Rare gas and mercury halide lasers

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Rare gas and mercury halide lasers have introduced new opportunities for achieving efficient scalable lasers at ultraviolet-visible wavelengths. The rare gas halide lasers such as KrF and ArF were originally demonstrated in electron-beam pumped mixtures of high pressure rare gases with halide donor species and mercury vapor in the case of HgCl and HgBr mercury halide lasers. This method of excitation forms the laser molecule directly in the excited state via ion-ion recombination, for expample $Kr^+$and F^- or Hg^+ and Cl^-. For this reason the formation kinetics of KrF* and HgCl* in e-beam pumped mixtures exhibit many similarities. Since these ionic formation channels require ~ 25 eV to produce the positive ion, a formation efficiency of approximately 20% for KrF and 9% for HgCl is possible. A review of laser experiments and kinetics measurements will be presented for e-beam pumped KrF and HgCl lasers. A general overview of scaling considerations resulting from these small scale experiments will be presented for KrF lasers.

The use of e-beam sustained discharges to excite these lasers has received attention as a method to achieve increased laser efficiency and will also be discussed. For example, the pumping of mercury metastables by ~ 5 eV discharge electrons leads to HgCl* formation via metastable collisions with halide donor molecules. In this case, a formation efficiency of $\sim 45\%$ for HgCl is possible.

Additional methods of producing mercury halide lasers will be reviewed. These include photolytic and avalanche discharge pumping of mercury dihalide vapors (HgX_2) which have produced lasing in HgCl, HgBr and HgI. Both techniques will be discussed and a review of recent lasing experiments will be presented.

稀有气体和汞卤化物激光器

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稀有气体和汞卤化物激光器为在紫外-可见波段的高效率的可按比例扩大的激光器创造了新的机会。稀有气体卤化物激光器，例如 KrF、ArF，最初是在电子束泵浦含卤素施主，在HgCl、HgBr汞卤化物激光器情况下汞蒸气的高压稀有气体混合物中被证实的。这种激励方法直接在激发态通过离子-离子复合生成激光分子，例如Kr^+和F^-或Hg^+和Cl^-。正因为如此，在电子束泵浦的混合物中，KrF* 和 HgCl 的形成动力学表现了许多相似性。由于这种电离形成渠道需要～25电子伏以产生正离子，所以对于 KrF，其形成率可能是20%左右，对于 HgCl 可能是9%左右。本文将对电子束泵浦的 KrF 和 HgCl* 激光器的激光实验和动力学测量作一评述。同时对KrF 激光器在这些小规模的实验基础上进行按比例扩大的考虑作一般的考察。

利用电子束维持放电来激励这些激光器作为一种提高激光效率的方法受到了人们的注意，本文对此也作了讨论。例如利用～5电子伏的放电电子束泵浦汞的亚稳态，结果通过与卤化物施主分子与亚稳态碰撞生成了 HgCl*，这种情况下，HgCl 的形成效率就可能达45%左右。

本文还评述了另外一些产生汞卤化物激光器的方法。其中包括光分解和雪崩放电泵浦汞二卤化物蒸气(HgX_2)，这种方法已在 HgCl、HgBr 和 HgI 中产生了激光作用。本文特别讨论这两种技术，并评述最近的一些激光实验。