Infrared multiphoton dissociation of methanol

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In this paper the experiment of IR multiphoton dissociation for CH_3OH was reported, which was carried out with focused irradiation of oscillation line in 9.6μm band from tunable TEA CO_2 laser. The authors have observed the relation between dissociation rate and pulse number, pulse energy, initial pressure of methanol vapor and spectral line frequecy.

Principal results of the experiment are as follows.

1. All the dissociation rates are approximately proportional to the pulse numbers under irradiation at three different laser frequences (1033.48 cm^{-1}, 1037.44 cm^{-1}, 1037.28 cm^{-1}). The disociation rate coefficient $C=-\frac{1}{n}\ln(p/p_0)$ slightly decreases with n increasing and is different for respective frequency. General order of magnitude for c is about 10^{-4}. per pulse.

2. The dissociation rates are proportional to the three-second power of pulse energy. Because an irradiation power density at focal spot is much more than the threshold power density in our experiment, it is satisfactory that $-\ln(p/p_0)$ is proportional to $E^{3/2}$. This situation is the same as in SF_6 system.

3. The dissociation rates increase linearly with initial pressure. In our experimental pressure range the result that the dissociation rate increases with rising of the initial pressure P_0 shows that the collisions considerably contribute to the dissociation. There maybe two kinds of typical machanism with which collisions effect on the dissociation: Collision reduced "throat" effect and V-V energy transfer.

4. The curve of dissociation rate with frequency is similar to that of linear absorption spectrum, but relative change of the former is weaker than the latter.

甲醇红外多光子离解

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本文报道用选频 TEA CO_2 激光器 9.6μ 波段振荡谱线聚焦辐照甲醇蒸汽实现红外多光子离解的实验。测定了离解速率对脉冲数目、脉冲能量、甲醇蒸汽的初始压力及激光谱线频率的依赖关系。

实验的主要结果有：

1．在三个不同激光频率（1033.48cm^{-1}，1037.44cm^{-1}，1073.28cm^{-1}）辐照下，离解速率 $-\ln(P/P_0)$ 都随脉冲数 n 增加近似成比例地增加。离解速率系数 $c=-\frac{1}{n}\ln(P/P_0)$ 随 n 增加而略有减小，且对不同频率有不同的值。一般 c 的数量级为 10^{-4} 每脉冲。

2．离解速率与脉冲能量的 3/2 幂成比例。由于在本实验中焦斑处辐射功率密度远大于离解阈值功率密度，与 SF_6 中情形一样，$-\ln(P/P_0)$ 对 $E^{3/2}$ 的正比关系很好满足。

3．离解速率随 P_0 线性增加。在本实验压力范围内离解速率随 P_0 增加而上升说明碰撞对于离解有明显贡献。这里碰撞作用可能有两种代表性机制：碰撞消除“喉道”效应和 V-V 能量转移。

4．离解速率随激光谱线频率变化与线性吸收谱的轮廓一致，但前者相对变化比后者弱得多。