Studies of tunable electron beam pumped excimer lasers

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Recently there has been considerable interest in diatomic and triatomic excimer lasers capable of UV and visible wavelength tunability. In this report the characteristics of two new blue-green electron beam pumped lasers, XeF ($C \rightarrow A$) [1] and Xe_2 Cll [2] will be described.

The experiments were carried out in a stainless steel cell attached to the field emission diode of a Pulserad 110 electron beam generator [3] . A beam of 1 Mev electrons with a pulsewidth of 10 nsec (FWHM) and a current density of 0.8 KA/cm² was injected transversely into the laser medium through a 50 micron thick titanium foil over an area of 10 cm². Sapphire vacuum windows were placed external to a high-Q cavity, thereby avoiding reflection losses which are significant for a low gain laser medium.

Detailed spectral and temporal fluorescence gain and laser measurements of high pressure Ar, Ne/Xe/NF_3 and Ar, Ne/Xe/CCl_4 mixtures for the $B \rightarrow X$ and C A transitions of XeF centered at 353 and 586 nm and for XeCl and Xe_2Cl transitions at 308 and 515 nm respectively are reported.

The peak output power of the XeF ($C \rightarrow A$) laser for an optimized mixture of 16 torr Xe, 8 torr NF_3 and 600 kPa Ar was of the order of 5 kw with a FWHM spectral bandwidth of 12 nm. For the triatomic Xe_2 Cl laser the peak output power was also several kW with a bandwidth of 30 nm for the same electron beam current density. Both laser spectra showed significant enhanced intracavity features due to the atomic and molecular absorption characteristics of the Ar or Ne diluents and to transient absorptions of other components (Xe, NF_2, CCl_4). Wavelength tunability of these lasers can be obtained by a suitable dispersive element such as a Littrow prism, grating or filter.

References

[1] W. E. Ernst and F. K. Tittel, Appl. Phys. Lett. 35, 36 (1979).
[2] F. K. Tittel, W. L. Wilson, R. E. Stickel, G. Marowsky, and W. E. Ernst, submitted to Appl. Phys. Lett.
[3] G. Marowsky, R. Cordray, F. K. Tittel, and W. L. Wilson, Appl. Optics 17, 3491 (1978).

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可调谐电子束泵浦准分子激光器的研究

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最近人们对在紫外和可见波段可调谐的双原子和三原子准分子激光器产生了很大的兴趣。在本报告中特描述两种新的电子束泵浦的蓝-绿光激光器 XeF(C→A)[1] 和 Xe_2Cl[2]。

实验是在一个不锈钢盒中进行的，这个盒紧连在一个 Pulserad 110 电子束发生器的场致发射二极管上[3]。一束脉宽10毫微秒(半极大值全宽)、电流密度0.8千安/厘米^2、能量1兆电子伏的电子束穿过50微米厚的钽箔横向注入到激光介质中，其覆盖面积为10厘米^2。蓝宝石的真空窗放在高Q腔外以避免反射损耗，这对于低增益的激光介质是十分重要的。

本文报导在 Ar·Ne/Xe/NF_3 和 Ar·Ne/Xe/CCl_4 混合物中XeF 的中心波长为 353 毫微米和586毫微米的 B→X 跃迁与 C→A 跃迁，以及 XeCl 和 Xe_2Cl 在308毫微米与515 毫微米的跃迁的详细光谱、瞬时荧光增益和激光的测量。

在16托 Xe、8托 NF_3 和600千帕 Ar 的最佳混合状况下，XeF (C→A)激光器的峰值输出功率是5千瓦数量级，半极大全宽的谱线宽度是12毫微米。在同样的束流密度下，三原子 Xe_2Cl 激光器的峰值输出功率也是几千瓦，线宽30毫微米。两种激光器的光谱表明，内腔性能由于Ar 或 Ne 稀释剂的原子分子吸收特性和其他成分 (Xe, NF_2, CCl_4) 的瞬态吸收而显著提高。激光器的波长调谐可利用合适的色散元件，例如 Littrow 棱镜、光栅或滤光片来获得。