Electrocatalysis

Electro fenton degradation of selected antiretroviral drugs using a low-cost iron-modified carbon cloth electrode

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Abstract

Human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) causes morbidity and mortality in infected patients. These epidemics are significantly reduced and treated globally with antiretroviral drugs (ARVDs). However, the eventual disposal of the ARVDs, either by excretion or otherwise enables them to end up as emerging hazardous contaminants in our environment. Of all the available methods to remove ARVDs from our water bodies, electrochemical methods are reckoned to be the most effective. As a result, it is imperative to acknowledge the interactive behavior of these pharmaceuticals on the surface of the electrode. In this study, iron particles were deposited on the carbon-cloth electrode by electrodeposition using chronoamperometry techniques. The synthesized electrode was characterized using scanning electron microscopy (SEM) with energy-dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) analysis. The electrochemical characterization of the material was also carried out using cyclic voltammetry (CV) and electrical impedance spectroscopy (EIS). Applicability of iron-supported carbon-cloth (CC) electrode was investigated by the electrochemical degradation of neivrapine (NVP), lamivudine (LVD), and zidovudine (ZDV) in wastewater as a model for organic pollutants in 50 mM K2SO4 electrolyte at a pH of 3. The SEM and EDX analysis showed the formation of iron nanoparticles within the matrix structure of the CC electrode. The XPS enlightened the presence of oxygen functional groups in the electrode's structure. EIS results are indicative that the modified electrode has a decreased charge transfer resistance (Rct) value as compared to the bare CC electrode. On the other hand, a CV result fosters good conductivity, enhanced current and large surface area of the modified electrode. Electrochemical studies with the modified CC electrode by electro-Fenton (EF) process show a decrease in the initial ARVDs concentration (20 mg/L) as compared with a bare electrode. Their rate constants were 1.52 × 10–3 mol−1 min−1 for ZDV, 1.20 × 10–3 mol−1 min−1 for NVP, and 1.18 × 10–3 mol−1 min−1 for LVD. The obtained removal efficiencies indicate that the iron particle in the synthesized improves the degradation efficiency.