L.4: A Pulsed XeCl laser driven by All Solid State Exciter.

Excimer lasers are pulsed gas discharge lasers, produce efficient and powerful radiation in the UV spectral range. They found applications in industrial, scientific and medical fields. Due to the short wave length, the required pump power density of excimer lasers are quite high. To provide such a high power density fast capacitor discharge circuits are used. A fast high voltage and high current switch is required to initiate a volumetric discharge for pumping excimer lasers. Conventional exciters employ thyratron as discharge switch for repetitive operation. However thyratron is expensive, strategic component and have limited lifetime. The use of all solid-state exciter (ASSE) offers several advantages over conventional excitations circuit. These are less expensive, reliable, can be used for high repetition rate operation and don't have lifetime limitations. A repetitively pulsed xenon chloride excimer laser driven by ASSE was designed and developed at Chemical and Excimer Laser Section of RRCAT. The photograph of the developed excimer laser system is depicted in fig (1).

The laser system mainly consists of laser head, UV spark pre-ionizer, all solid-state exciter (ASSE) with SCR as switch, a four-stage magnetic pulse compression circuit (MPC), magnetically coupled tangential blower, finned tube heat exchanger, and electrostatic precipitator. The laser head consist of two-nickel electrodes and UV pre-ionizer. These electrodes of 50 cm discharge length are placed 2.3 cm apart along their length. This arrangement leads to a discharge volume of 50 cm x 2.3 cm x 1 cm. The discharge gas is pre-ionized by spark generated between a pin and HV electrode. For high repetition rate laser operation, the gas is circulated in the active region using magnetically coupled tangential blower and set of water-cooled finned tube heat exchangers. All solid-state exciter has been used for excitation and schematic of the electric circuit is shown in fig (2). There is no thyratron in this mode of excitation.

The excitation circuit mentioned primarily consists of a solid-state pulser and a 4-stage MPC. The solid-state pulser consists of pulsed power supply, primary capacitor bank (C0),

Fig.L.4.1 : Photograph of the laser developed

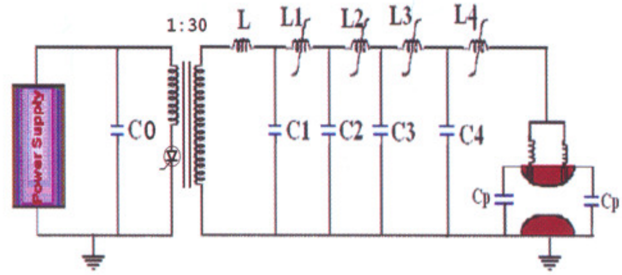

Fig.L.4.2 : Schematic of excitation circuit Primary storage capacitor C0 = 70 F; Saturable inductors: L1, L2, L3, L4; Capacitors C1, C2, C3, C4 = 50 nF each; Cp = 40 nF

SCR and a trigger generator. Here, solid-state switch is a distributed gate SCR rated at 1.8 kV and 1500 Amp. Main storage capacitor C0 is charged to ~1kV by constant current capacitor power supply and switched by SCR. The voltage pulse is stepped up and coupled to the MPC through a 1:30 step up pulse transformer. This arrangement resulted in charging of C1 in 8 μs. Typical voltage pulse is shown in fig 3. The MPC circuit basically consists of a capacitor bank (C1, C2, C3, C4) and a saturable inductor (L1, L2, L3, L4) in each stage. The 8 μs pulse is compressed by the four stage MPC to 100 ns (shown in fig. 4) and applied to the laser head. Here, the compression factor is 80.

Saturable inductors used are made of 20 nos of Ni-Zn ferrite cores of dimensions OD=150 mm, ID=100 mm and 15 mm thick. The no. of turns of these saturable inductors are 27, 9, 3 and 1 respectively. The laser uses gas mixture of 5 mbar

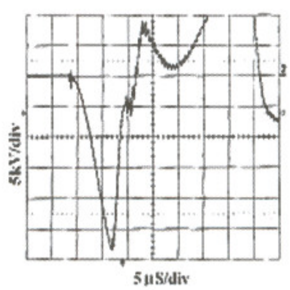

Fig.L.4.3 : 8 S Voltage pulse

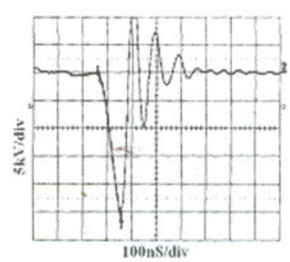

Fig.L.4.4 :Discharge voltage pulse

HCl, 80 mbar Xenon and rest is Neon with total pressure of 2500 mbar. The optical cavity is formed by a total reflecting plane mirror and a plane quartz window separated by 120 cm. Laser energy able to produce optical pulses of 150 mJ energy at 100 Hz reliably.

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