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研究论文

低量Yb^{3+}掺杂的TiO_2复合纳米粉体的制备及光催化活性

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摘要 利用酸催化的溶胶-凝胶法制备了纯TiO_2和低量Yb^{3+}(w=0.125%)掺杂的TiO_2复合纳米粉体, 采用XRD, BET, XPS, DRS和SPS等技术进行了表征, 以亚甲基蓝(MB)的光催化降解为探针反应, 评价了其光催化活性, 探讨了低量Yb^{3+}掺杂对TiO_2纳米粒子光催化活性的影响机制. 研究结果表明, 0.125% Yb^{3+}掺杂可以显著提高TiO_2纳米粒子的光催化活性. 低量Yb^{3+}掺杂可以抑制TiO_2由锐钛矿相向金红石相的转变, 阻碍TiO_2晶粒的生长, 改善粉体的表面织构特性, 提高高温组织稳定性. XPS分析表明, Yb^{3+}掺杂可以导致粉体的表面羟基含量增加. SPS分析表明, Yb^{3+}掺杂能够抑制光生e^-/h^+复合, 改善粒子表面的光吸收性能. 与纯TiO_2相比, Yb^{3+}掺杂TiO_2纳米粒子光催化氧化活性的提高应归因于Yb^{3+}掺杂抑制了e^-/h^+复合, 增加了表面羟基含量, 增大了比表面积, 增强了样品表面的光吸收能力.

关键词 纳米TiO_2, Yb^{3+}掺杂 光催化活性 环境净化

分类号

Preparation and Photocatalytic Activities of Low Amount Yb^{3+}-doped TiO_2 Composite Nano-powders

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Abstract Pure TiO_2 and 0.125% (w) Yb^{3+}-doped TiO_2 composite nano-particles were prepared by an acid-catalyzed sol-gel method and characterized by the techniques such as XPS, XRD, BET, DRS and SPS. The photocatalytic degradation of methylene blue (MB) in aqueous solution was used as a probe reaction to evaluate their photocatalytic activity. The mechanisms of effects of low amount Yb^{3+}-doping on the photocatalytic activity of the composite nano-particles were also discussed. The results show that 0.125% Yb^{3+}- doping can significantly enhance the photocatalytic activity of TiO_2 nano-particles. The presence of low amount of Yb^{3+} in TiO_2 can inhibit the phase transformation from anatase to rutile, suppress the growth of TiO_2 grains, raise the specific surface area, and improve the high temperature stabilization of pores in the composite nano-powders as well. The analytical results of XPS indicate that Yb^{3+}-doping can result in the increase in the density of the surface hydroxyl. The analytical results of SPS confirm that Yb^{3+}-doping can inhibit the recombination of the photo-produced electrons and holes, and improve the light absorption properties of the particle surface. Compared with pure TiO_2, the enhanced photocatalytic activity of the Yb^{3+}- doped TiO_2 nano-powders can be due to the inhibition of the recombination of the photo-produced e^-/h^+, the increase of the density of the surface hydroxyl and the specific surface area, and the improvement of the light absorption properties of the particle surface.

Key words nano-sized titania Yb^{3+}-doping photocatalytic activity environmental purification

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