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A comparative study on photocatalytic activities of various transition metal oxides nanoparticles synthesized by wet chemical route

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ABSTRACT

Co-precipitation route was used to synthesize different oxides of transition metals nano photocatalysts (Fe_2O_3, MnO_2, Co_3O_4, and ZnO). The crystal structure, morphology, and elemental composition confirmation were carried out energy dispersive X-ray spectroscopy through X-ray diffraction (XRD), field emission scanning electron microscopy, and EDXS techniques. XRD analysis results revealed that the transition metal oxides are highly pure and have a very small crystallite size. It was found that iron oxide and cobalt oxide nanostructures were cubic, whereas manganese oxide, and zinc oxide nanostructures have tetragonal crystal structures. Fourier transform infrared spectra were studied to further confirm and clarify the material's structure. Surface areas of the synthesized transition metal oxides nano photocatalysts were calculated through Brunauer–Emmett–Teller isotherms. The calculated optical band gap energy for different metal oxides was between 2.02 and 2.7 eV. The nano photocatalysts were applied in the presence of aqueous methylene blue solution under visible light incandescence in order to set up the ascendancy of heterogeneous photocatalysis. It is observed that the photocatalytic efficiency of the oxides of transition metals simply depends upon the particle size of the nano-sized material and its surface area. It is concluded that iron oxide nano-photocatalyst reveals the best photocatalytic efficiency because of the high surface/charge ratio and variation in surface orientations. It is suggested that nano-sized iron oxides (Fe_2O_3) is a propitious candidate to resolve environmental issues related to the poisonous ecosystem because it has a great potentiality in heterogeneous photo disintegration and can establish a better green environment.

Keywords: Nanoparticles; Surface area; Co-precipitation route; XRD; FTIR; Photocatalysis

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