Understanding the production of persulfate using boron-doped diamond (BDD) electrode

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Between the various oxidants available, persulfate ($S_2O_8^{-2}$) has been notable in recent years for use in soil remediation and decontamination of effluents. As studies to reduce levels of pollution have intensified in recent times it has become important to find a more efficient way of producing persulfate, as it has been increasingly used in oxidation processes in situ [1]. The electrode of boron-doped diamond (BDD) has attracted considerable interest of researchers due to its excellent properties for electroanalysis [2], non-active nature and its power to produce hydroxyl radicals (BDD($^{\bullet}OH$)) from water discharge on its surface from reaction (physically adsorbed on the anode surface; $H_2O \rightarrow {}^{\bullet}OH + e^- + H^+$). In the case of the sulfuric acid in aqueous solution can promote the formation of persulfate via two mechanisms [3-4].

$$2SO_4^{2-} \rightarrow S_2O_8^{2-} + 2e^- \quad (1)$$

$$2HSO_4^- \rightarrow S_2O_8^{2-}\ 2H^+ + 2e^- \quad (2)$$

However, some authors have suggested that reactions between $^{\bullet}OH$ radicals and sulphate, already present in solution, produce persulfate ($S_2O_8^{-2}$) [3-4]. However, no attempts have confirmed this electrochemical way because the studies are frequently performed at diluted sulfuric acid solutions. Thus, the object of this work was to study the effect of the ratio H_2O/H_2SO_4 on the electrochemical behavior of surface at BDD anode in order to verify the possible participation of hydroxyl radical on the production of persulfate at different temperatures (313 K and 333 K). Cyclic voltammetry studies and polarization curves were performed to understand the electrochemical behavior of BDD surface when different concentrations of H_2O were added to H_2SO_4 concentrated.

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