Comparison of the Photocatalytic and Photoelectrocatalytic Decolorization of Methyl Orange on Sputtered TiO_2 Thin Films

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Correlations between the photocatalytic and photoelectrocatalytic decolorization of methyl orange, using TiO_2 thin films sputtered under various conditions, were made. Three types of systems, namely: two photocatalytic systems, one with and one without a Pt counter electrode, and a third with a Pt counter electrode having an applied potential, were used to evaluate photocatalytic activity.

The crystal structure, morphology, bandgap energy, flatband potential, and the resistances of the TiO_2 films were characterized by X-ray diffraction, scanning electron microscopy, UV/vis spectroscopy, a photocurrent method, and electrochemical impedance spectroscopy, respectively. The results showed that the decolorization of methyl orange only occurred on the anode of the TiO_2/Ti electrode and that the decolorization rate increased 67% when the photocatalyst was coupled to a Pt electrode (0 V applied potential), and 275% when connected with the Pt cathode and 1 V *vs.* Ag/AgCl applied potential. The benefits of high crystallinity, a high quantity of the anatase, and a more negative flatband potential were found in the photocatalytic reaction, whereas the resistance of the film was the main factor affecting the photoelectrocatalytic activity.

Key words: Titanium Dioxide, Methyl Orange, Sputtering, Photoelectrocatalytic Activity, Photocatalytic Decolorization