

## L.3: MOPA-LOPUT based ~ 7 W single longitudinal mode laser at 1064 nm

Based on LOPUT cavity, a narrow linewidth laser at 10° nm was recently demonstrated in our laboratory. OPUT cavity stands for Linear Orthogonal Polarization modes resulting in Unidirectional Travelling wave cavity. LOPUT eliminates spatial hole burning by eliminating the standing waves in linear cavity and thus achieves the robustness of a unidirectional ring cavity in a compact linear cavity design itself. The onward and backward propagating beam in the gain medium are made orthogonally polarized using a special arrangement of Brewster plate, Faraday Rotator and quarter wave plate as shown in Fig. L.3.1.

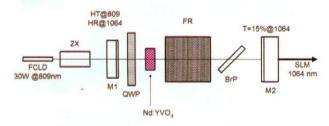


Fig.L.3.1: Schematic of the LOPUT cavity

Since, orthogonally polarized waves do not interfere with each other; the standing wave pattern is eliminated as in a unidirectional ring resonator. Fig. L.3.2 shows the state of polarization of laser beam inside the resonator. The orthogonally polarized waves passing though the gain medium are linearly polarized and are aligned with the

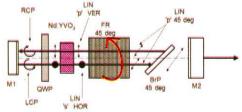


Fig. L.3.2: Polarization inside the LOPUT cavity

principal axes ( $\sigma$  and  $\pi$ ) of the anisotropic gain medium such as a-cut Nd:YVO4 used in the LOPUT laser. This is in sharp contrast to the Twisted Mode Cavity (TMC) proposed by Siegman [1], where circularly polarized modes passes through isotropic gain medium such as Nd:YAG. Even though TMC cannot be used with anisotropic gain medium, LOPUT geometry can be applied both to isotropic as well as anisotropic gain media.

Using a fibre coupled laser diode at 809 nm as the pump source, and plane-plane cavity stabilized by pump induced thermal lens in the gain medium as the resonator, we demonstrated more than 2 W of single frequency laser at 1064 nm from 12.7 W input power at 809 nm. Fig. L.3.3 shows the M<sup>2</sup> variation of the LOPUT laser as a function of the operating

output power. Instead of hard aperture, gain aperture was utilized in our laser setup. The laser beam was diffraction limited up to 1 W output power.

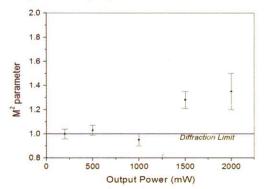


Fig. L.3.3: M<sup>2</sup> variation of LOPUT Laser

The polarization quality of the LOPUT laser was measured using a Glan Thompson prism, and was found to be limited by the extinction ratio 10,000: 1 of the analyzer. Fig. L.3.4 shows the typical Single Longitudinal Mode (SLM) performance of the LOPUT laser measured with a scanning confocal Fabry Perot Interferometer (FPI). The measured line width was ~ 5MHz at 1064 nm, and was instrument limited.

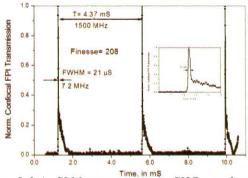


Fig. L.3.4: SLM measurement at SHG wavelength

Using the above LOPUT laser with a scaled up output power of 2.6W (M2  $\sim$ 1.8), a two stage CW Master Oscillator Power Amplifier (MOPA) was constructed using 0.3-at-% Nd:YVO4 crystals of 12 mm length. The MOPA produced  $\sim$  7W amplified LOPUT output at 1064 nm. The pump power per stage was 28.5 W at 808 nm. MOPA improved the beam quality of the output beam (M2  $\sim$  1.2). The SLM performance was verified with a scanning plane-plane FPI. In conclusion, we have demonstrated MOPA-LOPUT SLM laser  $\sim$ 7 W output power at 1064 nm in a diode end pumped geometry. Reference:

1. V Evtuhov and A E Siegman, Appl. Opt. 4, 142 (1965)

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