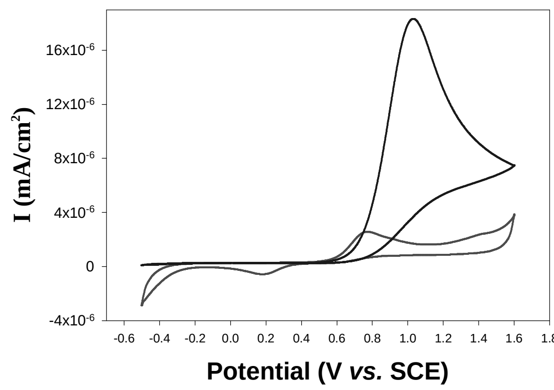

Fig. 1. Cyclic voltammograms for AA(1mM) and epinephrine

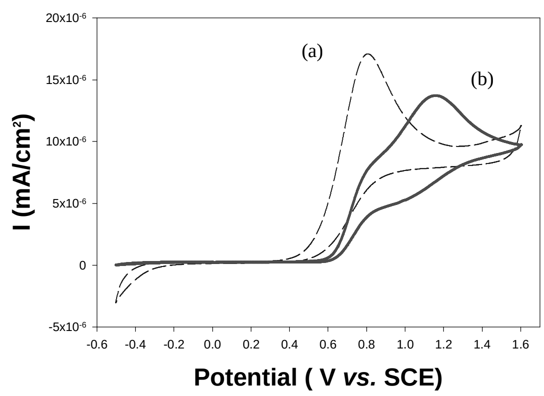

Fig. 2. Cyclic voltammorams for a 0.1MHClO_4 solution containing 0.1mM and 1mM ascorbic acid at untreated (a) and treated(b) diamond electrode.

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