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COMPARATIVE EVALUATION OF PHOTOCATALYTIC PERFORMANCE OF CE-DOPED MANGANESE NANOPARTICLES

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Abstract

In this study, undoped manganese (MnCO_3) and cerium (Ce)-doped manganese nanoparticles at varying concentrations (1%, 5%, and 10% Ce) were successfully synthesized via the hydrothermal method. All samples were prepared under identical synthesis conditions, and their crystal structures and morphological properties were characterized using X-ray diffraction (XRD) and scanning electron microscopy (SEM), respectively. XRD results revealed that the undoped manganese existed in the MnCO_3 phase; the 1% Ce-doped sample exhibited the emergence of the CeO_2 phase; and at 5% and 10% Ce doping levels, the MnCO_3 phase was replaced by Mn_2O_3 and Mn_3O_4 phases. SEM images demonstrated that Ce doping altered the particle morphology and increased the tendency for agglomeration. The photocatalytic performance was evaluated based on the degradation kinetics of methylene blue (MB) dye, showing that the 1% Ce-doped sample (Mn1Ce) exhibited the highest activity with a degradation rate of 94.5%. The rate constant derived from the pseudo-first-order kinetic model was calculated as $k = 0.1848 \text{ min}^{-1}$ for Mn1Ce . These findings indicate that Ce doping plays a significant role in enhancing the performance of manganese-based photocatalysts and that such nanomaterials hold great potential for environmental applications such as wastewater treatment.

Key words: Ce doping; hydrothermal synthesis; manganese nanoparticle; methylene blue degradation; photocatalysis

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