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氮氟掺杂二氧化钛(N,F-TiO_2)的制备及可见光催化活性的研究

Preparation of N, F-codoped TiO_2 and its photocatalytic activity under visible light

关键词：氮氟掺杂 二氧化钛 制备 可见光 催化活性

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摘要：以氨水为氮源,氢氟酸为氟源,采用溶胶-凝胶法制备了氮氟掺杂二氧化钛(N,F-TiO_2)光催化剂,并通过X-射线衍射(XRD)和扫描电镜(SEM)技术对其晶型和形态进行表征.最后以酸性红B为模型污染物,探讨了N和F加入量、焙烧温度、焙烧时间、照射时间、催化剂用量、溶液初始浓度和照射功率等因素对N,F-TiO_2可见光催化活性的影响.结果表明,制备的N,F-TiO_2以锐钛型为主,N和F的掺杂对TiO_2的晶相没有明显改变,但可以扩大TiO_2的可见光响应范围.当N和F的加入量均为2.0%,且在500 ℃下焙烧40 min时,得到的N,F-TiO_2的可见光催化活性明显高于单N或单F掺杂的TiO_2(N-TiO_2或F-TiO_2).对于50 mL浓度为10.0 mg·L^{-1}的酸性红B溶液,当催化剂加入量为1.5 g·L^{-1},128 W光照3.0 h,溶液pH=5.6时,去除率为85.40%.适当延长光照时间至4.0 h,降解率几乎可达100%.另外,研究还证明了N,F-TiO_2催化可见光降解过程中有·OH自由基生成.

Abstract: Preparation of N,F-codoped TiO_2 (N,F-TiO_2) photocatalyst using ammonia water as nitrogen sources and hydrofluoric acid as fluorine sources by sol-gel method was proposed. The crystal form and morphology of the as-prepared photocatalysts were characterized by X-ray diffraction (XRD) and scanning electron microscope (SEM). The influence of N-to-Ti and F-to-Ti molar ratio, calcination temperature and time, irradiation time, catalyst dose, initial concentration of solution and light power on catalytic activity of N,F-TiO_2 under visible light was investigated using acid red B as a model contaminant. The results showed that anatase is the main crystal form of N,F-TiO_2. Also, the doping of nitrogen and fluorine produced no significant change in the crystalline phase of TiO_2, but it could expand the range of response of TiO_2 to visible light. The highest catalytic activity of N,F-TiO_2 could be obtained at 2.0% molar ratio of N,F/Ti while calcining at 500 ℃ for 40 min, and it was obviously higher than that of N-TiO_2 or F-TiO_2. The degradation ratio reached 85.40% for 50 mL solution with 10 mg·L^{-1} acid red B at 1.5 g·L^{-1} N,F-TiO_2 dose, 3.0 h light irradiation, 128 W light power and pH=5.6. The removal ratio could reach nearly 100% by increasing the irradiation time to 4.0 h with no change of other conditions. In addition, the hydroxyl radicals (·OH) were proved to be generated in the catalyzed degradation by N,F-TiO_2 under visible light.

Key words: N F-codoped;TiO_2;preparation;visible light;catalytic activity

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