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研究论文

N 掺杂富含 (001) 晶面 TiO_2 纳米片的制备及 N 掺杂浓度对可见光催化活性的影响

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摘要 采用水热法制备了富含 (001) 晶面的锐钛矿型 TiO_2 纳米片, 并通过改变热处理过程中 NH_3 流速制备不同 N 掺杂浓度的 TiO_2 纳米片. 运用 X 射线衍射、场发射扫描电镜、高分辨率透射电子显微镜、紫外-可见漫反射光谱、X 射线光电子能谱和荧光光谱对光催化剂进行了结构和性能表征, 并以罗丹明 B 为目标降解物, 考察了 N 掺杂浓度对 TiO_2 纳米片可见光催化活性的影响. 结果表明, NH_3 流速为 40 ml/min 时制备的 N 掺杂 TiO_2 纳米片具有最低的光生电子-空穴复合速率, 最高的•OH 产生能力并表现出最高的光催化活性. 同时, 讨论了 N 掺杂浓度对 TiO_2 纳米片可见光催化活性影响的机理.

关键词: 氮掺杂 二氧化钛纳米片 氮浓度 光催化活性 (001) 晶面

Abstract: Anatase TiO_2 nanosheets with dominant (001) facets were prepared by a simple hydrothermal method. Nitrogen-doped TiO_2 nanosheets (TiO_2-N) with different nitrogen concentration were successfully synthesized by annealing TiO_2 nanosheets in NH_3 atmosphere with different NH_3 flow rate at 400 ° C for 3 h. The morphology, nanostructures, and properties of TiO_2-N were characterized by X-ray diffraction, field emission scanning electron microscopy, high resolution transmission electron microscopy, ultraviolet-visible diffuse reflection spectroscopy, X-ray photoelectron spectroscopy, and photoluminescence. The effects of NH_3 flow rate on the nanostructures, properties, and visible-light photoactivity in the degradation of rhodamine B (RhB) aqueous solution under visible light (λ > 400 nm) irradiation of the prepared photocatalysts were investigated. Among all the prepared photocatalysts including nitrogen modified P25 (Degussa), TiO_2-N prepared with a NH_3 flow rate of 40 ml/min gave the highest visible-light photoactivity because of the dominant (001) facets, visible light responsibility, the slowest photogenerated electron (e^-) and hole (h^+) pairs recombination rate, and the highest hydroxyl radicle (•OH) generation ability. Based on these experiments and analysis, the mechanisms of how the nitrogen concentration affects the visible-light photoactivity of TiO_2-N were proposed.

Keywords: nitrogen doping, titanium dioxide nanosheet, nitrogen concentration, photoactivity, (001) facets

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[1] Fujishima A, Honda K. Nature, 1972, 238: 37

[2] Asahi R, Morikawa T, Ohwaki T, Aoki K, Taga Y. Science, 2001, 293: 269

[3] Fujishima A, Zhang X T, Tryk D A. Surf Sci Rep, 2008, 63: 515

[4] Spadavecchia F, Cappelletti G, Ardizzone S, Ceotto M, Falciola L. J Phys Chem C, 2011, 115: 6381

[5] Liu J W, Han R, Zhao Y, Wang H T, Lu W J, Yu T F, Zhang Y X. J Phys Chem C, 2011, 115: 4507

[6] Xing M Y, Wu Y M, Zhang J L, Chen F. Nanoscale, 2010, 2: 1233

[7] Wu Y M, Liu H B, Zhang J L, Chen F. J Phys Chem C, 2009, 113: 14689

[8] Lu N, Quan X, Li J Y, Chen S, Yu H T, Chen G H. J Phys Chem C, 2007, 111: 11836

[9] Irie H, Watanabe Y, Hashimoto K. Chem Lett, 2003, 32: 772
[10] Liu S W, Yu J G, Wang W G. Phys Chem Chem Phys, 2010, 12: 12308
[11] Ohno T, Mitsui T, Matsumura M. Chem Lett, 2003, 32: 364
[12] Yu J C, Ho W, Yu J G, Yip H, Wong P K, Zhao J C. Environ Sci Technol, 2005, 39: 1175
[13] Yang M J, Hume C, Lee S, Son Y-H, Lee J-K. J Phys Chem C, 2010, 114: 15292
[14] Yang H G, Sun C H, Qiao S Z, Zou J, Liu G, Smith S C, Cheng H M, Lu G Q. Nature, 2008, 453: 638
[15] Amano F, Prieto-Mahaney O-O, Terada Y, Yasumoto T, Shibayama T, Ohtani B. Chem Mater, 2009, 21: 2601
[16] Selloni A. Nature Mater, 2008, 7: 613
[17] Pan J, Liu G, Lu G Q, Cheng H-M. Angew Chem, Int Ed, 2011, 50: 2133
[18] Yu J G, Fan J J, Lü K L. Nanoscale, 2010, 2: 2144
[19] Han X G, Kuang Q, Jin M S, Xie Z X, Zheng L S. J Am Chem Soc, 2009, 131: 3152
[20] Yu J G, Qi L F, Jaroniec M. J Phys Chem C, 2010, 114: 13118
[21] Liu G, Yu J C, Lu G Q, Cheng H M. Chem Commun, 2011, 47: 6763
[22] Liu G, Yang H G, Wang X W, Cheng L N, Pan J, Lu G Q, Cheng H M. J Am Chem Soc, 2009, 131: 12868
[23] Xiang Q J, Yu J G, Wang W G, Jaroniec M. Chem Commun, 2011, 47: 6906
[24] Liu G, Yang H G, Wang X W, Cheng L N, Lu H F, Wang L Z, Lu G Q, Cheng H M. J Phys Chem C, 2009, 113, 21784
[25] Xiang Q J, Yu J G, Jaroniec M. Phys Chem Chem Phys, 2011, 13: 4853
[26] Zhang Y H, Tang Z R, Fu X Z, Xu Y J. ACS Nano, 2010, 4: 7303
[27] Yu J G, Wang B. Appl Catal B, 2010, 94: 295
[28] Yu J G, Wang W G, Cheng B, Su B L. J Phys Chem C, 2009, 113: 6743
[29] Ma X Y, Chen Z G, Hartono S B, Jiang H B, Zou J, Qiao S Z, Yang H G. Chem Commun, 2010, 46: 6608
[30] Jagadale T C, Takale S P, Sonawane R S, Joshi H M, Patil S I, Kale B B, Ogale S B. J Phys Chem C, 2008, 112: 14595
[31] Chen X B, Burda C. J Am Chem Soc, 2008, 130: 5018
[32] Rehman S, Ullah R, Butt A M, Gohar N D. J Hazard Mater, 2009, 170: 560
[33] Liu G, Wang X W, Wang L Z, Chen Z G, Li F, Lu G Q, Cheng H M. J Colloid Interf Sci, 2009, 334: 171
[34] Serpone N, Lawless D, Khairutdinov R. J Phys Chem, 1995, 99: 16646
[35] Nakamura R, Tanaka T, Nakato Y. J Phys Chem B, 2004, 108: 10617
[36] Irie H, Watanabe Y, Hashimoto K. J Phys Chem B, 2003, 107: 5483
[37] Peng F, Cai L F, Yu H, Wang H J, Yang J. J Solid State Chem, 2008, 181: 130
[38] Di Valentin C, Finazzi E, Pacchioni G, Selloni A, Livraghi S, Paganini M C, Giamello E. Chem Phys, 2007, 339: 44
[39] Rengifo-Herrera J A, Mielczarski E, Mielczarski J, Castillo N C, Kiwi J, Pulgarin C. Appl Catal B, 2008, 84: 448
[40] Wu Y M, Xing M Y, Tian B Z, Zhang J L, Chen F. Chem Eng J, 2010, 162: 710
[41] Sathish M, Viswanathan B, Viswanath R P, Gopinath C S. Chem Mater, 2005, 17: 6349
[42] Tian H J, Hu L H, Zhang C N, Liu W Q, Huang Y, Mo L, Guo L, Sheng J, Dai S Y. J Phys Chem C, 2010, 114: 1627

[1] 高伟洁, 郭淑静, 张洪波, 潘秀莲, 包信和.氮掺杂碳纳米管对其负载的 Ru 催化剂上合成氨的促进作用[J]. 催化学报, 2011,32(8): 1418-1423
[2] 罗海英, 聂信, 李桂英, 刘冀锴, 安太成 .水热法合成的介孔二氧化钛的结构表征及其对水中 2,4,6-三溴苯酚的光催化降解活性[J]. 催化学报, 2011,32(8): 1349-1356
[3] 马鹏举, 闫国田, 钱俊杰, 张敏, 杨建军.新型 $N\text{-}TiO_2$ 的固相法制备及其光催化性能[J]. 催化学报, 2011,32(8): 1430-1435
[4] 王仕发, 杨华, 县涛.新型半导体可见光催化剂纳米锰酸钇[J]. 催化学报, 2011,32(7): 1199-1203
[5] 向全军, 余家国.暴露{001}面 TiO_2 纳米片分等级花状结构的制备及其光催化活性[J]. 催化学报, 2011,32(4): 525-531
[6] 路莹, 陈硕, 全燮, 于洪涛.TiO_2/Au 纳米棒阵列的制备及其光催化性能[J]. 催化学报, 2011,32(12): 1838-1843
[7] 朱宝林, 赵伟玲, 曾晨婕, 陈洁, 韩骐伟, 黄唯平.一维 CdS/TiO_2 纳米材料的制备及其光催化性能[J]. 催化学报, 2011,32(10): 1651-1655
[8] 郑华荣, 崔言娟, 张金水, 丁正新, 王心晨.Pt 助剂对 N 掺杂 TiO_2 可见光光催化性能的影响[J]. 催化学报, 2011,32(1): 100-105
[9] 谌春林 1,2, 张建 1, 王锐 1, 苏党生 1, 彭峰 2.氮掺杂多壁纳米碳管的合成和定量表征[J]. 催化学报, 2010,26(8): 948-954

[10] 景文珩;王韦岗;邢卫红.大孔-介孔氮掺杂二氧化钛的制备及其光催化性能测试[J]. 催化学报, 2009,30(5): 426-432

[11] 魏凤玉;桑蕾.高光催化活性和易分离回收的硫掺杂 TiO2 纳米管[J]. 催化学报, 2009,30(4): 335-339

[12] 杨亚辉;陈启元;李洁.B掺杂对K2La2Ti3O10光催化分解水制氢活性的影响[J]. 催化学报, 2009,30(2): 147-153

[13] 李长全;罗来涛;熊光伟 .ZnO纳米管的光学性质及其对甲基橙降解的光催化活性[J]. 催化学报, 2009,30(10): 1058-1062

[14] 程刚;周孝德;李艳;仝攀瑞;王理明.纳米ZnO-TiO2复合半导体的La3+改性及其光催化活性[J]. 催化学报, 2007,28(10): 885-889

[15] 魏凤玉;倪良锁.硼硫共掺杂TiO2的光催化性能及掺杂机理[J]. 催化学报, 2007,28(10): 905-909

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