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研究论文

CdS/TiO_2 纳米管可见光催化剂的制备、表征及光催化活性

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摘要 以纳米颗粒 TiO_2 (P25) 为原料, 采用水热合成法制备了具有锐钛矿晶型的 TiO_2 纳米管 (TNTs), 考察了水热反应温度和焙烧温度对 TNTs 形貌和结构的影响. 以具有双官能团结构的有机分子 2-巯基丙酸为偶联剂, 采用原位合成和在线组装的方法将 CdS 量子点 (QDs) 负载于 TNTs 上, 制得了 CdS/TNTs 可见光催化剂, 研究了 2-巯基丙酸浓度对 CdS 负载量和 CdS/TNTs 光催化活性的影响. 结果表明, 在水热温度为 150 °C, 焙烧温度为 400 °C 的条件下, 可制得管径为 8~10 nm, 管壁为 2~3 nm, 管长为数百纳米的锐钛矿型 TNTs. 经 CdS QDs 修饰后, TNTs 的吸收阈值拓展至 580 nm, 在模拟可见光照射下, CdS/TNTs 表现出优异的光催化降解罗丹明 B 性能.

关键词: 二氧化钛 纳米管 光催化剂 硫化镉 量子点 罗丹明 B 2-巯基丙酸 降解

Abstract: A typical hydrothermal synthesis was employed to prepare titania nanotubes (TNTs) with anatase crystal structure using P25 as a raw material. The effects of hydrothermal reaction temperature, calcination temperature on the morphology and crystal structure of TNTs were investigated. CdS quantum dots (QDs) formed in situ were assembled onto the surfaces of TNTs to form CdS/TNTs nanocomposite photocatalyst by using bifunctional organic linker, thiolactic acid. The effects of thiolactic acid concentration on the loading amount of CdS QDs and photoactivity of CdS/TNTs nanocomposite were also studied. The results indicated that when the hydrothermal reaction and calcination temperatures were 150 and 400 ºC, respectively, TNTs have anatase crystal structure with following unique properties, an average diameter of about 8–10 nm, the length of several hundred nanometers with uniform inner and outer diameter along the length direction, tube wall with multilayer structure of about 2–3 nm. After modification with CdS QDs, the absorption of CdS/TNTs nanocomposite in visible light area was enhanced greatly, compared with that of TNTs. The absorption edge of CdS/TNTs was extended to 580 nm. The CdS/TNTs exhibited excellent photocatalytic performance for RhB degradation under visible light irradiation simulated by halogen tungsten lamp.

Keywords: titania, nanotube, photocatalyst, cadmium sulfide, quantum dot, rhodamine B, 2-thiolactic acid, degradation

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