Structure and Photocatalytic Characteristics of TiO_2 Thin Film Coated on Stainless Steel for Chromium (VI) Removal Application

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ABSTRACT

In this work, TiO_2 films with high photocatalytic activities were coated on stainless steel plate by the sol-gel method. Stainless steel plate is a good substrate due to its large surface area, being corrosion-resistant and commercially-available. It was found that TiO_2 films exhibited a uniform surface with high in anatase structure. With increasing of calcination temperature, the higher amount of anatase and the bigger size of nanoparticle in the films were obtained. With multiple coating cycles of the thin film, the increase of thinckness can be expected. The photocatalytic activity in chromium(VI) removal of the TiO_2 film coated on stainless steel plate can be related to its crystallization and the thickness. Thicker and better crystallization of TiO_2 film resulted in its higher photocatalytic activity which was evaluated by the photocatalytic reduction of chromium (VI) in a cylindrical photoreactor. Results showed that chromium (VI) was successfully removed from aqueous solution in photocatalysis system using the obtained thin film in which percentage of anatase phase, nanoparticle size, and film thickness were major parameters controlling the photoactivity.

Key words: TiO_2 (Titanium dioxide), Thin film, Photocatalysis, Chromium(VI)

INTRODUCTION

Photocatalytic process has been of continuous interest in the treatment and purification of air and water since it can complete the reduction of metal ions. Furthermore, organic species can be completely mineralized to carbon dioxide or become nontoxic materials by photocatalytic pathway. Titanium dioxide (TiO_2) has been widely used as a photocatalyst due to its activity, photostability, non-toxicity and commercial availability (Oppenländer, 2003). As a result of the cost and difficulties in separating the TiO_2 particles from the suspension after completion of the reaction, the powder TiO_2 application is not found to be practical for commercial use (Matthews, 1987; Hilmi et al., 1999; Zhang et al., 2003). In order to overcome these disadvantages, preparations of TiO_2 thin film have been developed by different techniques, for example, chemical vapor deposition, chemical spray pyrolysis, electrodeposition and the sol-gel method. Many researches have focused on preparation by the sol-gel process since this method is very simple, easy to operate and can be applied to complex surfaces or large surface areas. Moreover, this technique is suitable for thin film deposition