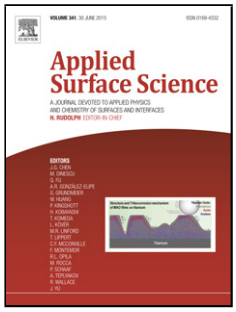

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PII: S0169-4332(15)02817-2
DOI: http://dx.doi.org/doi:10.1016/j.apsusc.2015.11.122
Reference: APSUSC 31839

To appear in: *APSUSC*

Received date: 15-9-2015
Revised date: 10-11-2015
Accepted date: 12-11-2015

Please cite this article as: W. Tang, K. Qiu, P. Zhang, X. Yuan, Synthesis and photocatalytic activity of ytterbium-doped titania/diatomite composite photocatalysts, *Applied Surface Science* (2015), http://dx.doi.org/10.1016/j.apsusc.2015.11.122

Synthesis and photocatalytic activity of ytterbium-doped titania/diatomite composite photocatalysts

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Abstract

Ytterbium-doped titanium dioxide (Yb-TiO_2)/diatomite composite materials with different Yb concentrations were prepared by sol–gel method. The phase structure, morphology, and chemical composition of the as-prepared composites were well characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy, Raman spectroscopy, scanning electron microscopy (SEM), and ultraviolet–visible (UV–vis) diffuse reflection spectroscopy. The XRD and Raman spectroscopy analysis indicated that the TiO_2 existed in the form of pure anatase in the composites. The SEM images exhibited the well deposition and dispersion of TiO_2 nanoparticles with little agglomeration on the surfaces of diatoms. The UV–vis diffuse reflection spectra showed that the band gap of TiO_2 could be narrowed by the introduction of Yb species, which was further affected by doping concentration of Yb. The photocatalytic activity of synthesized samples was investigated by the degradation of methylene blue (MB) under UV light irradiation. It was observed that the photocatalytic degradation followed a pseudo-first-order kinetics according to the Langmuir–Hinshelwood model. Compared to TiO_2 and TiO_2/diatomite, the Yb-TiO_2/diatomite composites exhibited higher photocatalytic activity toward degradation of MB using UV light irradiation.

Keywords: Diatomite; Ytterbium-doped titanium dioxide; Ionic doping; Photocatalysis; Methylene blue

1. Introduction

Over the past decades, significant amount of untreated wastewater is discharged into the environment at a breakneck pace. Dyes are used extensively in plastic, food, textile, and paper industries. Unfortunately, most of these dyes escape conventional wastewater treatment processes and persist in the environment attributed to their high stability to light, temperature, water, detergents, chemicals, and soap. Thus, they are one of the main reasons for water pollution. Most of the dyes pose potential health hazards to both human beings and environment because they are toxic and carcinogenic [1–3]. Several techniques have been used for the removal of dyes from wastewater, such as coagulation by chemicals, absorption on carbon, and ultrafiltration [4–6]. However, photocatalysis has been proved to be one of the most promising one. Among various semiconductors photocatalysts, titanium dioxide (TiO_2) has attracted growing interest due to its biological and chemical inertness, high photocatalytic activity, environmental friendliness, and low cost [7–9]. However, a

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