

Visible-light-induced In,S-TiO₂@rGO with enhanced photocatalytic activity for detoxification of atrazine

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The visible-light activated In,S-TiO₂@rGO nanocomposite was prepared using an innovative ultrasonic-assisted solvothermal method. The XRD patterns indicated the anatase structure for TiO₂ co-doped with indium and sulfur elements. FT-IR and Raman spectra analysis confirmed the presence of rGO in nanocomposites. In addition, SEM and HRTEM images confirmed the presence of mono-dispersed TiO₂ nanoparticles on rGO sheets. A considerable red shift in absorption edge of TiO₂ was observed after co-doping with In and S. Co-doping of TiO₂ with In and S elements and compositing with rGO significantly enhanced its visible-light photocatalytic activity which was strongly affected by the amount of In, S and rGO to TiO₂ ratio in the nanocomposite. The complete degradation and 95.5% mineralization of 20 mg/L atrazine (ATZ) was attained in the photocatalytic oxidation (PCO) process within 20 min with In,S co-doped TiO₂@rGO nanocomposite. The rate of ATZ degradation in the PCO process with In,S co-doped TiO₂@rGO nanocomposite was 80 times of that with pure TiO₂ as catalyst under visible-light irradiation. The enhanced photocatalytic activity of the In, S co-doped TiO₂@rGO is related to the synergistic effect of dopants contributing to improved visible light absorption and decreased recombination rate of the charge carriers. The degradation studies using various scavengers showed that hydroxyl radical was the main active species contributed in the photocatalytic degradation of ATZ under the selected conditions. In addition, the rate of ATZ degradation and mineralization in the photocatalytic process with the TiO₂@rGO nanocomposites as catalyst was 0.248 and 0.169 min⁻¹, respectively, which was remarkably greater than TiO₂. The prepared nanocomposite was found to be a reusable and durable catalyst for visible light photocatalytic degradation of ATZ. As-made In,S co-doped TiO₂@rGO nanocompsite could preserve its catalytic activity during four consecutive recycles for the ATZ removal process. The cytotoxicity of fresh and photocatalytic-treated ATZ solutions assessed using the human hepatic cells (HepG2) indicated that treating ATZ solution in the developed PCO process could be considerably detoxified.

Keywords: TiO₂ doping, Graphene oxide, Nanocomposite, Photocatalytic process.

References

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