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A large, stylized graphic of a green leaf, composed of several overlapping, semi-transparent layers of varying shades of green. The leaf is oriented vertically, with its tip pointing upwards and its base pointing downwards. It is positioned in the background, behind the main text.

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Synthesis and Characterization of TiO₂/CoFe₂O₄ photocatalysts

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Abstract – Nanocomposites of TiO₂/CoFe₂O₄ were prepared by the polymeric precursor method. These materials showed photocatalytic activity under UV-light due to the presence of TiO₂ on their surface, associated with the magnetic activity of CoFe₂O₄ cores, which is useful for the separation of the photocatalysts after use in an oxidative process. In rhodamine photodegradation, pure TiO₂ showed higher photocatalytic efficiency than the nanocomposites. However, in atrazine photodegradation, the nanocomposites were more effective than pure TiO₂.

A simple way to separate the catalyst is to associate the nanoparticles to a phase with magnetic activity, such as CoFe₂O₄ or Fe₃O₄, thus engineering a nanocomposite that can be separated by the action of a magnetic field. This paper presents an investigation of TiO₂-coated CoFe₂O₄ (TiO₂/CoFe₂O₄) synthesis in nanometric sizes by the polymeric precursor method [1,2] and the evaluation of the photocatalytic potential of these structures for the degradation of a dye - rhodamine B - and a pesticide - atrazine - under UV light. All the materials synthesized in this work were prepared through the polymeric precursor method. For the nanocomposites synthesis, the CoFe₂O₄ nanoparticles were dispersed in aqueous solution containing Ti resin, in weight ratios of CoFe₂O₄:TiO₂ of 11:89, 27:73, 39:61 and 56:44. After, the suspension was frozen in liquid nitrogen to avoid phase separation and freeze-drying. The resulting resin was treated at 450°C for 2 hours in order to obtain the TiO₂ phase on the surface of the CoFe₂O₄. A reference of pure TiO₂ anatase was synthesized by pure Ti resin calcination at 450°C for 2 hours. In the XRD characterization, the two expected phases (CoFe₂O₄ and TiO₂ anatase) were identified in all nanocomposites, and the presence of rutile TiO₂ phase was not detected, showing that the method led to the production of pure anatase. Also, no peaks related to pure iron or cobalt phases, such as hematite or cobalt oxide, were identified, showing that the thermal treatment did not cause phase segregation. Table 1 shows the first order rate constants (k) for both rhodamine and atrazine. The synthesized nanocomposites showed selectivity in the photodegradation concerning the compounds studied. In rhodamine photodegradation, the TiO₂ amount was the predominant factor in the photocatalytic activity. However, in atrazine photodegradation, all synthesized nanocomposites showed photocatalytic activity increased in relation to pure TiO₂.

Table1. Rate constants for rhodamine B and atrazine photodegradations.

System	k/h ⁻¹	System	k/h ⁻¹
<i>pure rhodamine</i>	0.036	<i>pure atrazine</i>	1.847
<i>TiO₂</i>	0.108	<i>TiO₂</i>	2.405
<i>11:89</i>	0.095	<i>11:89</i>	2.691
<i>27:73</i>	0.089	<i>27:73</i>	2.922
<i>39:61</i>	0.083	<i>39:61</i>	2.933
<i>56:44</i>	0.064	<i>56:44</i>	2.931

References

- [1]. H. A. J. L. Mourão, V. R. de Mendonça, A. R. Malagutti, C. Ribeiro, Quim. Nova 32 (2009) 2181.
[2]. M. Kakihana, M. Yoshimura, Bull. Chem. Soc. Jpn., 72 (1999) 1427