A Novel High-Performance Ti/ATONPs-MWCNTs Electrode Based on Screen Printing Technique for Degradation of C.I. Acid Red 73

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A large effective surface area and a good electrical conductivity are very important characteristics for electrodes used in wastewater treatment. To improve them while lowering the cost, a novel MWCNTs-modified (Ti/ATONPs-MWCNTs) electrode was produced by a screen-printing technique. To test its performance, the electrode was compared to two other electrodes, namely, Ti/SnO₂-Sb and Ti/ATONPs. Several important electrochemical measurements including impedance spectroscopy (EIS), cyclic voltammetry (CV), chronocoulometry (CC) and linear sweep voltammetry (LSV), were used in this study. A toxic organic dye (C.I. Acid Red 73) was chosen as the target pollutant to test the degradation by the removal of chroma and chemical oxygen demand (COD). Compared to Ti/SnO₂-Sb and Ti/ATONPs, Ti/ATONPs-MWCNTs show the lowest charge transfer resistance (0.24 Ω), the largest effective surface area (61.97 cm²·cm⁻²) and the highest oxygen evolution potential (2.15 V). It is known that superior values of these performance characteristics are very important for improving the efficiency of wastewater decontamination. After 90 min electrolysis using Ti/ATONPs-MWCNTs, the removal of AR 73 reached 59.4%, while the energy consumption was as low as only 6.2 Wh·L⁻¹. The remnant COD was only 45% after 3 h of degradation, with an instantaneous current efficiency (ICE) over 80% obtained for Ti/ATONPs-MWCNTs. These results demonstrate the promising prospects for the use of the novel Ti/ATONPs-MWCNTs electrodes in wastewater treatment processes.

Keywords: Adsorption-electrocatalysis, ATO nanoparticles, Multi-walls carbon nanotubes, Screen printing, Azo dyes

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