

Development of Nano-TiO₂ Doped by Metals and Applications to Environment Friendly Materials

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Abstract The development of nanometer titanium dioxide was summarized at the beginning. Secondly, preparation methods of nanometer titanium dioxide doped by different metal ions including the work of our group were introduced. Finally applications of nanometer titanium dioxide to environment friendly materials were discussed in order to solve increasing environmental problems relating to wastewater and polluted air.

Key words development, nanometer TiO₂, doping metal ions, environment friendly materials

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Titanium dioxide (TiO₂) has drawn much attention recently in the field of photocatalysis. Nanometer TiO₂ among various semiconductor nanometer particles for photochemical catalysis has characteristics of low cost and non-toxicity, high catalytic activity, moderate priced, strong oxidized ability, good stability and so on, and has out the widespread applied prospect in the chemical industry and environmental protection^[1]. However, TiO₂ as photocatalyst still has some insufficiencies. For example, the light absorption scope is narrow, the compound rate of photoproduction current carrier is high and so forth. Besides, TiO₂ photochemical catalysis activeness is insufficient under the non-illumination condition and the weak ultraviolet ray. Therefore how to enhance photochemical catalysis activeness of TiO₂ becomes a hot spot of researches. The ion-doped is one kind method of enhancing photochemical catalysis effect quite effectively, and it has already obtained great progresses.

1 The development of nano-TiO₂ doped by different metal ions

Hyung et al^[2] investigated Ag deposited TiO₂ nanoparticles under visible and UV light irradiation in order to evaluate and distinguish various effects of the Ag deposition on the TiO₂ photocatalytic activity. Xie et al^[3] reported that Nd³⁺ ion modified TiO₂ sol was prepared by chemical coprecipitation peptization method. Wang et al^[4] prepared Zirconium ions doped titanium dioxide nanocrystal by sol-gel method. Low amount

presence of Zr⁴⁺ could suppress the growth of TiO₂ grains, which resulted in the higher photocatalytic activity of the doped TiO₂. Kallel et al^[5] studied nanoparticles of titanium dioxide co-doped with Y³⁺ and Rb⁺ was prepared using the sol-gel method. An increase in the conductivity of nano-TiO₂ was shown when the samples were co-doped with Y³⁺ and Rb⁺.

Our group prepared TiO₂ thin film co-doped with Ag⁺ and Ce⁴⁺ by sol-gel method regarding tetraethyl orthotitanate as raw material. The synthesized products were characterized as following figures (seen Fig 1 and Fig 2). The results showed that metal ions doped could suppress the size of TiO₂ anatase phase grains, if regard methyl orange solution with PH=4 and c=10 ug/m as a subject of photocatalytic degradation, the photocatalytic activity of TiO₂ and modified by Ag⁺ and Ce⁴⁺ was raised.

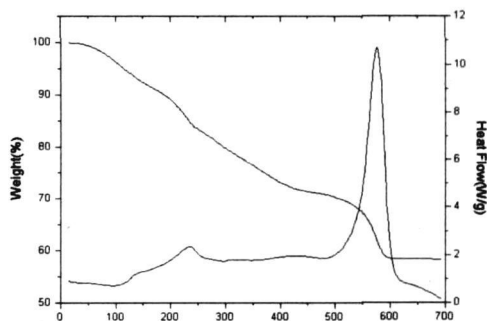


Fig 1 TG-DTA curve TiO₂ co-doped with Ag⁺ and Ce⁴⁺

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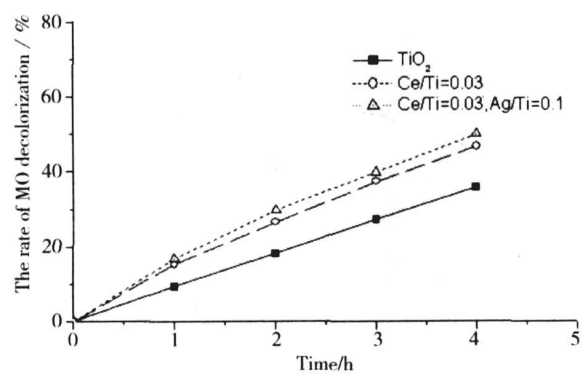


Fig 2 The effect of co-doped Ag^+ and Ce^{4+} on degeneration efficiency

2 Applications of nano- TiO_2 to environment friendly materials

As a new promising technology for eliminating organic pollutants and converting solar light energy into useful chemical energy, Nano- TiO_2 is an excellent photocatalyst with spacious application as an environment friendly material. It can treat manifold pollutants and it widely applies with its merits of decomposing products sufficiently and bringing no secondary pollution.

2.1 Decomposing organic compounds in sewage

There are large amount of organic pollutants in industrial and domestic sewage, especially a great quantity deleterious and harmful matters occurring in industrial sewage. The photocatalysis technology is one kind of more outstanding oxide technology than other traditional chemistry oxide methods, because its oxide ability is strong, oxide process has no selectivity and reactions are completed. Under activating in in situ illumination, catalyzing technology can finish oxidation of CHCl_3 , CCl_4 and C_2Cl_4 in water highly efficiently.

2.2 Depolluting in atmosphere and indoor gases

We make use of the photocatalysis technology to purify air due to following merits: economy, sterilizing and disinfecting broadly. Its effect is better than UV technology and filtration technology simply alone. Atmospheric pollution is to point to the nitrogen oxide and

sulfur hydride that the automobile tail gas and the industrial waste gas mainly. The coating material containing nano- TiO_2 is spread on building outside, whose photocatalysis can oxidize with these gases becoming hydrogen nitrate and sulfuric acid that have lower steam, and they will accompany with rain to be eliminated. Thus the purpose reducing air pollution can be reached.

3 Conclusions

Since nanometer photocatalysis technology is glorified the outstanding merit in the world, lots of countries have been studying and applying it broadly. Some countries and regions applied the photocatalysis technology as degassing means to improve environment. The air purified means in hospital, public facilities and taxi have already began to adopt photocatalyst. The nanometer photocatalysis technology is becoming nanometer science and technology bringing benefit to human beings, forceful implement comparatively long time directly. It will be able to make gigantic contribution in environmental protection.

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纳米 TiO_2 的金属离子掺杂进展及其在环境友好材料中的应用

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摘 要: 概括总结了纳米 TiO_2 的发展, 介绍金属离子掺杂纳米 TiO_2 制备方法, 其中包括本课题组所做的工作。讨论解决日益增长的与废水和空气污染相关环境问题及纳米 TiO_2 在环境友好材料中的应用。

关键词: 进展; 纳米 TiO_2 ; 金属离子掺杂; 环境友好材料

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