LASER PROGRAM

L.1 Development of 40 W copper HyBrID laser

Copper HyBrID (Hydrogen Bromide In Discharge) laser is a variant of copper vapour laser in which first copper bromide is generated in the discharge. For this a controlled amount of hydrogen bromide gas is injected along with neon buffer gas into the discharge region causing a reaction of hot metal copper with hydrogen bromide at >500°C. The copper bromide thus produced sublimes, generating copper bromide vapour. Subsequently the copper bromide molecules break in to copper and bromine atoms due to collisions with energetic electrons. Copper atoms thus produced are used in the lasing action. The copper atom density in the discharge tube is controlled by the quantity of HBr gas injected. Main advantages of this laser over metal copper vapour laser, are its lower operating temperature (500-800 °C compared to 1600°C in metal copper vapour laser), short start up time, operation at higher repetition rate, higher efficiency, higher average output power and better beam quality.

We have successfully developed a copper HyBrID laser, which produces 40 W average output power (24 W green and 16 W yellow) at 18 kHz pulse repetition frequency with 1.1% electro-optic efficiency (fig. L.1.1). The lasing action builds up 8-10 minutes after the start up from cold condition and attains full power thereafter within 10-12 minutes (fig. L.1.2). The output power remains quite stable, and has been tested over few hours of continuous operation. The lasing action disappears within 5 minutes after the flow of HBr is stopped.

Fig. L.1.3 shows the discharge voltage, discharge current and laser pulse (both green and yellow) recorded using an oscilloscope. The beginning of laser current approximately at a time when the discharge voltage reaches maximum indicates availability of significantly lower inter pulse electron density of this kind of laser [*D.R. Jones et al, Optics Communication111 (1994), p394-402*]. The laser pulse width (FWHM) is ~55 ns which is also ~40% more than that of elemental CVL.

Fig. L.1.1 *Copper HyBrID laser*

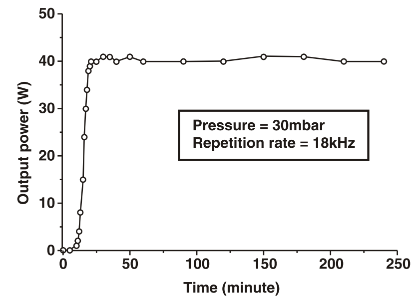

Fig. L.1.2 *Out put power vs. time from cold start up (Input power=3.7kW)*

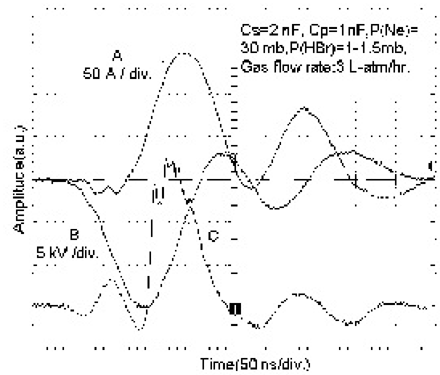

Fig. L.1.3 *Laser Current (A), Discharge voltage (B) & Laser pulse (C)*

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L.2 Photodynamic treatment of oral tumours in hamster cheek pouch model using chlorine p6, a chlorophyll derivative

Studies have been carried out to evaluate use of chlorine p6, a chlorophyll derivative, for photodynamic treatment of oral carcinoma in hamster cheek pouch model. Chlorine p6 (Cp6), synthesized in house, was administered either intraperitoneal (IP) at a dose of 1.5 mg/kg body weight or applied topically at 1.0 mg/kg body weight. The accumulation of Cp6 in tumour, normal mucosa, and abdominal skin was monitored non-invasively via measurement of the 400 nm excited drug fluorescence using a bifurcated optical fibre probe. Intraperitoneal administration of Cp6 was observed to lead to a significant accumulation of the drug in tumour (left panel of fig. L.2.1), if its size was smaller than 5 mm. For larger tumour sizes, poor accumulation of drug in tumour was observed presumably due to poor vasculature of large tumours. Here topical application gave better results. For both routes for drug administration the