

Fe₂O₃/TiO₂ 纳米管的制备及其光电催化降解染料废水性能

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摘要 采用阴极电沉积和阳极氧化法制备了 Fe₂O₃ 改性 TiO₂ 纳米管 (Fe₂O₃/TiO₂-NTs) 电极, 运用场发射扫描电子显微镜、透射电子显微镜、X 射线衍射和紫外-可见漫反射光谱等手段对其进行了表征, 考察了其光电化学性能, 并研究了复合电极光电催化降解甲基橙染料废水的反应性能。结果表明, Fe₂O₃ 的负载成功地将 TiO₂-NTs 的光响应区间拓宽到可见光区域, Fe₂O₃/TiO₂-NTs 复合电极的光电流密度达到 TiO₂-NTs 电极的 3 倍。在光电催化反应中, Fe₂O₃/TiO₂-NTs 复合电极对甲基橙的脱色效果明显优于 TiO₂-NTs 电极, 以 Fe₂O₃/TiO₂-NTs 为阳极, 光照 5 min, 甲基橙溶液的脱色率可达 90% 以上。

关键词: 氧化铁 二氧化钛 纳米管 光电催化 可见光 甲基橙 降解

Abstract: The Fe₂O₃/TiO₂ nanotubes electrode was prepared using cathodically electrochemical deposition and anodic oxidation method. The properties of the composite electrode were characterized by scanning electron microscopy, transmission electronic microscope, X-ray diffraction, and UV-Vis diffuse reflectance spectroscopy. The decolorization of methyl orange was investigated using the composite electrode as a photoanode. The results indicated that Fe₂O₃ nanoparticles were uniformly dispersed on the surface of TiO₂ nanotubes electrode. The adsorption edge of the composite electrode exhibited a red shift compared with the pure TiO₂ nanotubes electrode. In addition, Fe₂O₃/TiO₂ nanotubes electrode showed higher current density than TiO₂ nanotubes electrode under irradiation. It indicated that the metal oxide modification successfully broadened the absorption spectrum of TiO₂ nanotubes to the visible light region. Moreover, it was in favor of the separation of photo-induced electron-hole pairs. The Fe₂O₃/TiO₂ nanotubes electrode performed higher photoelectrocatalytic activity for the degradation of methyl orange. Furthermore, it was found that methyl orange had a higher decolorization rate under the acidic condition. When the initial pH value was 3, the decolorization rate of methyl orange solution could reach 91.7% under the light irradiation for 5 min.

Keywords: ferric oxide, titania, nanotube, photoelectrocatalysis, visible light, methyl orange, degradation

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