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Role of SiOx Interlayer on Lead Oxide Electrodeposited on Stainless Steel for Promoting Electrochemical Treatment of Wastewater Containing Textile Dye

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Abstract : The main objective of this work is to investigate the efficiency of depollution power related to PbO_2 layer deposited onto a stainless steel (SS) substrate with SiOx as interlayer. The elaborated electrode was used as anode for anodic oxidation of wastewater containing Amaranth dye, as recalcitrant organic pollutant model. SiOx interlayer was performed using Plasma Enhanced Chemical Vapor Deposition 'PECVD' in plasma fed with argon, oxygen, and tetraethoxysilane (TEOS, Si precursor) in different ratios, onto the SS substrate. PbO_2 layer was produced by pulsed electrodeposition on SS/SiOx. The morphological of different surfaces are depicted with Field Emission Scanning Electron Microscope (FESEM) and the composition of the lead oxide layer was investigated by X-Ray Diffractometry (XRD). The results showed that the SiOx interlayer with more rich oxygen content improved better the nucleation of β-PbO_2 form. Electrochemical Impedance Spectroscopy (EIS) measurements undertaken on different interfaces (at optimized conditions) revealed a decrease of Rfilm while CPE film increases for SiOx interlayer, characterized by a more inorganic nature and deposited in a plasma fed by higher O2-to-TEOS ratios. Quantitative determinations of the Amaranth dye degradation rate were performed in terms of colour and COD removals, reaching a 95% and an 80% respectively removal at pH = 2 in 300 min. Results proved the improvement of the degradation wastewater containing the amaranth dye. During the electrolysis, the Amaranth dye solution was sampled at 30 min intervals and analyzed by 'High-performance Liquid Chromatography' HPLC. The gradual degradation of the Amaranth dye confirmed by the decrease in UV absorption using the SS/SiOx(20:20:1)/PbO_2 anode, the reaction exhibited an apparent first-order kinetic for electrolysis time of 5 hours, with an initial rate constant of about 0.02 min^{-1}.

Keywords : electrochemical treatment, PbO_2 anodes, COD removal, plasma
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