Facile synthesis and characterization of \( \text{WO}_3 - \text{Al}_2\text{O}_3 \) nanocomposites as an effective photocatalyst for degradation of Congo red under UV and visible light irradiation

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For the purpose of this study, sol-gel method at different molar ratios was used to prepare \( \text{WO}_3 - \text{Al}_2\text{O}_3 \) nanocomposites. Then, the synthesized nanocomposites were characterized by different techniques including Fourier transform infrared spectroscopy, field emission scanning electron microscopy coupled with energy-dispersive spectroscopy, X-ray diffraction, photoluminescence spectroscopy, adsorption–desorption \( \text{N}_2 \) isotherms Brunauer–Emmet–Teller and Barrett–Joyner–Halenda. The results revealed that the specific surface area of \( \text{WO}_3 \) nanoparticles (NPs) increased from 2.83 to 41.80 m\(^2\) g\(^{-1}\) due to the incorporation of \( \text{Al}_2\text{O}_3 \) in the composite. Moreover, the photocatalytic activity of the samples was evaluated in the degradation of Congo red (CR) in aqueous solution under UV and visible light irradiation with optimization of different parameters. The photocatalytic activity of the \( \text{WO}_3 - \text{Al}_2\text{O}_3 \) nanocomposites was compared with pure \( \text{WO}_3 \) NPs and photocatalytic performance of the \( \text{WO}_3 \) NPs increased by incorporation of \( \text{Al}_2\text{O}_3 \) in the composite. Finally, the degradation percentage of CR was achieved 100% within 30 min by changing molar ratio, pH and catalyst dosage. The enhanced photocatalytic performance was attributed to the increased specific surface area and decreased electron–hole pair recombination.

Keywords: \( \text{WO}_3 - \text{Al}_2\text{O}_3 \) nanocomposites; Sol-gel; Photocatalytic degradation; Congo red

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