MULTIWAVELENGTH EXCIMER LASER STUDIES*

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ABSTRACT

The simultaneous generation of both UV and blue-green coherent radiation in electron beam pumped high pressure argon buffered Kr, Xe, NF_3, F_2 mixtures is reported. In the case of the XeF(B→X) at 351 nm and XeF(C→A) centered at 480 nm the relative output of the two lasers can be adjusted by variation of the krypton partial pressure. In these studies, a total output of more than 0.5 J/l was realized, corresponding to an efficiency of ~0.5%.

DISCUSSION

For various applications such as materials processing, multicolor laser spectroscopy, and in medical laser systems, it is desirable to have a multiwavelength laser output. The simultaneous efficient operation of XeF(B→X) and XeF(C→A) laser action in the same rare gas halide mixture is reported.

Fig. 1 shows the XeF(C→A) peak gain coefficient measured at 488 nm as a function of XeF(B→X) intracavity flux. The peak gain for the aligned XeF(B→X) cavity, g_a, is normalized to the peak gain for the misaligned cavity, g_m. The solid line is the result of a modelling calculation for the XeF(C→A) gain dependence on the XeF(B→X) flux using the kinetic data given in Ref. 1. Both experiments and theoretical analysis showed that the XeF(C→A) peak gain does not decrease considerably until the XeF(B→X) intracavity flux exceeds several MW cm^{-2}. Consequently a XeF(B→X) and a XeF(C→A) laser could operate simultaneously in the same device, both exhibiting high photon fluxes.

The experimental set-up used in this work has been described in detail in Ref. 2. Various multicomponent gas mixtures comprised of F_2, NF_3, Xe, Kr, and Ar were excited by an intense electron beam (1 Mev, 200 A cm^{-2}, 10 ns FWHM). A special dual wavelength resonator was employed using mirrors that were highly reflective at both 350 nm and ~480 nm.

The temporal and spectral behavior of the XeF(B→X) and XeF(C→A) laser output was investigated.[3] The output energies at 350 nm and around 475 nm were studied as a function of the Kr pressure as shown in Fig. 2. A combined energy of more than 0.5 J/l, corresponding to an efficiency of ~0.5%, was obtained. By variation of the Kr pressure, the relative output energy at the two wavelengths could be

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varied conveniently.

The addition of Kr plays an important kinetic role in the Kr_2F production possibly leading to improved XeF(C→A) performance especially on the short wavelength side of XeF(C→A) spectrum. Furthermore, it was shown that the presence of Kr reduces considerably the transient absorption for XeF(C→A) emission. On the other hand, Kr_2F is a strong absorber at 350 nm, which explains the reduction of XeF(B→X) output with increasing Kr pressure.

Further improvement in efficiency by optimum resonator design and mixture refinement appears possible. Simultaneous dual wavelength operation has also recently been achieved in commercial discharge excited rare gas halide excimer lasers.[4]

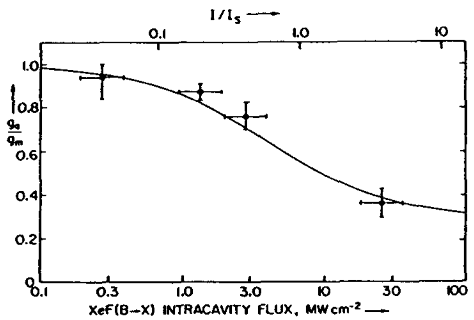

Fig. 1. Normalized XeF(C→A) peak gain coefficient at 488 nm vs. XeF(B→X) intracavity flux.

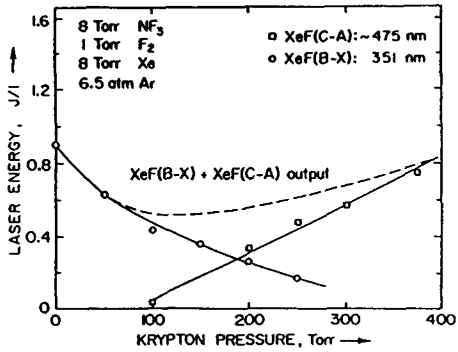

Fig. 2. XeF(B→X) and XeF(C→A) dual laser output energy vs. Kr pressure.

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