

Supplementary Information for

ZnO/ZnFe₂O₄ nanocomposite as a broad-spectrum photo-Fenton-like photocatalyst with near-infrared activity

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1. Photoluminescence spectra of ZnO, ZnFe₂O₄, and ZnO/ZnFe₂O₄ nanocomposite

The photoluminescence (PL) emission spectroscopy is useful to disclose the migration, transfer, and recombination processes of the photogenerated electron-hole pairs in the semiconductors. The PL emission spectra of various photocatalysts with excitation at 325 nm were presented in Fig. S3. It can be seen that both ZnFe₂O₄ and ZnO/ZnFe₂O₄ nanocomposite exhibit very low emissions while the ZnO display a strong and broad emission peak centered at around 382 nm due to the recombination of free excitons through an exciton-exciton collision process. As we known, a weaker PL intensity represents a lower recombination process of the electron-holes under light irradiation. Therefore, the low intensity of the PL spectrum of ZnO/ZnFe₂O₄ nanocomposite indicates that the nanocomposite can capture the photo-induced charge carriers and inhibit the recombination of electrons and holes.

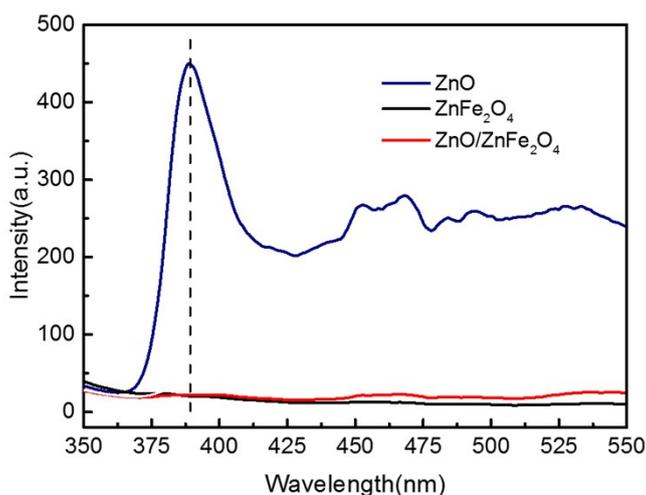


Fig. S1 PL spectra of ZnO, ZnFe₂O₄, Zn/ZnFe₂O₄ nanocomposite. The excitation wavelength is 325 nm.

2. XRD patterns of as-synthesized ZnO and ZnFe₂O₄

ZnO and ZnFe₂O₄ nanoparticles were prepared by the same coprecipitation/calcination method as control photocatalysts of the as-prepared ZnO/ZnFe₂O₄ nanocomposite. Fig. S1 shows their XRD patterns. The XRD pattern of ZnO nanoparticles displays sharp diffraction peaks indexed to the (100), (002), (101), (102), (110), (103), (200), (112) and (201) planes of ZnO with hexagonal wurtzite structure (JCPDS Card No.36-1451) while the XRD pattern of ZnFe₂O₄ nanoparticles shows the (111), (220), (311), (400), (422), (511) and (440) crystal planes of cubic spinel ZnFe₂O₄ (JCPDS Card No. 22-1012), suggesting the successful preparation of ZnO and ZnFe₂O₄ nanoparticles.

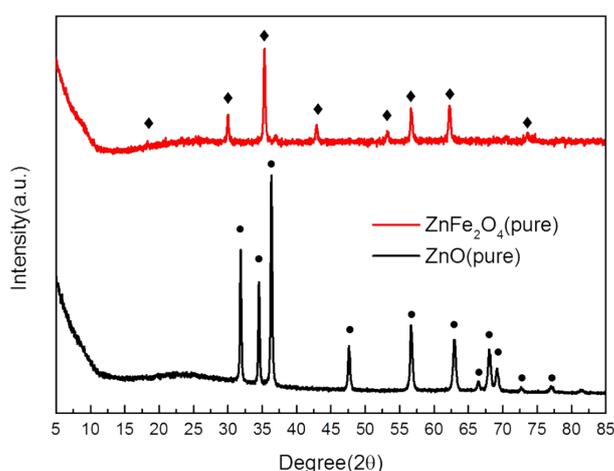


Fig. S2 The XRD patterns of pure ZnO and ZnFe₂O₄ synthesized by the changing the molar ratio of Zn to Fe.

3. FTIR spectra of as-prepared ZnO/ZnFe₂O₄ nanocomposite

Fig. S2 shows the FTIR spectra of (I) MO, (II, III) ZnO/ZnFe₂O₄ nanocomposite, (IV) ZnO/ZnFe₂O₄ nanocomposite after mixing with MO in aqueous solution in the dark for 6 h at room temperature and (V) ZnO/ZnFe₂O₄ nanocomposite after mixing with MO in aqueous solution in the dark for 6 h followed by irradiating under NIR light for 6 h. In Fig. S2(III), the two characteristic peaks at 550.7 and 442.6 cm⁻¹ correspond to the bending and stretching vibrations of Zn-O and Fe-O in the ZnO/ZnFe₂O₄ nanocomposite. Meanwhile, the bands at 3442.9 and 1639.9 cm⁻¹ can be assigned to the stretching vibration of adsorbed water on the surface of ZnO/ZnFe₂O₄ nanocomposite. In the FTIR spectrum of MO, the asymmetric -CH₃ stretching vibrations at 2910.6 cm⁻¹, ring vibrations at 1036.1 cm⁻¹, and the aromatic -C=C- ring stretching vibration at 1607.2 cm⁻¹ appear. This further confirms the chemical structure of methyl orange. While compared with the FTIR spectrum of ZnO/ZnFe₂O₄ nanocomposite after interacting with MO in the dark for 6 h, as shown in Fig. S2 (IV, V), no conspicuous peaks corresponding to MO can be observed, suggesting that the absorbed amount of MO is too small to be detected. It is therefore

concluded that the removal of MO is ascribed to its photodegradation under NIR light irradiation.

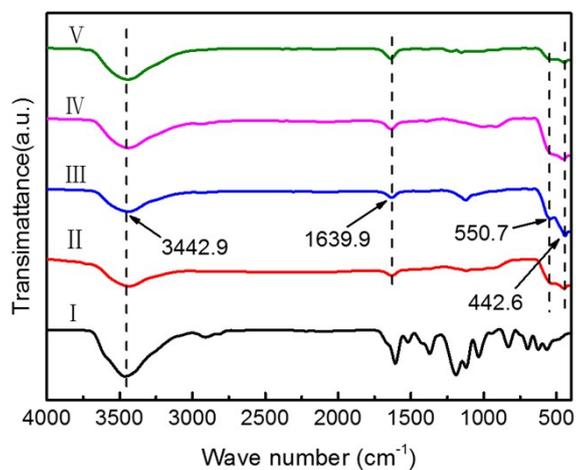


Fig. S3 FTIR spectra of (I) methyl orange, (II, III) ZnO/ZnFe₂O₄ nanocomposite, (IV) ZnO/ZnFe₂O₄ nanocomposite after mixing with MO in aqueous solution in the dark for 6h at room temperature, (V) ZnO/ZnFe₂O₄ nanocomposite after mixing with MO in aqueous solution in the dark for 6h at room temperature followed by irradiating under near-infrared light for 6h.