Photocatalytic Degradation of Phenolic Compounds from Wastewater Using Titanium dioxide@reduced Graphene Oxide (TiO₂@rGO) Nanocomposites

Lu Yu*, Bo Tang

School of Chemistry and Chemical Engineering, Henan Institute of Science and Technology, Xinxiang, 453003, China

*E-mail: LuYu2021@hotmail.com, iamyl57@163.com

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In this work, the synthesis of titanium dioxide@reduced graphene oxide (TiO₂@rGO) nanocomposite as a photocatalyst for the degradation of phenol as a chemical pollutant of industrial wastewater was investigated. XRD, SEM, UV-Vis absorption spectra, and EIS were used to characterize the samples. In TiO₂@rGO, the structural results revealed a significant combination of TiO₂ and rGO. The optical characteristics revealed that E_g values for bare TiO₂ and TiO₂-rGO composites were 3.14 eV and 3.07 eV, respectively, which corresponded to the shrinking band gap value of TiO₂-rGO nanocomposites. Because of the successful inclusion of rGO into the nanocomposite structure and the greater effective surface area, EIS evaluation revealed that TiO₂-rGO had a greater specific capacitance than TiO₂. Under UV irradiation for 35 minutes, photocatalytic tests revealed phenolic degradation efficiencies of 59.2% and 100% for bare TiO₂ and TiO₂-rGO composites, respectively. As a result, rGO considerably increased the degrading efficiency of bare TiO₂. Furthermore, after 30 minutes of visible irradiation, the phenolic degradation efficiencies for bare TiO₂ and TiO₂-rGO composites were 44.1% and 100%, respectively, indicating that visual irradiation promotes the degradation rate for TiO₂-rGO nanocomposites. As a consequence, TiO₂-rGO nanocomposites not only were photoexcited in the UV region but their catalytic efficiency in the visible region was also delayed.

Keywords: TiO₂@rGO nanocomposite; Photocatalytic degradation; Phenolic compounds; Electrochemical impedance spectroscopy

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