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ZnO Coated Magnetic Particles: Preparation, Characterization and Photocatalytic Activity

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Topic: Beyond the Elements: building Nano- and Bio-materials

Abstract:
Ground- and surface water pollution by pesticides is a worldwide concern, and there is an urgent need to apply efficient, economical and sustainable remediation strategies to detoxify polluted waters.Due to their high effectiveness, heterogeneous photocatalysis using ZnO or TiO_2 Degussa P-25 has been successfully tested for the elimination of pesticides.[1]However, the use of aqueous suspension of nanoparticles (NPs) of ZnO or TiO_2 Degussa P-25 involves a stage of separation and recovery of the NPs, so that this methodology is not economically viable for industrial applications.[2] To avoid this inconvenience, other strategies have been developed. Magnetization of NPs is a promising and important approach for their use in photocatalytic treatments. The key development of this study was to use underlying SiO_2layer coating magnetite particles followed by a ZnO layer applied using the sol-gel technique, to effectively anchor the ZnO to theparticles ($MSZn_2Ps$).$MSZn_2Ps$were successfully prepared and characterized by different techniques as X-ray diffractometry (XRD), fieldemission scanning electron microscopy (FE-SEM), energy dispersive X-ray spectroscopy analysis (EDX), X-ray photoelectron spectroscopy (XPS), Brunauer-Emmett-Teller (BET, N_2), UV-vis diffuse reflectance spectroscopy (UV-vis DR) and Fourier-transform infrared spectroscopy (FTIR). The photocatalytic efficiency of the magnetic NPs was assessed by their ability to degrade different pesticides in water exposed to solar irradiation. The photooxidation of these pesticides followed first order kinetics. In addition, these magnetic particles can be easily separated from the water with a magnet. Finally, the addition of ZnO coated magnetic particles in tandem with the oxidant $Na_2S_2O_8$, strongly enhances the degradation rate of these pesticides. From the results of this work, it can be concluded that photocatalytic oxidation using $MSZn_2Ps$ magnetic particles might be a promising method to remove some organic pollutants from water.

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