A study on the Electrochemical water Treatment of Waste Cutting Fluid Using BDD Electrode

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Abstract

The band gap of diamond is 5.45ev, which is much larger than that of silicon, which is generally used as a semiconductor device, of 1.12ev. Diamond is known as a typical insulator due to its wide bandgap, but research is continuing to dope the crystal lattice structure with boron, nitrogen, and phosphorus to utilize it as a P-type or N-type semiconductor. Boron-doped diamond (BDD) has a wide potential window of 2.8V and has excellent oxygen generation overvoltage, so it is used as an anode electrode in the advanced oxidation process (AOP) among electrochemical water treatment methods.

In this study, a BDD thin film was deposited using the Hot Filament Chemical Vapor Deposition (HFCVD) method. Electrochemical water treatment was attempted on waste cutting oil by fabricating BDD electrodes. Characterization of the deposited thin film by boron concentration was evaluated through SEM, Raman spectroscopy, and X-ray diffraction analysis to evaluate the surface shape, growth rate, bonding structure and crystallinity. And the electrochemical characteristics were analyzed through I-V curve, cyclic voltammetry, and Hall effects measurement. As the ratio of boron to carbon atoms, that is, the B/C ratio, increased, the growth rate, crystal size, and crystallinity of the thin film decreased. Through the I-V curve and cyclic voltammetry, the best electrical properties were exhibited when 2000ppm of boron was doped. The width of the potential window measured by the cyclic voltammetry was 2.8V, and it was confirmed that it had an oxygen overvoltage characteristic capable of reacting with strong oxygen-based oxidizing agents such as hydroxyl radicals and ozone. As a result of electrochemical water treatment by depositing BDD on the Ti substrate under the deposition condition of 2000 ppm of waste cutting fluid used in the cutting process, it was confirmed that 95% of the total organic carbon (TOC) was removed in about 30 minutes, and the Ti electrode The TOC removal rate was 27%, indicating that the electrochemical waste cutting fluid treatment characteristics of the BDD electrode were excellent.