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研究论文

氟掺杂锐钛矿型TiO_2溶胶的制备、表征及催化性能

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摘要 以四氯化钛为前驱物, 采用改性的沉淀-溶胶-水热晶化法制备了一种具有锐钛矿型结构的氟掺杂的二氧化钛(F-TiO_2)溶胶. 研究了氟掺杂、水热晶化的温度、时间及介质pH值对溶胶粒子的晶型和晶化度的影响. 采用XRD, TG-DTA, TEM, UV-Vis-DRS, FTIR, XPS技术及吸附、表面酸度测定手段对溶胶粒子的结构进行了表征. XRD分析结果表明: 氟的掺入可以降低水热晶化反应的温度或减少反应时间、提高粒子的晶化度, 溶胶粒子具有锐钛矿型结构; TEM分析显示: 粒子呈圆球型, 平均粒径大约为6.5 nm. XPS测定结果表明; 氟在溶胶粒子中以吸附态和结合态两种形式存在; 吸附、表面酸度及光催化活性测定表明: 与P25型TiO_2及纯TiO_2溶胶粒子相比, F-TiO_2溶胶粒子具有更大的吸附能力、更强的表面酸度及更高的光催化活性. 还从光生载流子分离效率等方面探讨了掺杂对催化剂活性影响的机理.

关键词 沉淀-溶胶-水热晶化法 制备 表征 氟 二氧化钛溶胶

分类号

Preparation, Characterization and Photocatalytic Performance of Anatase F Doped TiO_2 Sol

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Abstract A fluorine doped TiO_2 sol (F-TiO_2) was prepared by a modified precipitation-sol-hydrothermal crystallization method using $TiCl_4$ as precursor. The influence of F doping, hydrothermal treating temperature and time, pH values of medium on the morphology and crystallization was studied. The structure of as-prepared F-TiO_2 sol was characterized by XRD, UV-Vis-DRS, TEM, TG-DTA, FTIR, XPS, and adsorption capacity determination and surface acidity determination. It was confirmed by XRD that F-TiO_2 sol particles had anatase crystalline structure; moreover, the addition of fluorine could decrease the temperature and shorten the time of process of hydrothermal crystallization, and improve the crystallization of particle significantly. The TEM images indicated that F-TiO_2 particles in sol were spherical, and the average particle size was *ca.* 6.5 nm. The XPS results showed that fluorine atoms were adopted by TiO_2 sol particles with two forms. One was physically adsorbed on the surface of TiO_2, and the other was embedded into TiO_2 crystal lattice. The experiments of the determination on interfacial adsorption capacity, surface acidity and the photocatalytic activity found that F-TiO_2 sol had stronger surface acidity, higher adsorption capability and good photocatalytic activity for decomposition of rhodamine B than pure TiO_2 sol and P25 TiO_2. Furthermore, the promotion mechanism of fluorine on the photocatalytic activities and structure of TiO_2 was discussed based on the separation efficiency theory of charge carrier.

Key words precipitation-sol-hydrothermal method preparation characterization fluorine titanium dioxide sol

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