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Synthesis, characterization, and photocatalytic activity of co-doped Ag–, Mg–TiO_2-P25 by photodeposition and impregnation methods

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ABSTRACT

In the present study, Ag–TiO_2-P25 nanoparticle was synthesized using photodeposition technique and Mg was impregnated onto the Ag–TiO_2-P25 for the preparation of co-doped nanoparticles. The physicochemical properties were characterized by X-ray diffraction (XRD), specific surface area and porosity (Brunauer–Emmett–Teller (BET) and Barret–Joyner–Halender), transmission electron microscopy, diffuse reflectance spectroscopy (DRS), scanning electron microscopy, X-ray photoelectron spectroscopy, and energy dispersive X-ray spectroscopy techniques. The BET surface area of the co-doped TiO_2-P25 was larger than that of the monometallic catalysts and the XRD data showed anatase and rutile crystalline phases in catalysts, indicating that Ag and Mg co-doping did not influence the crystal patterns of TiO_2-P25. Also, the DRS results indicated that the band gap of co-doped photocatalyst was smaller than that of the monometallic and undoped TiO_2-P25 and there was a shift in the absorption band toward the visible light region. Additionally, the photocatalytic efficiency of the synthesized catalysts was evaluated by degradation of C.I. Acid Red 27 under visible light irradiation. The results showed that Ag-(1 wt%) and Mg-(0.25 wt %) co-doped TiO_2-P25 had the highest photoactivity among all samples under visible light. The optimum calcination temperature and time were 350°C and 1 h, respectively. The results of the total organic carbon analysis indicated 66% mineralization of AR27 after 20 min of irradiation time.

Keywords: Heterogeneous photocatalysis; Mg impregnation; Ag photodeposition; TiO_2-P25 nanoparticles; Co-doped; C. I. Acid Red 27

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