

Fe₃O₄/SiO₂/TiO₂ Nanoparticles as Catalyst for Recovery of Gold from the Mixture of Au(III) and Cu(II) Ions

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Abstract : Fe₃O₄/SiO₂/TiO₂ nanoparticles have been synthesized and applied as a photocatalyst for the recovery of gold from the mixture of Au(III) and Cu(II) ions. The synthesis was started by the preparation of magnetite (Fe₃O₄) using coprecipitation and sonication methods, followed by SiO₂ coating on magnetite using sol-gel reactions, and then TiO₂ coating using sol-gel process. Characterization was performed by using infrared spectroscopy, X-ray diffraction, transmission electron microscopy methods. Activity of Fe₃O₄/SiO₂/TiO₂ nanoparticles was evaluated as a photocatalyst for recovery of gold through photoreduction of Au(III) ions in Au(III) and Cu(II) ions mixture with a ratio of 1:1, in a closed reactor equipped with UV lamp. The photoreduction yield was represented as a percentage (%) of reduced Au(III) which was calculated by subtraction of initial Au(III) concentration by the unreduced one. The unreduced Au(III) was determined by atomic absorption spectrometry. Results showed that the Fe₃O₄/SiO₂/TiO₂ nanoparticles were successfully synthesised with excellent magnetic and photocatalytic properties. The nanoparticles present optimum activity at a pH of 5 under UV irradiation for 120 minutes. At the optimum condition, the Fe₃O₄/SiO₂/TiO₂ nanoparticles could reduce Au³⁺ to Au⁰ 97.24%. In the mixture of Au(III) and Cu(II) ions, the Au(III) ions are more easily reducible than Cu(II) ions with the reduction results of 96.9% and 45.80% for Au(III) and Cu(II) ions, respectively. In addition, the presence of Cu(II) ions has no significant effect on the amount of gold recovered and its reduction reaction rate.

Keywords : Fe₃O₄/SiO₂/TiO₂, photocatalyst, recovery, gold, Au(III) and Cu(II) mixture

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