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Preparation and characterization of N doped TiO_2/ sepiolite composite materials

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Keywords: titanium dioxide, modification, speiolite, photocatalysis

Abstract. Nitrogen doped TiO_2/sepiolite composite materials (N-TiO_2/sep) with different nitrogen contents were prepared by a sol-gel method and characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), respectively. XRD and SEM results showed that anatase-TiO_2 nanoparticles were distributed homogenously on the surface of sepiolite. XPS revealed that N atoms could incorporate into the lattice of anatase TiO_2 substituting the oxygen atoms sites of oxygen atoms.

Introduction

Presently, heterogeneous photocatalysis has attracted more attention in the advanced oxidation process for the mineralization of organic pollutants in wastewater. Titanium dioxide (TiO_2) powders have been widely used as an eminent material in the field of environmental applications because of the excellent photocatalytic activity, chemical stability, powerful oxidation strength, non-toxicity, commercial availability and cheapness[1,2]. However, several shortcomings, i.e., a high band gap (Eg =3.2 eV, only absorbing the UV light of 387 nm) and difficulty in separation of fine TiO_2 powder from the aqueous phase after use, seriously limited the practical application of TiO_2.

Recently, much effort has been devoted to preparing the TiO_2 photocatalyst that was capable of efficient utilization of the visible light constituting the main parts of the solar spectrum. Several strategies including the doping of TiO_2 with transition metals [3], anchoring organic dyes onto the surface of TiO_2 [4], and the doping of TiO_2 with anionic nonmetals have been investigated. Among them, nonmetal dopants[5-8], especially N element, may be more appropriate for the extension of photocatalytic activity of TiO_2 into the visible region than other methods because their impurity states are near the valence band edge, but they do not act as charge carriers, and their role as recombination centers might be minimized compared to metal cation doping.

Sepiolite was a nonlayered clay mineral showing a microfibrous morphology and a particular texture that provides a high specific surface area (>300 m^2/g) and porous volume (0.4 cm^3/g). Therefore, this silicate appears as an attractive support. In this paper, organically modified microfibrous sepiolite was used as the support for nanosized TiO_2 formed by an in situ hydrolysis process between the alkoxide precursor and the surface of the silicate. The organophilic interphase on the silicate surface which was formed by ion-exchange reactions with alkylammonium salts solutions, acted like a templating medium which provided titanium dioxide nanoparticles with relatively monodiperse particle sizes on the surface. N doped TiO_2/sepiolite was prepared using the urea as the precursors of nitrogen to extend its light absorption into the visible region. The N doped TiO_2/sepiolite was characterization by XRD, SEM and XPS, respectively. It was expected that these materials can be used as adsorbents/photocatalysts for environmental applications.