化学学报 1993 51 (2): 161-165 ISSN: 0567-7351 CN: 31-1320/06

氯分子束与钛表面激光化学反应动力学

卢平和,秦启宗

复旦大学激光化学研究室

收稿日期 修回日期 网络版发布日期 接受日期

摘要 本文采用飞行时间质谱技术测定了在紫外(355nm), 可见(560nm)和近代红外(1064nm)脉冲激光作用下, 氯分子束与Ti表面反应产物的质量分布和速度分布。所得结果表明, 不同波长激光诱导反应的主要产物相同, 有Ti, TiCl, TiCl3和TiCl4。在高能量密度的紫外激光作用下, 首次测得具有很高动能的原生Ti+。各种含Ti氯化物的飞行时间谱, 能满意地用单组分或多组分Maxwell-Boltzmann公式拟合和分析。上述激光诱导气-固表面反应的机理主要由氯分子在Ti表面上的解离吸附, 吸附态氯原子在表面上生成TiClx(X=1～4)的连串反应以及激光诱导脱附所组成。近红外激光主要引起热脱附, 而紫外激光的作用还原可能有非热脱附过程。

关键词 反应机理 反应动力学 氯 钛 激光化学 分子束 表面反应 金属表面 飞行时间谱

分类号 0643

Dynamics of laser-induced reactions of Cl2 molecular beam with a titanium surface

LU PINGHE,QIN QIZONG

Abstract A mass selected time-of-flight (TOF) technique has been used to determine the mass distribution and velocity distribution of the reaction products of Cl2 molecular beam reacted with a Ti surface under pulsed UV (355nm), Vis (560nm) and near IR (1064nm) laser irradiation.the results show that the main reaction products, such as Ti, TiCl, TiCl3 and TiCl4are the same for different wavelength of laser radiations. the genuine Ti+ ions with high kinetic energy have been detected for the first time under the UV laser irradiation at high laser fluence. all of the TOf spectra for the Ti-contained chlorides can be fitted satisfactory with singly-or multi-component maxwell-boltzmann distribution.A mechanism with three steps, which mainly involves the dissociative chemisorption of the Cl2 molecules on the Ti surface, the consecutive reactions of the adsorbed Cl atoms to form TiClx(X=1～4) on the surface and the laser-induced desorption processes has been employed to explain the results of these laser-induced gas-surface reactions. it is found that the laserinduced thermaldesorption play a dominant role for the 1064nm laser irradiation, while competing nonthermal desorption processes are also important for the 355nm case.

Key words REACTION MECHANISM REACTION KINETICS CHLORINE TITANIUM LASER CHEMISTRY MOLECULAR BEAM SURFACE REACTION TIME OF FLIGHT SPECTRA

DOI:

通讯作者