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研究论文

Pt/BiOCl 纳米片的制备、表征及其光催化性能

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摘要 采用光化学沉积法制备了一系列不同 Pt 含量的新型 Pt/BiOCl 纳米片光催化剂, 运用 N2 物理吸附-脱附、X 射线粉末衍射、扫描电镜、透射电镜、X 射线光电子能谱、光致发光光谱、紫外-可见漫反射光谱等手段对 Pt/BiOCl 进行了表征, 并以 λ = 254 nm 的紫外灯和钨灯为光源, 考察了 Pt 含量对 Pt/BiOCl 光催化降解酸性橙 II 活性的影响. 结果表明, 沉积的 Pt 对 BiOCl 样品比表面积的影响不大, 但可有效增强催化剂对可见光的吸收能力, 显著抑制光生电子与空穴的复合. 当 Pt 含量为 1%~2% 时, 能大幅度提高紫外光下 BiOCl 催化降解染料的活性, 并产生可见光活性. 这是由于 Pt/BiOCl 具有一定的可见光吸收能力, 产生了 Pt 纳米粒子的等离子体光催化作用.

关键词: 铂纳米粒子 铋氧氯 光催化 可见光 酸性橙 II

Abstract: A series of novel Pt/BiOCl nanoplate photocatalysts were synthesized by a photodeposition method. The as-synthesized products were characterized by N_2 physical adsorption, X-ray diffraction, scanning electron microscopy, transmission electron microscopy, X-ray photoelectron spectroscopy, photoluminescence (PL) emission spectroscopy, and UV-Vis diffuse reflectance spectroscopy (DRS). The photocatalytic activity of the samples was evaluated by photocatalytic degradation of acid orange II under both UV light (λ = 254 nm) and visible light irradiation. The N_2 physical adsorption test showed that the deposition of Pt nanoparticles could not produce obvious change in the specific surface area of the catalyst. The UV-Vis DRS results indicated that the presence of Pt nanoparticles could effectively increase the visible light absorption ability of Pt/BiOCl. The PL spectra indicated that Pt could effectively suppress the recombination of photogenerated hole-electron pairs of Pt/BiOCl. Activity tests showed that the deposition of Pt (1%–2%, mass fraction) greatly promotes the UV right photocatalytic activity. Pt also brought about an obvious visible light activity, which could be attributed to the visible light absorption and plasmon photocatalysis role of deposited Pt nanoparticles.

Keywords: platinum nanoparticle, bismuth oxychloride, photocatalysis, visible light, acid orange II

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[1] 向全军, 余家国. 催化学报 (Xiang Q J, Yu J G. Chin J Catal), 2011, 32: 525

[2] 许蕾蕾, 倪磊, 施伟东, 官建国. 催化学报 (Xu L L, Ni L, Shi W D, Guan J G. Chin J Catal), 2012, 33: 1011

[3] 余长林, 杨凯, 舒庆, Yu J C, 操芳芳, 李鑫. 催化学报 (Yu Ch L, Yang K, Shu Q, Yu J C, Cao F F, Li X. Chin J Catal), 2011, 32: 555

[4] 刘晓霞, 樊彩梅, 王韵芳, 王雅文, 张小超, 梁镇海. 中国科学: 化学 (Lui X X, Fan C M, Wang Y F, Wang Y W, Zhang X Ch, Liang Zh H. Sci Sin Chi 2012, 42: 1145

[5] Yu Ch L, Yang K, Shu Q, Yu J C, Cao F F, Li X, Zhou X C. Sci China: Chem, 2012, 55: 1807

[6] Yu Ch L, Fan Q Zh, Xie Y, Chen J Ch, Shu Q, Yu J C. J Hazard Mater, 2012, 237-238: 38

[7] 张寅, 邵芸, 陈欢, 万海勤, 万玉秋, 郑寿荣. 环境科学 (Zhang Y, Shao Y, Chen H, Wan H Q, Wan Y Q, Zheng Sh R. Enviren Sci), 2012, 33: 88

[8] 陈淑海, 徐耀, 吕宝亮, 吴东. 物理化学学报 (Chen Sh H, Xu Y, Lü B L, Wu D. Acta Phys-Chim Sin), 2011, 27: 2933

[9] Asiltürk M, Sayilkan F, Arpaç E. J Photochem Photobiol A, 2009, 203: 64

[10] Yu J G, Yu J C, Cheng B, Zhao X J. J Sol-Gel Sci Technol, 2002, 24: 39

[11] 余长林, 杨凯, Yu J C, 操芳芳, 李鑫, 周晓春. 无机材料学报 (Yu Ch L, Yang K, Yu J C, Cao F F, Li X , Zhou X Ch. J Inorg Mater), 2011, 26: 115

[12] 刘阳, 王晟, 王骋, 许章炼, 陈文兴, 蒋杰, 韦坚红. 催化学报 (Liu Y, Wang Sh, Wang T, Xu Zh L, Chen W X, Jiang J, Wei J H. Chin J Catal), 2010, 485

[13] Jiang J, Zhao K, Xiao X Y, Zhang L Zh. J Am Chem Soc, 2012, 134: 4473

[14] Ai Z H, Ho W K, Lee S C. J Phys Chem C, 2011, 115: 25330

[15] Zhang D Q, Wen M Ch, Jiang B, Li G Sh, Yu J C. J Hazard Mater, 2012, 211/212: 104

[16] Yu Ch L, Zhou W Q, Yu J C, Cao F F, Li X. Chin J Chem, 2012, 30: 721

[17] Yu Ch L, Fan C F, Yu J C, Zhou W Q, Yang K. Mater Res Bull, 2011, 46:140

[18] Wang W D, Huang F Q, Lin X P, Yang J H. Catal Commun, 2008, 9: 8

[19] Shenawi-Khalil S, Uvarov V, Kritsman Y, Menes E, Popov I, Sasson Y. Catal Commun, 2011, 12: 1136

[20] Xia J X, Yin Sh, Li H M, Xu H, Yan Y Sh, Zhang Q. Langmuir, 2011, 27: 1200

[21] Dong F, Sun Y J, Fu M, Wu Zh B, Lee S C. J Hazard Mater, 2012, 219/220: 26

[22] Cao J, Xu B Y, Lin H L, Luo B D, Chen Sh F. Chem Engin J, 2012, 185/186: 91

[23] Liu H, Cao W R, Su Y, Wang Y, Wang X H. Appl Catal B, 2012, 111/112: 271

[24] Yu Ch L, Fan C F, Meng X J, Yang K, Cao F F, Li X. Reac Kinet, Mech Catal, 2011, 103: 141

[25] 余长林, 操芳芳, 舒庆, 包玉龙, 谢志鹏, 余济美, 杨凯. 物理化学学报 (Yu Ch L, Cao F F, Shu Q, Bao Y L, Xie Zh P, Yu J M, Yang K. Acta Phys-Chi Sin), 2012, 28: 647

[26] Klare M, Scheen J, Vogelsang K, Jacobs H, Broekaert J A C. Chemosphere, 2000, 41: 353

[27] Einaga H, Futamura S, Ibusuki T. Environ Sci Technol, 2001, 35: 1880

[28] Sun B, Vorontsov A V, Smirniotis P G. Langmuir, 2003, 19: 3151

[29] Teoh W Y, Mädler L, Amal R. J Catal, 2007, 251: 271

[30] Fleisch T H, Zajac G W, Schreiner J O, Mains G J. Appl Surf Sci, 1986, 26: 488

[31] Langhammer C, Yuan Zh, Zori? I, Kasemo B. Nano Lett, 2006, 6: 833

[32] Xiong Y J, Chen J Y, Wiley B, Xia Y N, Yin Y D, Li Zh Y. Nano Lett, 2005, 5: 1237

[33] Chen J Y, Wiley B, McLellan J, Xiong Y J, Li Zh Y, Xia Y N. Nano Lett, 2005, 5: 2058

[34] Kim Y I, Atherton S J, Brigham E S, Mallouk T E. J Phys Chem, 1993, 97: 11802

[35] Dai G P, Yu J G, Liu G. J Phys Chem C, 2011, 115: 7339

[1] 许士洪, 谭东栋, 鲁巍, 时鹏辉, 毕得福, 马春燕, 上官文峰.液相沉积法制备可磁分离复合光催化剂纳米球及其催化性能[J]. 催化学报, 2013,34(2): 367-372

[2] 冯连荣, 胡丰田, 刘成宝, 陈丰, 徐楠, 刘守清, 陈志刚.活性炭-铁酸镍磁性催化剂的光催化性能[J]. 催化学报, 2012,33(8): 1417-1422

[3] 丛燕青, 李哲, 张轶, 王齐, 徐谦, 伏芳霞.Fe_2O_3/TiO_2 纳米管的制备及其光电催化降解染料废水性能[J]. 催化学报, 2012,33(8): 1402-1409

[4] 许蕾蕾, 倪磊, 施伟东, 官建国.可分散的 In_2O_3/Ta_2O_5 复合光催化剂的制备及其光催化制氢性能[J]. 催化学报, 2012,33(7): 1101-1108