ADVANCES IN MATERIALS ENGINEERING

Volume 2

Edited By:
Md Abdul Maleque
Iskandar Idris Yaacob
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Chapter 004

Development of Carbon Doped TiO_2 Photocatalyst for Pigment Degradation

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Abstract. TiO_2 is a semiconductor and is chemically activated by light energy. The photoactivity of TiO_2 tends to decompose organic materials coming in contact with it. However, one limitation of TiO_2 photocatalyst is that it is active only under UV light, not visible light. Doping TiO_2 with carbon here aims to make it photoactive in visible light as well as more photoactive in UV light. Carbon-doped TiO_2 was prepared from Degussa P25 TiO_2 doped with white sugar as the carbon source in a low temperature process. Methyl orange (MO) was used as the representative for degradation test under the UV light irradiation. The MO degradation test showed that the 2% C doped Degussa P25 has the highest photocatalytic activity and the photocatalytic activity of Degussa P25 has been enhanced in the UV light range.

Introduction

Titanium dioxide (TiO_2) is a semiconductive material which has been applied in many industrial applications. It has been used as a pigment, powder for cosmetics, as well as a photocatalyst working under UV light [1]. When illuminated with UV light, an electron is promoted from the valence band to the conduction band of TiO2 to produce an electron-hole pair. Hydroxyl radicals are produced when reacting with water molecules, since the positive hole has a high oxidative potential [2]. The hydroxyl radicals are powerful oxidizers because the electron-hole pair recombines much more slowly than other reactions. Since it is a strong oxidizer, it has been used widely for environmental applications. These include air purification, water purification, antifog mirrors, self-cleaning tiles and self-sterilizing operating theater floor tiles [1,2]. Methyl orange was used for measuring the degradation rate in the photocatalytic activity test because it was able to change its color when it has been neutralized. TiO2 photocatalysts can only be activated as a catalyst by UV light irridiation ($\lambda < 400$nm). UV occupies only 4% of the light emitted by sunlight. However, by doping TiO2 photocatalyst with certain elements, its photocatalytic activity can be enhanced. As a result, the usage of TiO2 as photocatalyst for environmental applications would be enhanced in the UV light region. Therefore, better utilization of light sources such as sunlight and florescent light for photocatalysis is expected if doping of TiO2 is done [1-3].

The chapter has focused on the development of carbon doped TiO_2 photocatalyst. Carbon can be doped into TiO_2 by carbonization [4,5], heating of TiO_2 gel in a furnace [6], ball milling of TiO_2 with ethanol [7] and oxidizing-carbonizing of Ti surface to produce