BORON-DOPED DIAMOND: SENSOR FOR CHROMATOGRAPHIC ANALYSIS OF INORGANIC ANIONS

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ABSTRACT

In this study, the behavior of boron-doped diamond electrodes in amperometric detection was investigated. The electrodes were used as sensors in a gas chromatographic system for the detection of anions. The results showed that the boron-doped diamond electrodes exhibited better electrochemical behavior compared to glassy carbon electrodes. The electrodes were tested in a range of pH values, and it was found that the optimal pH range was between 3 and 7. The sensitivity of the electrodes was found to be pH-dependent, with the highest sensitivity observed at pH 3. The electrodes were also tested for their selectivity and were found to be selective for the detection of inorganic anions. The electrodes were successfully used for the detection of anions in various samples, including pharmaceuticals, environmental samples, and food samples. The results showed that the boron-doped diamond electrodes were a promising alternative to traditional electrodes for the detection of inorganic anions.
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ABSTRACT

This work illustrates the application of boron-doped diamond (BDD) thin film in ion chromatography. Oxidation of inorganic anions; i.e. (iodide, nitrite, thiosulfate and thiocyanate) was investigated at boron-doped diamond electrodes using cyclic voltammetry. Most of these anions provided well-defined cyclic voltammogram for BDD. The background current at BDD was lower than the usual glassy carbon electrode.

The BDD was employed as a sensing electrode for amperometric detection of a commercial liquid chromatograph. The separation mode was ion chromatography. The detection potential was made at 1.2 V (vs Ag/AgCl). The separation utilized a polymer-based strong anion-exchange resin (IonPac AG16, 4 x 50 mm i.d. and IonPac AS16, 4 x 250 mm i.d.). Results showed that pH 12 gave a reasonable separation. Detection of the anions at the BDD electrode is best at pH 3. Therefore, there is a mismatch between the pH of the separation and the detection. To solve this, a stream of hydrochloric acid (2 M HCl) was pumped to merge with the stream of mobile phase (pH 12) at the end of the separation column. In this condition, the pH at the BDD detection cell is as low as pH 3.

The proposed IC-BDD method gave a linear calibration for these inorganic anions in the range of 1-20 mgL\(^{-1}\). The method is reproducible with minimal within-day and between-day variation. The method was successfully applied to determine iodide in nuclear emergency tablets, thiosulfate in anti-infective drug and nitrite in shrimp farm water. The limit of detection were 0.28, 0.20, 0.95 and 0.57 mgL\(^{-1}\) for iodide, nitrite, thiosulfate and thiocyanate, respectively.

KEY WORDS: BORON-DOPED DIAMOND / ION CHROMATOGRAPHY/ SENSOR / POST COLUMN / ELECTROCHEMICAL DETECTION.

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