Preparation and Photocatalytic Activity of N-TiO_2/Sepiolite Nanocomposite

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Abstract

To utilize visible light and separate of TiO_2 nanoparticles more efficiently in photocatalytic reactions, nitrogen doped TiO2/sepiolite composites (N-TiO_2/sep) with different nitrogen contents were prepared by a sol-gel method and characterized by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and UV-vis spectroscopy. XRD showed that anatase-TiO_2 nanoparticles were loaded on the surface of sepiolite. XPS revealed that N atoms could incorporate into the lattice of anatase TiO_2 substituting the sites of oxygen atoms. UV-vis spectroscopy showed that the visible light absorption of N-TiO_2/sep samples decreased with the increase of calciantion temperature and increased with the increase of N content. The photocatalytic activities of obtained N-TiO_2/sep samples were evaluated by methylene blue degradation under visible light irradiation. It was found that the N-TiO_2/sep samples had the higher photocatalytic activity than that of TiO_2/sep.

First page example

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Preparation and photocatalytic activity of N-TiO_2/sepiolite nanocomposite

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Keywords: titanium dioxide, modification, speiolite, photocatalysis, methylene blue

Abstract. To utilize visible light and separate of TiO_2 nanoparticles more efficiently in photocatalytic reactions, nitrogen doped TiO_2/sepiolite composites (N-TiO_2/sep) with different nitrogen contents were prepared by a sol-gel method and characterized by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and UV-vis spectroscopy. XRD showed that anatase-TiO_2 nanoparticles were loaded on the surface of sepiolite. XPS revealed that N atoms could incorporate into the lattice of anatase TiO_2 substituting the sites of oxygen atoms. UV-vis spectroscopy showed that the visible light absorption of N-TiO_2/sep samples decreased with the increase of calciantion temperature and increased with the increase of N content. The photocatalytic activities of obtained N-TiO_2/sep samples were evaluated by methylene blue degradation under visible light irradiation. It was found that the N-TiO_2/sep samples had the higher photocatalytic activity than that of TiO_2/sep.

Introduction

Titanium dioxide (TiO_2) was one of the important photocatalysts because of its high activity, chemical stability, robustness against photocorrosion, low toxicity, no-twain pollution and availability at low cost so far, especially for the detoxification [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.

Since the idea of doping TiO_2 materials with nonmetal elements was first presented by Asahi [3], a number of researches have focused on the exploitation of nonmetal doping to lower the threshold energy of TiO_2 for excitation in order to utilize a larger fraction of visible light for conversion to photochemical energy. To date, Many TiO_2 nanomaterials doped with inorganic elements, such as C [4], N [5], S[6], and P[7] have been successfully synthesized, and showed enhanced visible-light photocatalytic activities than pure TiO_2. Among these inorganic dopants, it was found that substitutional nitrogen doping was particularly effective in decreasing the band gap of anatase due to promote the formation of N2p states above the valence band of TiO_2.

In order to enhance the separation performance of TiO_2, intensive research has been carried out to immobilize or impregnate TiO_2 onto an inert and porous supporting matrix such as silica, alumina, zeolites, glass fibres, glass, quartz and activated carbon [8,9]. Among these support, clay or a clay-based matrix was a promising material because of its chemically inert, resistant to deterioration, commercially available in large quantities and has many industrial, catalytic and environmental applications [10-12]. 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 for photocatalyst.