

ENHANCING DYE DEGRADATION WITH YAM PEEL-MEDIATED SILVER, ZINC OXIDE NANOPARTICLES AND THEIR COMPOSITE

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Using agricultural waste for synthesizing nanoparticles (NPs) is becoming increasingly crucial to support environmental sustainability. This study focused on the biogenic synthesis of silver (Ag), zinc oxide (ZnO) NPs, and silver@zinc oxide nanocomposite (Ag@ZnO NC) and evaluate their photocatalytic activity. The optimal conditions for synthesizing nanomaterials (NMs) with increased yields were identified. Many analytical techniques were used to characterize NMs. Preliminary verification was provided by surface plasmon resonance peaks, observed at 400-430 nm for Ag NPs, 350-360 nm for ZnO NPs, and 350-450 nm for Ag@ZnO NC. Bioactive chemicals serving as reducing, capping, and stabilizing agents were found in the phytoextracts by FT-IR analysis, and ZnO NP and NC synthesis were confirmed by the Zn-O bond stretching mode in 500-700 cm⁻¹ range. The synthesis of flake-shaped Ag NPs, spherical-shaped ZnO NPs, and nanoflower-shaped Ag@ZnO NC was confirmed by SEM analysis. Ag was found coexisting with ZnO in the NC, with an average particle size of 60.2 nm, according to TEM images. Particle sizes for ZnO NPs and Ag NPs mediated by yam peel were 82.4 nm and 92.8 nm, respectively. The XRD analysis confirmed that Ag@ZnO NC has both face-centered cubic structure and hexagonal wurtzite structure. Energy dispersive spectroscopy analysis confirmed that Ag NPs contained only Ag; ZnO NPs contained Zn and O; and the NC contained all three elements. Under optimized conditions, NMs demonstrated varying degrees of photodegradation efficiency for pigment dye. The NC exhibited the highest efficiency, achieving a maximum of 89.9%, and ZnO NPs followed closely with an efficiency of 89.05%. In contrast, Ag NPs showed a lower photodegradation efficiency of 45.4%. A control sample, exposed to sunlight under identical conditions but without NMs, showed negligible photodegradation, confirming the catalytic role of the NMs. These results indicate that while ZnO NPs are highly effective, the combination of Ag and ZnO in NC offers a slight improvement in photodegradation efficiency due to the synergistic effect.

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