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COAXIAL, GLASS FLASHLAMP FOR ORGANIC DYE LASER*

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Several types of ultrafast flashlamp system were investigated as optical pumps for organic dye lasers[1-7]. First flashlamp system[1] utilized a coaxial flashlamp mounted axially on a low inductance disk capacitor. The discharge took place in the airfilled annular region between two quartz tubes, the inner of which serves as a dye cuvette. This, air filled flashlamp, was fired by reducing the pressure in the discharge region (eliminating electrical switch) in order to achieve shortest flash rise time. Schmidt and Schäfer[3] obtained a similar rise time with conventional linear xenon flashlamp driven by low inductance capacitor. Furomoto and Ceccon[4] investigated various types of coaxial flashlamps with the discharge taking place in different gases (argon, krypton and xenon).

The aim of this letter is to present a new, compact glass flashlamp and the dye laser system. Coaxial xenon flashlamp, Fig. 1, was made of Pyrex glass with inner tube having internal diameter 5.8 mm. The outer tube had a wall thickness 1.2 mm and the inner one 1.0 mm. Arc channel thickness was 1.2 mm and the discharge length-distance between two tungsten electrodes, was 13.5 cm. Research grade xenon gas was used at various pressures and gas filling system was maintained as clean as possible to eliminate gases with high electron attachment coefficient.

The dye laser cell-central part of the flashlamp (Fig. 1) was closed with ordinary glass windows with no antireflection coating. This cuvette contained the organic dye in a suitable solvent and the solutions were circulated in all experiments. Hemispherical laser resonator consisted of one flat dielectric mirror coated for 99.5% and one curved mirror (radius 100 cm) with 98%

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reflectivity in the region 5800—6400 Å. These mirrors were spaced approximately 25 cm appart.

Flashlamp was mounted on the capacitor in order to minimize inductance of the electric circuit. The electrical discharge was driven by low inductance,

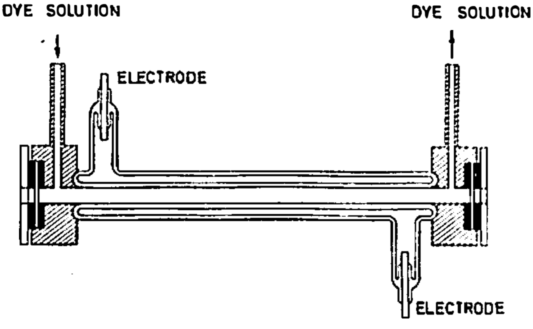

Fig. 1. Schematic diagram of glass, coaxial flashlamp.

2.5 μF capacitor (Hivotronic) charged from 3.5 to 8.0 kV. The discharge was initiated by high voltage pulse applied to external coiled wire electrode. Rogowsky coil was used to measure discharge current, while transient voltage was monitored by high voltage probe. The discharge current was critically damped with pulse width (at 1/3 of current maximum) 5.0 μs and rise time of 2.8 μs. Peak current varied during the experiment from 1.6 to 7.2 kA

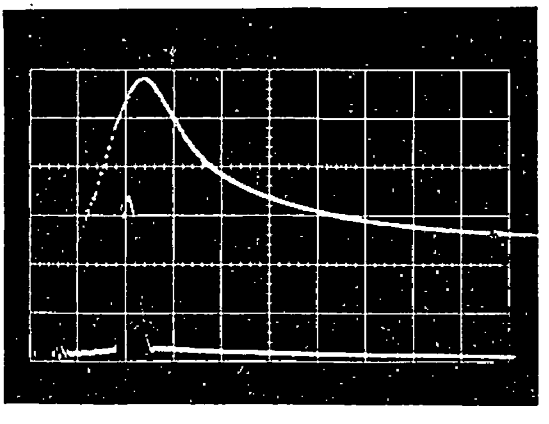

Fig. 2. Characteristic flashlamp pulse (upper trace) and laser emission from $5 \cdot 10^{-5}$ M/l rhodamine 6G in ethanol. Time base 2 μsec/cm.

(power input 3.1 to 32.3 MW) what correspond to the current density of 4.5 to 20.5 kA/cm² if it was assumed that the whole arc channel was filled with the discharge.

A number of experiments were carried out to determine an optimum flashlamp xenon filling pressure. This was achieved by measuring laser power output at constant power input at various xenon pressures. It was found that optimum filling pressure was about 150 Torr although laser power output did not change more than 15% in the pressure range from 90 to 320 Torr.

The laser experiments were carried out with air equilibrated ethanolic solutions containing $5 \cdot 10^{-5}$ M/l of rhodamine 6 G (BDH adsorption indicator) or rhodamine B (Fluka AG, adsorption indicator). Characteristic oscillogram of the flashlamp light and laser pulse is given in Fig. 2. Flashlamp power input: 15.3 J and 16.5 J for rhodamine 6 G and B respectively, was measured at the threshold for laser operation at optimum xenon filling pressure. The output power of this laser can probably be increased by optimizing flashlamp rise time (decreasing circuit inductance) and by purification of dyes. If quartz flashlamp is used it would be possible to extend the spectral range of applications to blue organic dyes.

References

1) P. P. Sorokin and J. R. Lankard, IBM J. Res. Develop. **11** (1967) 148;
2) P. P. Sorokin, J. R. Lankard, V. L. Moruzzi and E. C. Hammond, J. Chem. Phys. **48** (1968) 4726;
3) W. Schmidt and F. P. Schäfer, Z. Naturforsch. **22a** (1967) 1563;
4) H. W. Furumoto and H. Ceccon, Appl. Opt. **8** (1969) 1613;
5) B. Snavely, Proc. IEEE **57** (1969) 1374;
6) A. J. Gibson, J. Phys. **E2** (1969) 802;
7) J. Bunkenburg, Rev. Sci. Instr. **43** (1972) 497.