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研究论文

柠檬酸辅助水热法制备可见光高效去除甲基橙的 Bi_2WO_6 纳米片

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摘要 以 $Bi(NO_3)_3 \cdot 5H_2O$ 和 $Na_2WO_3 \cdot 2H_2O$ 为原料, 以柠檬酸为络合剂, 采用辅助水热法制备了 Bi_2WO_6 纳米片, 运用 X 射线衍射、扫描电镜、场发射高分辨透射电镜、拉曼光谱、红外光谱和紫外-可见漫反射光谱等手段对样品进行了表征, 并考察了该催化剂光催化去除甲基橙反应性能. 结果表明, 通过调节体系的 pH 值可制得结晶度良好的正交晶系钨铋矿型结构的 Bi_2WO_6 纳米片状晶体. 柠檬酸的添加使得制备的 Bi_2WO_6 颗粒的拉曼光谱特征峰发生蓝移, 紫外-可见光吸收边发生红移, 其能带隙减小至 2.55 eV. 光催化反应结果表明, 催化剂制备时体系 pH 值是影响其可见光催化活性的主要因素, pH = 7.0 时制备的 Bi_2WO_6 纳米片光催化效率最高, 可见光照射 15 min, 浓度为 10 mg/L 甲基橙溶液的降解率可达到 100%, 且循环使用 5 次后, 其光催化活性并没有明显降低, 表明 Bi_2WO_6 是一种稳定有效的可见光催化剂.

关键词: 钨酸铋 水热法 柠檬酸 纳米片 光催化 甲基橙

Abstract: Bi_2WO_6 nanosheets with highly efficient photocatalytic activity under visible light irradiation were prepared by a hydrothermal method using $Bi(NO_3)_3 \cdot 5H_2O$ and $Na_2WO_3 \cdot 2H_2O$ as starting materials and citric acid as the chelating agent. The properties of the as-prepared samples were investigated by X-ray diffraction, field emission high resolution transmission electron microscopy, Raman spectroscopy, and UV-Vis diffusion reflectance spectroscopy. The photocatalytic properties of the Bi_2WO_6 catalyst were also investigated. The results show that Bi_2WO_6 nanosheets with orthorhombic structure can be obtained by adjusting the pH value of the reaction system. Compared with the Bi_2WO_6 catalyst prepared without citric acid, the Raman bands of the nanosheets assisted with citric acid present blue shift and show a significant red shift in the absorption band and its band gap was narrowed to 2.55 eV. The pH value of the reaction system is the main factor affecting the visible light-driven photocatalytic activity. The Bi_2WO_6 sample prepared at pH = 7.0 shows a higher photocatalytic activity. Over this catalyst, the 100% degradation of methyl orange solution (10 mg/L) is obtained after visible light irradiation for 15 min. In addition, after 5 recycles, there is no significant decrease in its photocatalytic activity, indicating that Bi_2WO_6 is a stable photocatalyst for degradation of methyl orange under visible light irradiation.

Keywords: tungsten acid bismuth, hydrothermal synthesis, citric acid, nanosheet, photocatalysis, methyl orange

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