

Development of TiO₂ thin films prepared by the polymeric precursor method applied to photocatalytic degradation of rhodamine B

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Semiconductor-mediated photocatalytic oxidation has been accepted as a promising method for the removal of organic contaminants from wastewater. Among the semiconductors employed, TiO₂ is known to be a good photocatalyst because of its high efficiency, low cost, chemical inertness, and photostability. TiO₂ semiconductor photocatalysts have the potential to oxidize a wide range of organic compounds, including chlorinated organic compounds, such as dioxins, into harmless compounds such as CO₂ and H₂O by irradiation with UV light. UV light excites the electrons from the valence band to the conduction band of the TiO₂, leaving holes in the valence band. These electrons and holes can then initiate redox reactions with molecular species adsorbed on the surfaces of the catalysts. Depending on the adopted method of synthesis to prepare the TiO₂ they can be gotten nanoparticles with various crystal types such as rutile, brookite, anatase, being last the desirable one for photocatalysis. One of the methods of interest for anatase TiO₂ nanoparticles attainment is the polymeric precursor method, which consists of the formation of polyester in which the metallic ions are homogeneously distributed in the polymeric chain. Therefore, the aim of this work was to prepare and to optimize TiO₂ thin films obtained by a polymeric precursor method to be applied in the photodegradation of rhodamine B dye in aqueous solution, thus investigating a steady system for use in photoreactors. The TiO₂ thin films were deposited on borosilicate glass substrates by spin-coating method from polymeric resins prepared in accordance with a previous report [2]. The films were prepared with different layers and annealing at 450°C. The microstructural characterization of the films was performed using atomic force microscopy (AFM—Nanoscope IIIa). The grain size from 20 to 100 nm and surface roughness of 1.3 nm were obtained from the TiO₂ thin films containing four layers. Photocatalytic degradation for a rhodamine B aqueous solution at neutral pH using the TiO₂ thin films with different layers under UV irradiation were investigated. The results indicated that the photocatalytic activity increased with increasing of number of TiO₂ layers deposited, being the highest efficiency obtained for the film with four layer of TiO₂. It was also verified that 56.6% of the rhodamine B was degraded after four hours with only UV irradiation, while that 82.3% of rhodamine B degradation was reached with UV irradiation and using the four layers of TiO₂ thin film photocatalyst. These results show that the polymeric precursor method allows obtain homogeneous thin films with high photocatalytic activity to rhodamine degradation.

Keywords: photocatalysis, TiO₂ thin films, polymeric precursor method, organic dyes

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[1] M. Anpo, M. Takeuchi, *Journal of Catalysis*. **216**, 505 (2003).

[2] C. M. Ronconi, C. Ribeiro, L.O.S. Bulhões, E. C. Pereira, *J. Alloys Compounds*. doi:10.1016/j.jallcom.2007.11.060

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