L.3: 70% enhancement in output power capability of a wide aperture copper vapor laser with hydrogen additive in its neon buffer gas

Standard copper vapor lasers with moderate tube bore of 45-50 mm bore, simple C-C discharge circuit and using pure neon as buffer gas are severely limited by output power capability to ~ 30-35 Watt at 5-6 kHz rep-rate. Also due to load mismatch conditions this type of CVLs often encounter latch-on conditions of high voltage switch thyratron resulting in possibility of frequent disruptions in their continuous operation.

Use of hydrogen in its buffer gas in highly optimized proportion results in enhanced performance with increase in output power, operating frequency (rep-rate) and efficiency with better load matching conditions. So far 50 % maximum increase in output power on using hydrogen as additive has been reported in literature in a small bore CVL device and 25-30 % in case of wide aperture CVL systems. The presence of hydrogen in buffer gas ensures better inter-pulse plasma relaxation, removal of excess electrons from discharge by process of disociative attachment (DA) and maintains high discharge voltage due to reduced conductivity between laser electrodes. In house development of a simplified rate equation model for CVL system by us also reveals increase in CVL gain on reducing the pre-pulse electron density. This confirms the main role of hydrogen as an additive in enhancing the CVL performance significantly.

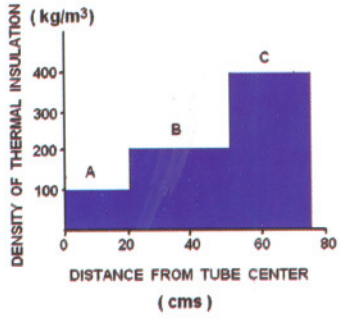

Fig.L.3.1 Longitudinal profiling of thermal insulation around discharge tube

We recently demonstrated in our laboratory, a standard 30 Watt CVL with hydrogen additive and achieved power enhancement of ~ 70 % with output power achieved in excess of 50 Watt at ~ 10-11 kHz rep-rate. The CVL was based on 47-50 mm bore x 1500 mm length discharge tube with modified (longitudinally profiled) thermal assembly around it to ensure minimum end thermal losses and increase in tube temperature to ~ 1600 ° C (Fig.L.3.1). Fig L.3.2 show laser power buildup with time with hydrogen additive. The high enhancement achieved is due to fine optimization of hydrogen content, increased tube temperature to 1600 C using new thermal assembly and better load matching conditions Fig. L.3.3 show CVL operating with hydrogen additive with maximum power of 54 Watt at 11.5 kHz

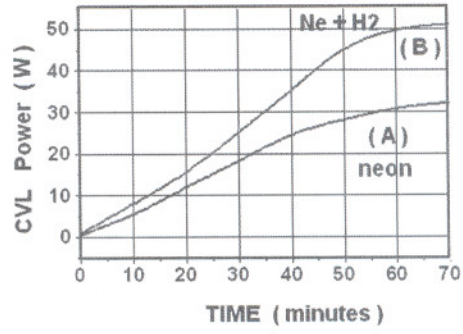

Fig.L.3.2 Laser power buildup with time : (A) with pure neon. (B) Neon + hydrogen

Fig.L.3.3. CVL operating with hydrogen additive delivering 54.6 W at 11.5 kHz rep-rate

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L.4: Measurement of Nanometer scale-Optical Path Length Variations Using Phase Sensitive Spectral-Domain Optical Coherence Tomography

Optical coherence tomography (OCT) can provide non-invasive cross-sectional images of biological microstructures in real time with resolutions down to few micrometers. Spectral domain OCT retrieves depth information in the sample by the Fourier transformation of the intensity of the