

Magnetically recyclable Fe₃O₄/TiO₂ core/shell submicroparticles: synthesis, characterization, and photocatalytic activity

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The application of semiconductors for treating polluted waters and wastewaters is a promising environmental remediation technology, especially for organic pollutants. Among several oxide semiconductor photocatalysts, TiO₂ is the most suitable material for a widespread environmental application, due to its biological and chemical inertness, strong oxidizing power, cost effectiveness, and stability regarding photo and chemical corrosion [1]. However, TiO₂ also has some disadvantages, such as: it is UV-excited and it is usually necessary an additional step (e.g. filtration or centrifugation) for recycling purposes. In trying to solve those drawbacks, we used a simple synthetic strategy for producing a magnetic photocatalyst Fe₃O₄/TiO₂ core/shell submicroparticles with high surface area. The magnetic photocatalyst Fe₃O₄/TiO₂ in a core/shell structure were fabricated through a three-step process: (1) α -Fe₂O₃ nanoparticles were obtained, by precipitation, from FeCl₃.6H₂O 0.01 mol L⁻¹, which underwent a forced acid hydrolysis at 100°C for 48 h [2]; (2) α -Fe₂O₃/TiO₂ particles were obtained, by heterocoagulation, of Ti⁴⁺ oxide species on the α -Fe₂O₃, followed by thermal treatment at 500°C for 2 h; and (3) Magnetic photocatalyst Fe₃O₄/TiO₂ core/shell submicroparticles were obtained by thermal annealing at 400°C for 1 h under reducing atmosphere (H₂) of the α -Fe₂O₃/TiO₂ particles. We used Acid Blue 9 (C.I. 42090) dye decolorization for investigating the photocatalytic activity the pH and catalyst dosage effects through a 2² factorial design. We obtained magnetically recyclable Fe₃O₄/TiO₂ core/shell submicroparticles (Figure 1a) with specific surface area of 80 m²/g (Figure 1b). The magnetic photocatalyst presented two distinct band gap energies: 3.0 and 2.2 eV (Figure 1c). The greatest color removal (83%) was achieved with pH 3.0, 1.0 g L⁻¹ of photocatalyst, and 1 h of reaction.

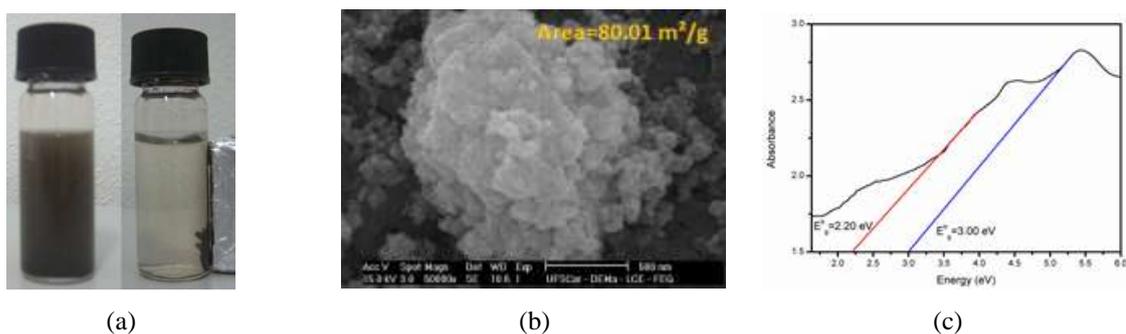


Figure 1: Magnetically recyclable Fe₃O₄/TiO₂ core/shell submicroparticles: a) magnetic separation, (b) SEM image, and (c) diffuse reflectance UV-VIS spectroscopy (DRS).

Keywords: Magnetic photocatalyst; Fe₃O₄/TiO₂ core/shell submicroparticles; AOPs.

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