Infrared lasers as a way for selective chemistry and isotope separation

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Unimolecular reactions induced by the absorption of multiple quanta of monochromatic infrared radiation (hereafter URIMIR) are a new focal point in chemical dynamics. Whereas much of the effort in this field is directed toward the unravelling of the details of the mechanism by which a single molecule can absorb many tens of infrared photons, applications in the areas of isotope separation, selective chemical reactions, and chemical kinetics are rapidly developing.

In the current paper we review the currently accepted model for URIMIR, accentuating the two limiting cases of an early bottleneck in the discrete states and a bottleneck near the reaction threshold.

A quantitative description of URIMIR in terms of the energy grained master equation is discussed. The theoretical results are compared with some new experiments on the time dependence of the URIMIR yield, and the average number of photons absorbed per molecule.

Recently discovered effects of an applied magnetic field on the reaction yield and the isotopic selectivity are shown.

Finally, a short discussion of the criteria for effective isotope separation using URIMIR is presented.

红外多光子离解和同位素分离

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单色红外辐射多量子吸收引发的单分子反应(URIMIR)是化学动力学中的一个新的重点课题。而目前在该领域中进行的大部分研究工作集中以下几方面：弄清单分子吸收多达几十个红外光子的详细机理，在冈位素分离领域中的应用，以及选择性化学反应等，化学动力的研究正在迅速发展。

本文评述了目前已被接受的 URIMIR 模型，重点是两种极限情况—即不连续态中的早期瓶颈效应以及接近反应阈值时的瓶颈效应。

用能量获得主方程对 URIMIR 进行了定量描述。把最近得到的 URIMIR 产额与时间的关系、每个分子所吸收的平均光子数的实验结果与理论预言作了比较。

还给出了外加磁场对反应产额及冈位素选择性的影响的近来的研究结果。

最后对有效冈位素分离的判据作了扼要讨论。