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# Efficient Simultaneous Multiwavelength UV/Visible Operation of Excimer Lasers*

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## Abstract

Efficient, simultaneous multiwavelength oscillation of an e-beam pumped rare gas-halide laser has been demonstrated. Laser oscillation from both the 353 nm XeF(B→X) transition and the broadband XeF(C→A) transition at 480 nm was obtained with a combined output in excess of 0.5 J/liter, corresponding to an efficiency of nearly 1%. Potential applications will be discussed.

## Summary

Electrically excited rare gas-halide lasers operating on the B→X transition have been under investigation for several years, and are capable of very efficient (~ 2-5%) generation of high power UV radiation. Recently, efficient (> 1%) operation of the tunable, blue-green XeF(C→A) laser with an energy output in excess of 3 J/liter was also demonstrated [1]. For a variety of applications such as frequency mixing, multistep photoexcitation, materials processing or laser surgery, it might be of interest to have an efficient laser that is capable of emitting both intense UV and tunable visible radiation at the same time. In this paper, the feasibility of efficient, simultaneous operation of the XeF(B→X) and XeF(C→A) lasers excited in the same medium is reported for the first time.

Experiments were performed by exciting various high pressure gas mixtures comprised of Ar, Kr, Xe, $F_2$ and $NF_3$ with an intense electron beam (1 MeV, 200 $Acm^{-2}$, 10 ns FWHM), under conditions previously found to be compatible with efficient XeF(C→A) laser operation [1]. In order to investigate the possibility of simultaneous oscillation on both XeF laser transitions, a dual wavelength resonator was designed using mirrors that were highly reflective at 353 nm as well as in the blue-green region near 480 nm.

The accompanying figure shows the time integrated UV/visible laser pulse energy density as a function of Kr pressure for representative conditions. With no Kr in the mixture oscillation on the 353 nm UV B→X transition alone is observed. As the Kr pressure is increased the B→X output decreases gradually in response to the increasing importance of competitive KrF and $Kr_2F$ reactions, the

* Supported in part by the Office of Naval Research, The National Science Foundation and the Robert A. Welch Foundation

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latter species a strong absorber at 353 nm. However, the presence of Kr significantly reduces absorption in the blue-green region [1]. The resultant increase in XeF(C→A) gain with increasing Kr pressure, combined with the decreasing competitive B→X oscillation, leads to a gradual increase in broadband C→A output centered at about 480 nm. The combined UV/visible output exceeds 0.5 J/liter throughout the entire range of Kr pressures, corresponding to an intrinsic efficiency of approximately 1%, a value comparable to that of conventional B→X rare gas-halide lasers.

Such a novel multiwavelength excimer laser may be useful in various applications as for example in cardiovascular surgery where UV radiation may be used to ablate tissue [3], but visible radiation is required to guide the surgical procedure.

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