Kinetics of rare gas halide lasers

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Rare gas halide lasers have advanced greatly the performance of near and middle UV gas lasers. Although the excited molecule is created in rather simple gas mixtures by discharge or electron-beam excitation, the complex kinetic processes which govern formation, fluorescence and collisional quenching have been obscure. Measurements to quantify these processes must be made.

These measurements have been aimed initially toward obtaining the radiative lifetimes and quenching rate constants of those excimer molecules for which the stable di-halide molecule (RX_2) exists. By fast photolytic dissociation of the dihalide, the rare gas monohalide (RX) molecule can be produced in surroundings containing a single predominant quenching gas without involving a complex formation process. This technique has produced radiative lifetimes and quenching rate constants for XeF (B and C,) KrF (B) and several of the mercury halides.

While synthesis of other dihalides of interest may be possible, formation and quenching measurements also can be obtained by studying the emission and absorption characteristics of the excimer. By probing the absorption of XeCl ($X \rightarrow B$) transition, destruction rate constants for the lowest vibrational levels of XeCl have been measured. These rates have little dependence on vibrational level suggesting the conclusion that the vibrational levels rapidly equilibrate.

Observations of the time dependent XeCl fluorescent emission as a function of gas mixture confirms the theoretical conclusion that two paths of formation exist, an ionic path and a metastable path. It is seen that with an adequate halogen density the ionic path dominates. It appears possible to investigate the kinetics of the transient species in each formation path by means of the emission and absorption techniques now developed. Further results of these studies will be included.

稀有气体卤化物激光动力学

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稀有气体卤化物激光器大大提高了近紫外和中紫外激光器的性能。虽然受激分子是在比较简单的气体混合物中利用放电或电子束激励形成的，但是支配其形成过程、荧光以及碰撞猝灭的复杂动力学过程还不十分清楚。因此必须对这些过程进行定量的测量。

这些测量最初是以获得那些存在稳定的二卤化物分子(RX_2)的受激准分子辐射寿命和猝灭率常数为目的的。利用二卤化物的快速光分解，稀有气体—卤化物（RX）分子能在含有一种占优势的猝灭气体的环境中产生，而不牵涉复杂的形成过程。这种技术已用来测量XeF（B和C）、KrF（B)和几种汞卤化物的辐射寿命和猝灭率常数。

当可能合成其它感兴趣的二卤化物时，也可以通过研究准分子的发射与吸收特性来获得形成与猝灭的测量。通过探测XeCl（X→B)跃迁的吸收，已测得XeCl最低振动能级的离解率常数。这些速率很少依赖振动能级，从而使我们得出了振动能级快速平衡的结论。

和时间有关的XeCl荧光发射作为气体混合比的函数的实验观察，进一步证实了存在两种形成途径的理论，一种是离子途径，一种是亚稳态途径。可以看到当卤素密度合适时离子途径是主要的。利用目前发展的发射与吸收技术似乎可能研究每一种形成途径的瞬时粒子的动力学过程。本文也将讨论这些研究的进一步结果。