Core-shell $ZnFe_2O_4$/ZnS composites for photocatalytic applications

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$ZnFe_2O_4$/ZnS core-shell nanocomposites were prepared to combine the magnetization effect of $ZnFe_2O_4$ nanoparticles (NPs) and the photocatalytic activity of ZnS for retrievable photocatalytic systems. A two-step synthesis procedure was adopted to prepare the $ZnFe_2O_4$/ZnS core-shell nanocomposites. First, magnetic $ZnFe_2O_4$ NPs with an average dimension of 60 nm were synthesized by a hydrothermal method. Then, ZnS NPs with an approximate dimension of 5 nm were successfully attached to the surface of the as-synthesized $ZnFe_2O_4$ magnetic NPs through a co-precipitation process. Structural features of $ZnFe_2O_4$ NPs and the composite material were investigated with PXRD and TEM measurements. Although bulk $ZnFe_2O_4$ is an antiferromagnetic material, hydrothermally prepared $ZnFe_2O_4$ NPs exhibited high enough magnetization to make it possible to re-collect the composites by a magnet after photocatalytic reactions. Photocatalytic decomposition of methyl orange by $ZnFe_2O_4$/ZnS core-shell nanocomposites under the irradiation of near-visible light was compared with that of ZnS NPs under the same conditions. The $ZnFe_2O_4$/ZnS core-shell nanocomposites showed much faster reaction rate in early stage of reaction (within the first 3 h), and comparable effects after 4 h. Therefore, the $ZnFe_2O_4$/ZnS nanocomposites prepared by simple approach can be a promising retrievable photocatalyst.

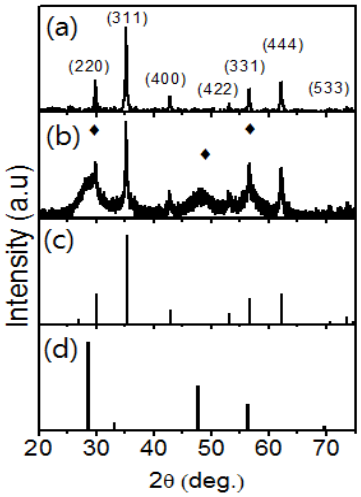

Fig. 1 (a) $ZnFe_2O_4$ nanoparticle; (b) $ZnFe_2O_4$ /ZnS composite; (c) ICDD data of $ZnFe_2O_4$; (d) ICDD data of ZnS

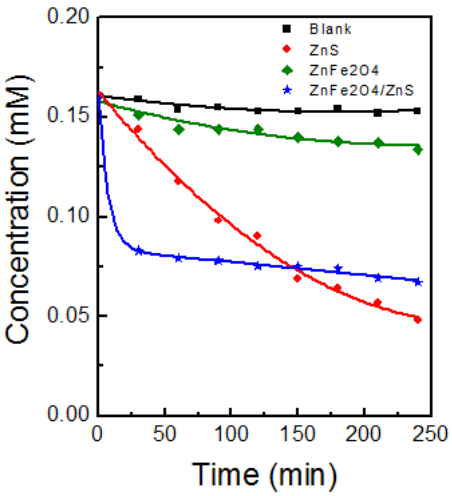

Fig. 2 photocalalytic behavior of $ZnFe_2O_4$ nanoparticle, ZnS nanoparticle, and $ZnFe_2O_4$ /ZnS composite