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Wood apple agro-waste based zinc oxide nanoparticles and their photocatalytic activity

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Utilizing agricultural waste for synthesizing nanoparticles (NPs) has increasing importance as it is essential for promoting environmental sustainability. This study focused on biogenic synthesizing ZnO NPs from wood apple outer shell (WA) extract to examine the photocatalytic activity against a widely used industrial dye, IC orange pigment dye (PD). The optimal conditions for synthesizing ZnO NPs with higher yields were identified by varying the conditions (ion precursor concentration, ratio of plant extract to ion solution, pH, irradiation methods, and incubation time). UV-Vis spectroscopy, FTIR, SEM, TEM, EDS, and XRD analysis were used to characterize the NPs. Surface plasmon resonance peaks between 350 and 370 nm was used to preliminary confirm the formation of ZnO NPs. FTIR analysis indicated the stretching mode of the Zn-O bond in the range of 500-700 cm^{-1}. SEM analysis revealed the spherical morphology of NPs, while the particle size of 82.4 nm was observed through TEM analysis. XRD analysis confirmed the formation of the hexagonal crystalline structure of ZnO NPs, while EDS confirmed the chemical elements as Zn and O. Under the optimum operational conditions (pH, catalytic load, and dye concentration), the greenly synthesized WA-mediated ZnO NPs demonstrated exceptional photodegradation efficiency of 90.52 % at 360 mins. This exceptional performance is attributed to the wide-bandgap semiconductor capabilities of the ZnO NPs, aligning with the absorption of solar light.

Key words: Photocatalytic activity, Pigment dye, Wood apple, ZnO NPs
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