Fabrication and characterization of Ag-doped titania: impact of dye-sensitization, phenol decomposition kinetics and biodegradability index

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Received 16 July 2014; Accepted 8 March 2015

ABSTRACT

Heterogeneous photocatalytic wastewater treatment using TiO₂ is a well-accepted technique under UV light illumination. Different strategies are employed to modify TiO₂ for shifting its photo-response to the visible light. In this work, Ag-doped TiO₂ nano-composites were synthesized by UV photo-reduction method to narrow down the band gap energy. Further, dye sensitization was performed using Eosin Yellowish to find out its influence on phenol decomposition. Synthesized catalysts were characterized using diffuse UV–vis spectroscopy, Fourier transform infrared spectroscopy, X-ray diffraction, transmission electron microscopy (TEM), Brunner Emmer Teller (BET) area and zeta-potential measurements. Nanowire like structure was observed with 30–70 nm in diameter from TEM images. BET surface area was decreased considerably with Ag-doping (maximum 31.6%) and dye sensitization (40.6%). Ag concentration and solution pH showed dramatic impact on phenol decomposition with maximum 87% at pH 7, Ag-loading 1% (w/w) and catalyst dose 0.5 g L⁻¹. Practically no positive synergy was noted with dye sensitization even though the photo-responses were moved intensely to the visible region. The pseudo-first order kinetic exhibited sound agreement to the experimental results with correlation coefficient ≥0.98. Moreover, the enhancement of biodegradability is investigated in terms of biochemical to chemical oxygen demand.

Keywords: Photo-catalyst; Ag-doping; Dye-sensitization; Phenol degradation