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纳秒脉冲激光/纳米金悬浮体系催化降解2,4,5-TCP

Catalytic degradation of 2,4,5-trichlorophenol in aqueous suspensions of gold nanoparticles using nanosecond pulsed laser

关键词: [脉冲激光](#) [纳米金](#) [2,4,5-三氯苯酚](#) [降解](#)基金项目: [天津市科技兴海项目\(No.KJXH2011-11\)](#); [国家自然科学基金\(No.20777052\)](#)

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摘要: 以脉冲激光为光源、纳米金为催化剂,对2,4,5-三氯苯酚(2,4,5-TCP)进行了光催化降解研究,测定了其反应动力学参数,确定了该降解体系中2,4,5-三氯苯酚的单位能量降解率和平均反应速率。EDX能谱和透射电镜表征结果表明,已成功制备了纳米金颗粒,形态主要呈球状,粒径分布均匀,大小在15~20 nm之间。以亚甲基蓝为底物对纳米金的光催化性能进行了表征,结果表明,所制备的纳米金具有较好的催化性能,添加纳米金组比对照组的亚甲基蓝脱色率增加了约15.7%。以2,4,5-TCP为底物时,脉冲激光照射40 min,最高催化降解率约为85%,单位能量降解率为 $0.18256\% \cdot J^{-1}$,平均反应速率为 0.04667 min^{-1} ,反应符合准一级动力学方程 $\ln(C_0/C_t) = -0.1141 + 0.04667t$ 。

Abstract: Using 266 nm nanosecond pulsed laser, the degradation of 2,4,5-trichlorophenol in aqueous suspensions of gold nanoparticles (GNs) was studied. The photocatalytic degradation dynamics of 2,4,5-trichlorophenol irradiated by nanosecond pulsed laser were modeled. The degradation rate per unit energy and the average reaction rate were also investigated. The energy-dispersive X-ray spectroscopy and transmission electron microscopy results show that GNs were successfully prepared. The prepared GNs were mainly spherical, having a uniform particle-size distribution between 15~20 nm. The photocatalytic ability of GNs was characterized using methylene blue as substrate. The prepared GNs showed good catalytic performance. The decolorization rate has increased by about 15.7% by the addition of GNs. When 2,4,5-trichlorophenol was used as substrate, the highest degradation rate of 85% was reached after reacting for 40 minutes. Besides, the degradation rate per unit energy and the average reaction rate were $0.18256\% \cdot J^{-1}$ and 0.04667 min^{-1} , respectively. Furthermore, the degradation processes of 2,4,5-trichlorophenol followed pseudo-first order kinetics.

Key words: [nanosecond pulsed laser](#) [gold nanoparticle](#) [2,4,5-trichlorophenol](#) [degradation](#)

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