Preparation of a PbO₂ Electrode with Graphene Interlayer and for Electrochemical Oxidation of Doxycycline

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A graphene interlayer was introduced into a Ti/SnO₂-Sb₂O₃/PbO₂ electrode by electrophoretic deposition and electro position methods to form a Ti/SnO₂-Sb₂O₃/graphene/PbO₂ electrode (G/PbO₂). In comparison to the Ti/SnO₂-Sb₂O₃/PbO₂ electrode (PbO₂), the surface of the G/PbO₂ electrode was flat with fewer surface cracks, and smaller crystal sizes. Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) results showed that the G/PbO₂ electrode had a large electrochemically active surface area and more active sites. The accelerated lifetime of the G/PbO₂ electrode was 72 h, which was longer than that of the PbO₂ electrode (40 h). In addition, the graphene interlayer improved the ability to generate OH[•]. The real electrochemical oxidation abilities of the G/PbO₂ and PbO₂ electrodes were also studied using doxycycline (DC) as a model pollutant. After 150 min of electrolysis, the DC, total organic carbon (TOC) removal rate and instantaneous current efficiency (ICE) of the G/PbO₂ electrode were 98.5%, 32.3% and 1.80%, respectively, which was higher than those of the PbO₂ electrode (93.6%, 28.7% and 1.60%, respectively). Furthermore, six intermediate products were identified based on HPLC-MS, and oxidation pathways were proposed.

Keywords: graphene; PbO₂ electrode; doxycycline; electrochemical oxidation

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