ABSTRACT

Textile industry wastewater contains Congo red dye, which is resistant to natural degradation and disrupts aquatic ecosystems. This study aims to synthesize and apply pure ZnO and Ni-doped ZnO thin-film anodes as photocatalysts for the decolorization of Congo red solution using the electro-photocatalysis method. ZnO and Ni^{2+}-doped ZnO were synthesized via the sol-gel method and deposited onto ITO glass substrates using the dip-coating technique, followed by characterization with XRD, SEM-EDX, and UV-DRS. The decolorization efficiency was evaluated using UV-Vis spectrophotometry on a 30 mg/L Congo red solution for 120 minutes under ultraviolet (UV) and visible light irradiation. XRD characterization revealed a hexagonal wurtzite structure in the anodes and the formation of ZnO with high intensity, whereas the Ni dopant appeared with relatively low intensity. SEM analysis showed that ZnO and Ni-ZnO/ITO anodes exhibited flake-like morphologies, while EDX confirmed the presence of Ni^{2+} ions within the ZnO crystal lattice. UV-Vis DRS results indicated a reduction in band gap values from 3.09 eV (ZnO) to 2.89 eV and 2.75 eV (Ni-doped ZnO). Electro-photodegradation tests of Congo red demonstrated the best performance with 5% Ni-ZnO, achieving 84.28% decolorization under UV light and 98.27% under visible light.

Keywords: *Anode, Electro-photodecolorization, Congo Red, ZnO*