

## 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  $\text{Fe}_3\text{O}_4$  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  $\text{Fe}_3\text{O}_4$  surface. The average diameter of the aggregated  $\text{Fe}_3\text{O}_4$  nanoparticle (NP) is 20 nm, while that of  $\text{Fe}_3\text{O}_4@\text{ZnO}$  NCs is nearly 30 nm. The  $\text{Fe}_3\text{O}_4$  NP and  $\text{Fe}_3\text{O}_4@\text{ZnO}$  NC show typical superparamagnetic behavior with low coercivity. The saturation magnetization ( $M_s$ ) of  $\text{Fe}_3\text{O}_4$  NP was measured at about  $66.26 \text{ emu.g}^{-1}$  and then declined to  $34.79 \text{ emu.g}^{-1}$  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.