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研究论文

影响 TiO_2 纳米管光电催化还原 Cr(VI) 的因素探讨

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- 摘要
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摘要 采用阳极氧化法在 Ti 基底上生长 TiO2 纳米管 (TNT) 阵列薄膜, 利用扫描电镜和 X 射线衍射对样品的形貌和结构进行了表征. 以 TNT 薄膜为光阳极、Ti 网为光阴极, 在酸性条件下进行紫外光光电催化还原 Cr(VI), 探讨了外加偏压、NaCl 浓度、柠檬酸浓度以及 Cr(VI) 初始浓度对反应性能的影响. 结果表明, 外加电压有效地促进了电子和空穴的分离, 使 Cr(VI) 的光电催化还原效率明显高于光催化; NaCl 的引入增加了体系的导电性, 可在一定程度上提高 Cr(VI) 的光电还原反应速率. 另外, 柠檬酸作为空穴捕获剂可有效地捕获光生空穴, 在一定浓度范围内, Cr(VI) 的光电还原反应速率随柠檬酸浓度的增加而增加. 在 1.5 V 偏压, 1.0 mol/L NaCl, 0.5 mmol/L 柠檬酸条件下, 初始浓度为 17.7 mg/L 的 Cr(VI) 反应 60 min 时, 其转化率达到 98.6%.

关键词: 二氧化钛纳米管 六价铬 光电催化 还原

Abstract: TiO_2 nanotube (TNT) arrays present excellent light trapping and electronic conduction ability. TNT film was prepared by the anodic oxidation method using Ti slice as the substrate. The morphology and structure of the TNT film were characterized by scanning electron microscopy and X-ray diffraction, respectively. Photoelectrocatalytic (PEC) reduction of Cr(VI) was carried out using the TNT arrays as the photoanode and Ti mesh as the photocathode under acid conditions and ultraviolet light irradiation. The influencing factors such as applied voltage, NaCl concentration, citric acid concentration, and Cr(VI) initial concentration were investigated. The applied voltage facilitates the separation of electron-hole pairs, making the PEC reaction rate of Cr(VI) much higher than that of photocatalysis. The introduction of NaCl increases the electrical conductivity of solution, getting enhanced PEC reaction rate of Cr(VI) to some extent. Citric acid, behaving as the hole scavenger, can capture photogenerated holes effectively. The PEC reaction rate of Cr(VI) increases with increasing citric acid concentration in a certain range. Under the conditions of 1.5 V voltage, 1.0 mol/L NaCl, and 0.5 mmol/L citric acid, the conversion of 17.7 mg/L Cr(VI) achieved 98.6% at 60 min irradiation.

Keywords: titania nanotube, chromium (VI), photoelectrocatalysis, reduction

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