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Sodium lauryl sulphate-mediated manganese doping to enhance photocatalytic performance of cadmium sulphide-manganese composite

Abstract

This research investigates the effect of manganese doping concentration in cadmium sulphide (CdS) nanoparticles synthesized using sodium lauryl sulfate (SLS) surfactant to improve photocatalytic activity. We systematically controlled the manganese precursor concentration at 0.004 g, 0.0099 g, 0.0148 g, 0.0198 g, and 0.0247 g to achieve optimal doping efficiency and modulate the structural transformation of CdS-Mn nanocomposites. It was observed that the bandgap energy varied between 2.16 eV and 2.27 eV. Forward scattering of the X-rays was measured for the crystal at an incident photon energy of 2.27 eV, depending on Mn concentration, using UV–Vis absorption spectra. XRD analysis of CdS confirmed its wurtzite form with a peak shift at $2\theta \approx 32°$, attributed to lattice contraction upon Mn doping. Transmission electron microscopy analysis provided a particle size estimate of about 7–8 nm. The reduction of methylene blue through photocatalytic activity under UV light showed that the highest degradation efficiency was achieved with Mn doping at 0.0148 g. The presence of SLS improved nanoparticle dispersion, preventing particle agglomeration and requiring stabilization, which is essential for high photocatalytic activity. The findings of this study are valuable for understanding the interaction process between Mn-doped CdS nanoparticles and SLS, as well as the synergistic effects that effectively enhance photocatalytic performance.

Keywords

Doping; Nanocomposite; Photocatalysis; Surfactant; Synergistic effect