

Synthesis, characterization, and photocatalytic activity of $\text{Fe}_3\text{O}_4@\text{ZnO}$ nanocomposite

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Abstrak

A magnetic $\text{Fe}_3\text{O}_4@\text{ZnO}$ nanocomposite (NC) was successfully synthesized by a wet milling method using a high energy milling (HEM) machine. The magnetic $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC was characterized by an X-ray Diffractometer (XRD), scanning and transmission electron microscopes (SEM and TEM), and a vibrating sample magnetometer (VSM). X-ray diffraction results show that $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC consisted of ZnO and Fe_3O_4 phases. The microstructure analysis indicated that $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC presented a ZnO shell wrapped around the surface of a magnetic Fe_3O_4 surface. The average diameter of the aggregated Fe_3O_4 nanoparticle (NP) is 20 nm, while that of $\text{Fe}_3\text{O}_4@\text{ZnO}$ NCs is nearly 30 nm. The Fe_3O_4 NP and $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC show typical superparamagnetic behavior with low coercivity. The saturation magnetization (M_s) of Fe_3O_4 NP was measured at about 66.26 emu.g^{-1} and then declined to 34.79 emu.g^{-1} after being encapsulated with a ZnO shell. The photoactivities of the $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC under UV irradiation were quantified by the degradation of a methylene blue (MB) dye solution. The result reveals that the photodegradation efficiency of $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC is favorable at pH neutral ($\text{pH} = 7$) reaching 100%. By increasing the MB dye concentration from 10 ppm to 40 ppm, the photodegradation efficiency decreases from 100% to 52%. The $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC can be easily collected by an external magnet. The magnetic $\text{Fe}_3\text{O}_4@\text{ZnO}$ NC could be extended to various potential applications, such as purification processes, catalysis, separation, and photodegradation.