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Preliminary Research on the Preparation of Ce-Doped TiO_2 by Sol Method

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Keyword: Sol method; TiO_2

Abstract: butyl titanate, water and anhydrous ethanol were used as raw materials; Cerium-doped TiO_2 was prepared by sol method at room temperature. Then it was characterized by X ray diffraction, Raman spectra, Uv-vis absorption spectra and Scanning Electron Microscope. The results show that TiO_2 crystal can be got by sol method at room temperature. Cerium-doped TiO_2 has the better catalytic performance for methyl orange.

Introduction

At present, environmental pollution had been a major topic in the world, to solve this global problem, we need to find a new material of energy saving, low consumption and safety. TiO_2 has some properties, such as good photosensitivity, air sensitivity and higher photocatalytic activity. At same time, the organic matter at room temperature in water, air and soil can be decomposed into carbon dioxide and water by nano TiO_2[1-8]. So cerium doped TiO_2 by Sol method was prepared with Sol method in this paper.

Experiment

1.1 Materials

Butyl titanate (A.R), Anhydrous ethanol (A.R), Cerium nitrate (A.R), Nitrate (A.R), Methyl orange (A.R)

1.2 Preparation

First, 0.50 wt% Cerium nitrate was added into anhydrous ethanol, then a certain amount of butyl titanate was added into ethanol solution to form solution A. The quantitative water was mixed with the other half amount anhydrous ethanol to form solution B. Secondly, solution A was dropped bit by bit to the solution B under stirring state, and then the mix solution was stayed for 72 hours for getting TiO_2 Sol. Thirdly, the TiO_2 Sol was poured into petri dishes, and fast dried with the infrared lamp. In the final, TiO_2 was obtained after grinding [9].

1.3 Characterization

Phase analysis was completed on TD-3500 type the X-ray diffraction from Dandong Tongda Company; Raman spectrum was completed on InVia laser Raman spectrometer from Renishaw Company; Microscopic structure test was completed on JMS-6490LV Scanning Electron Microscope.

1.4 Photocatalytic performance

0.2 g TiO_2 powder was added into 50 mg•L^{-1}(120 mL) methyl orange solution of under room temperature. The mixed solution was dispersed under ultrasonic for 20 minutes in dark environment, and mixed solution was shake for 60 minutes under visible light irradiated. In the final, the mixed solution was separated on centrifuge for 5 minutes at the rate of 4000 r/min. Absorbance of solution was measured by Ultraviolet Visible spectrophotometer.

Results and discussion

2.1 Characterization of doped titanium dioxide

Fig.1 was XRD patters of titanium dioxide. Result was analyzed by Jade5.0 software, which shows that the main phase of the titanium dioxide was Anatase, Brookite. Phase analysis show that TiO_2 crystals can be got by Sol method at room temperature.

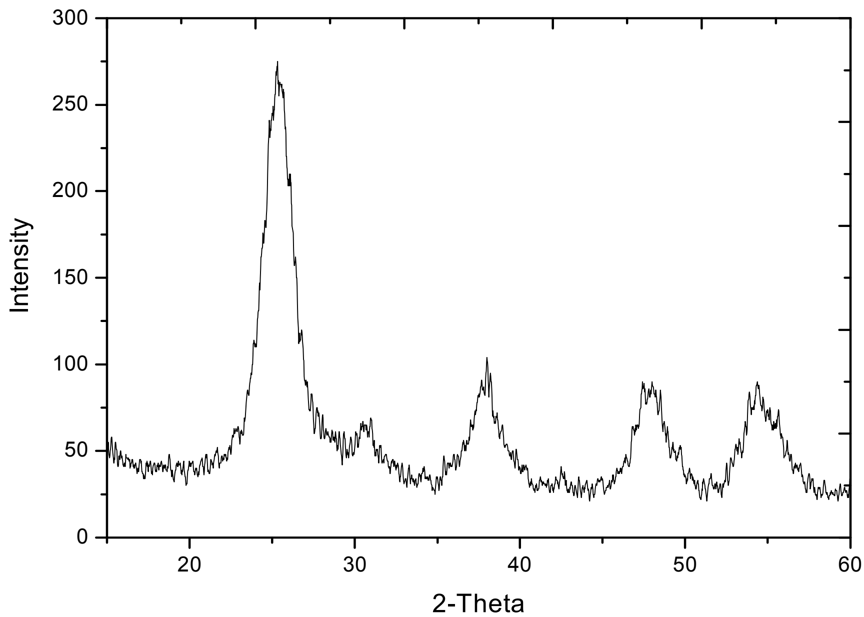
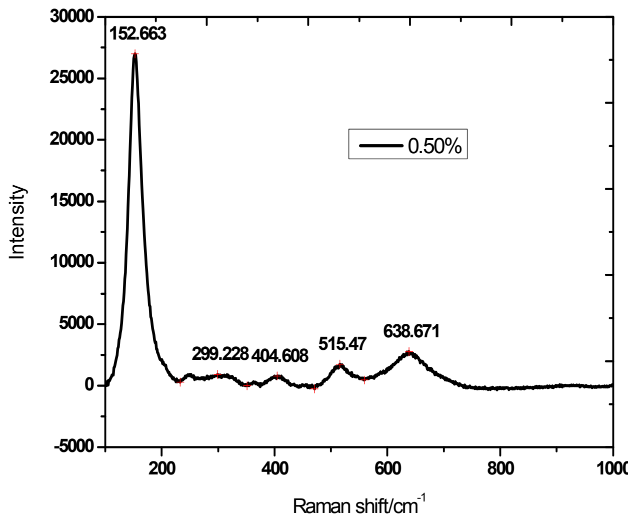


Fig.1 XRD patters of titanium dioxide

Fig.2 was Raman spectra of TiO_2. Fig.2 show that Raman shift of TiO_2 appeared in 152 cm^{-1}, 638 cm^{-1}, 514 cm^{-1} and 404 cm^{-1}. Positions of the Raman shift were relatively close to Anatase. But there is a red shift at 152 cm^{-1}, it may be because TiO_2 contained a certain amount of Brookite. Fig.3 is ultraviolet visible absorption spectrum of TiO_2, which show that absorption performance of TiO_2 for light gradually was strengthened from visible light to ultraviolet wavelength range.



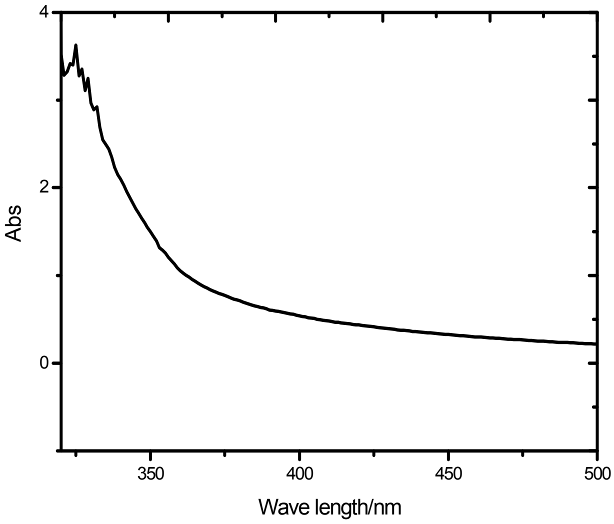


Fig.2 Raman spectra of TiO_2 Fig.3 Uv-vis absorption spectrum of TiO_2

Fig.4 was the SEM photograph of TiO_2. The preparation of TiO_2 by Sol method contained larger particles and small particles. Tiny nano particles were adhered on the surface of the larger particles, which coincided with the results of X-ray diffraction. From Fig.4, we can know that two phases exist in the TiO_2 powers prepared by Sol method at room temperature.

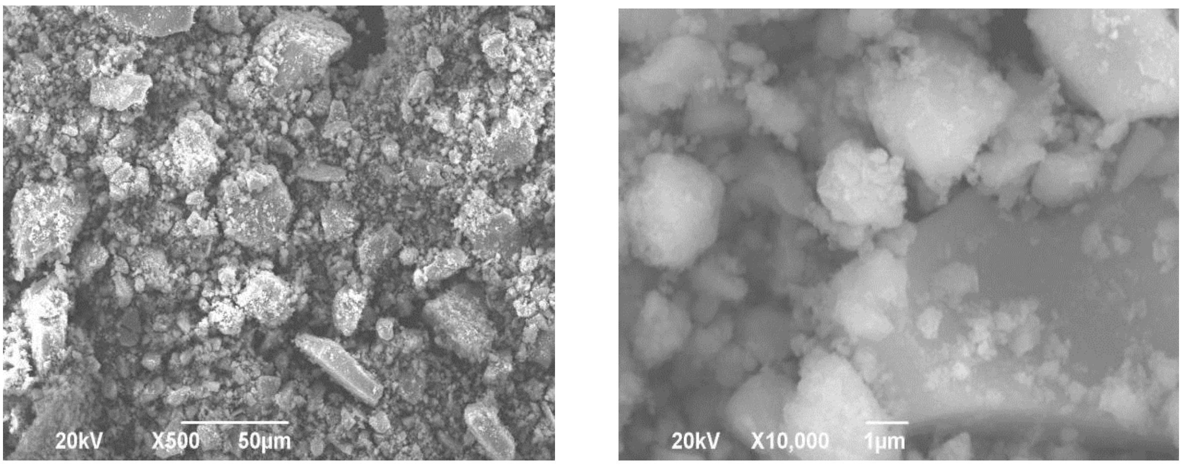


Fig.4 SEM photograph of titanium dioxide

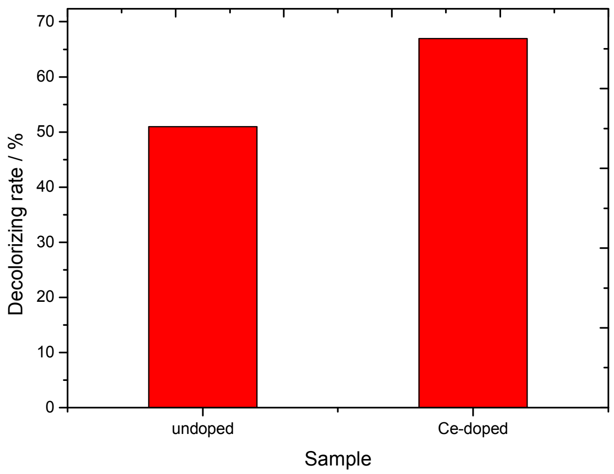


Fig.5 The decolorizing performance of TiO_2 for methyl orange solution

Fig.5 is the decolorizing performance of TiO_2 for methyl orange solution. It shows that Cerium-doped TiO_2 has the better catalytic performance for methyl orange.

Conclusions

Butyl titanate, water and anhydrous ethanol were used as raw materials, cerium doped TiO_2 was prepared by sol method at low temperature. The results show that this method can get TiO_2 crystal under room temperature; Cerium-doped TiO_2 has the better catalytic performance for methyl orange.

Acknowledgements

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