Electrochemical Detection and Degradation of Bisphenol A Using Boron-Doped Diamond Electrodes

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Bisphenol A (BPA) is a compound known as one of the main endocrine disruptors present in the environment. The consequences of this presence have been widely reported in recent years and several health effects have been attributed to the presence of BPA in the human body, such as many kinds of cancer, decreased sperm count and fertility, among others. This compound is widely used in the chemical industry, mainly in the production of resins and polycarbonate plastics, which are applied in the manufacture of many household utensils [1]; thus, its main sources in the environment are industrial effluents, domestic sewage, and sludge from sewage treatment plants. Hence, electrochemical methods for the detection and degradation of this compound have great relevance. Boron-doped diamond (BDD) electrodes show many interesting features for applications in electroanalysis and in the treatment of wastewater containing organic compounds: high overpotential for O2 evolution, low background current, and stability in different media [2]. In this work we report the electrochemical determination of BPA by differential pulse voltammetry (DPV) and its electrochemical degradation using BDD electrodes. DPV parameters (modulation amplitude, scan rate, and modulation time) were optimized using 0.5 mol L–1 H2SO4 as supporting electrolyte. The obtained response presented adequate repeatability and reproducibility, and the obtained analytical curve (range 0.44 – 5.2 μmol L–1) presented good linearity (R2 = 0.999), yielding a detection limit of 0.21 μmol L–1. For the electrochemical degradation of BPA (150 mg L–1 in 0.1 mol L–1 Na2SO4) using a Nb/BDD anode in a filter-press reactor with stainless steel cathodes, the effects of volumetric flow rate (Q), temperature (θ), pH, and current density (j) were investigated. Positive effects of Q and θ lead to increased COD removal; the pH does not present a significant effect. Higher j values lead to a decrease in the current efficiency; thus the best attained condition is for the lower value studied (j = 6.5 mA cm–2). When NaCl (1.5 g L–1) is added to the solution, a significant improvement in the electrolysis time necessary to attain 90 % of COD removal (at 30 mA cm–2) is observed due to the electrogeneration of active chlorine, whose HOCl and OCl– species are predominant at pH 6; for j = 6.5 mA cm–2, no improvement is observed. Compared to other anodes (Ti-Pt/β-PbO2 and RuTiO2), in the absence and presence of Cl– ions in solution, the use of the Nb/BDD anode leads to a superior performance in the electrochemical degradation of BPA, with attainment of total removal of the solution COD.


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