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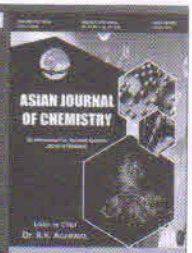

Tailoring of Copper(II) Oxide-Cellulose Nanocomposites for Efficient Photocatalytic Degradation of Thymol Blue

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The widespread release of synthetic dyes into aquatic ecosystems poses a serious environmental risk as a result of their toxicity, persistence and resistance to biodegradation. In this study, cellulose extracted from banana peels was combined with synthesized copper(II) oxide nanoparticles to fabricate CuO-cellulose nanocomposites for visible-light-driven degradation of thymol blue (ThB). The cellulose was isolated through sequential alkaline treatment, bleaching and acid hydrolysis, while CuO nanoparticles were prepared *via* co-precipitation and subsequent calcination. The nanocomposites were obtained by refluxing CuO with dispersed cellulose under alkaline conditions. Structural and compositional analyses through XRD, FTIR, XPS and FE-SEM/EDX confirmed the monoclinic CuO phase, the preservation of cellulose crystallinity and uniform nanoparticle anchoring on the cellulose matrix. UV-Vis DRS and Tauc analysis revealed that incorporation of cellulose effectively narrowed the band gap of CuO, enhancing visible-light absorption and interfacial charge transfer. Photocatalytic performance was assessed using ThB dye under controlled pH and temperature. Among the investigated compositions, the CuO-cellulose (3%) nanocomposite at 0.20 g/L exhibited the highest degradation efficiency, attributed to improved adsorption capacity, suppressed charge recombination and enhanced ROS generation. The results demonstrate the synergistic interaction between CuO and cellulose, offering a low-cost, sustainable and efficient photocatalyst for the removal of organic pollutant under visible light.

Keywords: Photocatalysis, Thymol blue, Wastewater treatment, Organic pollutants, Copper(II) oxide, Cellulose.