A Xenon Ion Pumped Open Dye Stream Laser

M. GALLARDO, R. DUCHOWICZ, J. O. TOCHO, H. F. RANEA SANDOVAL, AND M. GARAVAGLIA

Abstract—A pulsed xenon ion laser with an output power of 1 kW over the blue-green lines was used to pump an open dye stream laser. An efficiency of the order of 40 percent was determined in broad-band mode operation. The bandwidth in this case was 48 nm (from 582 to 630 nm).

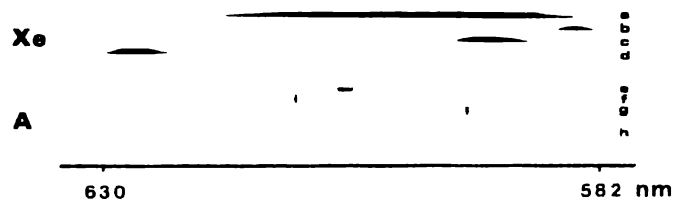

Fig. 1. Dye laser spectra photographed in 4.8 Å/mm grating spectrometer dispersion. Excitations accomplished by xenon and argon ion lasers. *a*: No intracavity tuning elements used; *b*: tuning wedge included in the folded cavity at low gain; *c*: similar to *b* at high gain; *d*: similar to *c* at another spectral region; *e*: no intracavity tuning elements used; *f*: tuning wedge included in the folded cavity; *g*: similar to *f* at another spectral region; and *h*: tuning wedge and etalon included in the folded cavity.

THE xenon ion laser was employed as pump source of dye lasers in the visible region [1]-[4] and its use to pump dyes was predicted in the near ultraviolet one [4]. In the four references previously mentioned, dyes were forced to circulate through Brewster angle cells or á Hansch cell.

The purpose of this letter is to report the pumping of an open dye stream laser by means of a high-power pulsed xenon ion laser. The xenon laser tube is similar to that reported before [5]. Instead, the excitation of the active medium was accomplished by means of a specially designed ac power supply [6]. A 10 kV at 50 mA commercial type transformer was used in the electric circuit. The discharge repetion rate can be selected between 50 or 100 Hz. The output power of the laser over all the visible lines was 2 kW. The laser spectrum was composed of several lines whose wavelengths were λλ: 495.42, 500.78, 515.91, 526.02, 535.29, 539.46, and 595.57 nm.

A xenon laser output of 1 kW over the blue-green lines was employed to pump the dye laser. This xenon laser emission was characterized with an FWHM of 80 ns. Power and pulse-width measurements were made with a commercial EG & G photoconductive silicon detector.

A three-mirror folded cavity with the open dye stream at Brewster's angle Spectra-Physics Model 375 was used in experiments. The input mirror facilitated the simultaneous focusing of all the xenon pumping laser lines into the dye stream. The pumped dye was an Ethylene Glycol solution of Rhodamine 6 G of 2.10^{-3} M concentration, that is, the same as recommended by Spectra-Physics for the CW argon ion laser pumping. No attempts at all in optimizing the output as a function of the concentration were made. The dye flow rate was the minimum compatible with the operation of the Spectra-Physics Dye Circulator Model 376.

When the dye laser was operated without both the tuning wedge and the fine tuning etalon, the total output power over a spectral region of 48 nm width was 400 W. In such experimental conditions, the broad-band conversion efficiency exceeded 40 percent. The dye laser pulse profile followed the xenon laser pump pulse profile, and its FWHM was also 80 ns.

Fig. 1 shows various dye laser spectra obtained with pulsed xenon ion and CW argon ion pump lasers. In the first spectrum, 48 nm broad-band dye laser emission due to the xenon pump was obtained when no intracavity tuning elements were used. The others were photographed when the tuning wedge was included in the folded cavity. The spectral width of the emission depends on the laser gain along the wavelength region tuned. In the low gain region, a width of 9 nm was observed, while in the high gain region the width increased up to 14 nm. Experimental conditions and results are summarized in Table I.

With the purpose of comparing the emission of the xenon pumped dye laser with that largely known from the CW argon ion pumped dye laser, Fig. 1 also shows its spectra, photographed without intracavity tuning elements, with the wedge and the wedge plus the etalon, respectively. See Table I for more details.

In a previous paper [7], the lack of influence of the interferometric tuning elements on the spectral width narrowing when the illuminating light pulse is short, as for example, when it is excited with a nitrogen laser (FWHM ~ 5 ns), was demonstrated. In the present case, since the FWHM of the pumping xenon ion laser pulse is 80 ns, it was possible to observe the reduced influence of the tuning wedge on the spectral width. The natural explanation of this effect could be the low number of passages of the light through the tuning elements.

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The authors are with the Centro de Investigaciones Opticas (CONICET-UNLP-LEMIT), Casilla de Correo 124, 1900 La Plata, Argentina.

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TABLE I

Laser Pump Source	Spectral width (nm)			Pulse width (ns)
	No tuning elements	Tuning wedge	Tuning wedge plus etalon	
CW Argon	2	0.2 - 0.3	0.05	∞
Pulsed Xenon	48	9 - 14	0.2	80

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