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Facile in situ synthesis and characterization of Ag_3PO_4 supported TiO_2 nanocomposite for visible light photocatalysis

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ABSTRACT

Facile in situ synthesis and characterization of stable Ag_3PO_4/TiO_2 nanoparticles for visible light photocatalytic water treatment has been reported. The surface morphology, crystal structure and chemical properties of the photocatalyst were characterized by using UV–Vis–NIR spectroscopy, field emission scanning electron microscopy, X-ray diffraction, X-ray photoelectron spectroscopy, transmission electron microscopy and nitrogen physisorption. The synthesized powder nanoparticles were polycrystalline in nature with calculated energy band gap in the range of 2.3–2.5 eV. Deposition of Ag_3PO_4 over the surface of TiO_2 resulted in increased stability of the photocatalyst and a significant shift in the UV absorption spectrum toward visible region. The photocatalytic experiments were performed in a batch reactor under 112 W cool white visible light irradiation with $\lambda > 400$ nm. The degradation of 2-chlorophenol (2-CP) as a model pollutant was investigated and reaction parameters for best catalyst performance were optimized. The catalyst showed complete degradation of 15 mg·L^{-1} 2-CP within 120 min while 92.5% degradation of 25 mg·L^{-1} 2-CP was achieved within 180 min under optimized conditions (i.e., 1 g·L^{-1} catalyst dose, at solution pH 3 and irradiation time of 180 min). The experimental results showed that the photocatalytic degradation results followed pseudo-first-order reaction kinetics and confirmed that Ag_3PO_4/TiO_2 has high potential for degradation of 2-CP from wastewater under visible light irradiation.

Keywords: Ag_3PO_4/TiO_2 nanoparticles; Advanced oxidation; 2-Chlorophenol; Visible light photocatalysis; Wastewater

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