

## TUEE2 .pdf

limited to the 465–495-nm range within which the  $\text{XeF}(C \rightarrow A)$  gain is a maximum.

Such a novel  $\text{XeF}(C \rightarrow A)$  excimer laser has the potential to become an efficient tunable high-power laser source in addition to being applicable to the amplification of subpicosecond pulses in the blue-green region. (12 min)

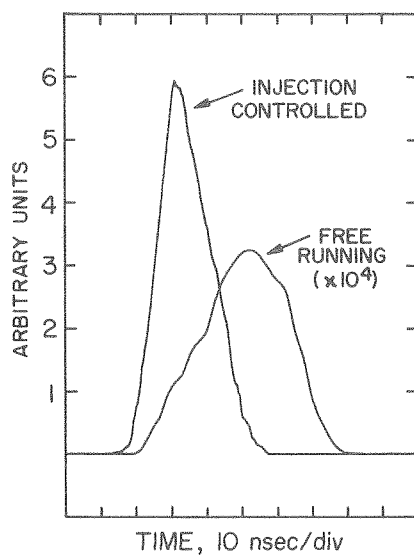
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2. W. L. Nighan, F. K. Tittel, W. L. Wilson, N. Nishida, Y. Zhu, and R. Sauerbrey, *Appl. Phys. Lett.* **45**, 947 (1984).
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#### TUEE2 Efficient broadband tunable excimer laser of ultranarrow bandwidth

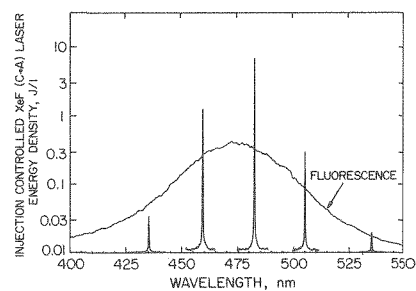
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Simultaneous efficient ( $>1\%$ ) laser output of narrow spectral output ( $\Delta\lambda \sim 0.001$  nm) has been demonstrated by injection control of an electrically excited  $\text{XeF}(C \rightarrow A)$  laser medium. Experiments were performed by exciting an optimized gas mixture comprised of 6.5-atm Ar, 300-Torr Kr, 8-Torr Xe, 1-Torr  $\text{F}_2$ , and 8-Torr  $\text{NF}_3$  with an intense electron beam (1 MeV,  $200 \text{ Acm}^{-2}$ , 10-ns FWHM). Specific details of the experimental arrangement have been reported previously.<sup>1-3</sup> The source of the injected radiation was a narrow bandwidth excimer-pumped dye laser system. Different confocal unstable resonator geometries were used having magnifications ranging from 1.05 to 1.23. With this setup the medium-cavity combination functioned as a multipass amplifier for the injected pulse.<sup>3</sup>

The temporal relationship between the injection controlled  $\text{XeF}(C \rightarrow A)$  laser output at 482 nm and the free-running broadband  $\text{XeF}(C \rightarrow A)$  laser output energy is shown in Fig. 1. Because the durations of the gain and dye laser pulse are both small, 50 and 10ns, respectively, the timing of the dye laser pulse with respect to the electron beam pulse was found to be critical. Therefore, it had to be controlled to within a few nanoseconds to obtain optimum performance. Presented in Fig. 2 are the spectra of five different injection controlled  $\text{XeF}(C \rightarrow A)$  laser outputs compared to the broadband  $\text{XeF}(C \rightarrow A)$  fluorescence spectrum of the free-running laser. The vertical scale indicates the wavelength dependence of the energy density extracted within a narrow linewidth. A maximum output of 90 mJ was obtained at 482.5 nm by injecting a 1-mJ pulse into a cavity with a magnification of 1.08, which corresponds to output energy density and intrinsic efficiency values of  $\sim 5 \text{ J/liter}$  and  $\sim 3\%$ , respectively. The output energy density was found to be in excess of  $0.5 \text{ J/liter}$  from 455 to 500 nm. Evaluation of the spectral characteristics of the narrowed  $\text{XeF}(C \rightarrow A)$  output with a  $0.5\text{-cm}^{-1}$  FSR Fabry-Perot etalon indicates that the spectral width is nearly the same as that of the dye laser input, i.e.,  $\Delta\lambda \sim 0.001$  nm. The overall spectral tuning range was limited by the resonator mirror characteristics to the 435–535-nm range, compared to the broadband laser spectrum of a free-running oscillator (stable or unstable) typically



TUEE2 Fig. 1. Temporal relationship between the 482-nm XeF( $C \rightarrow A$ ) laser output at the cavity exit and the broadband free-running XeF( $C \rightarrow A$ ) laser output. The gas mixture was comprised of 6.5-atm Ar, 300-Torr Kr, 8-Torr Xe, 8-Torr NF<sub>3</sub>, and 1-Torr F<sub>2</sub>.



TUEE2 Fig. 2. Time integrated spectra of the XeF( $C \rightarrow A$ ) fluorescence laser emission for injection controlled conditions of Fig. 1 at five different wavelengths. Data for 482.5 nm were obtained using a magnification  $M = 1.08$  optics, while the 435-, 459.4-, 505-, and 535-nm spectra were obtained with  $M = 1.05$  cavity. The resolution limit of the measurement system was 0.0008 nm.