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STUDY OF THERMAL LENSING IN ND:YVO_4 UNDER INTENSE DIODE END-PUMPING CONDITIONS

I.O. Musgrave, W.A Clarkson and D.C. Hanna

Optoelectronics Research Centre, University of Southampton, Southampton, SO17 1BJ. UK

tel: +44 2380 593138, fax: +44 2380 593142, iom@orc.soton.ac.uk

With its natural birefringence and high $\sigma\tau_f$ product, Nd:YVO_4 is a popular choice as a lasing material for diode pumped solid-state lasers. The short absorption length for pump light at ~809nm relaxes the constraints on diode beam quality allowing tighter pump beam focusing and hence the use of relatively small laser mode sizes. However, in comparison to Nd:YAG it has poorer thermal properties, resulting in strong thermal-lensing, a knowledge of which is essential for optimum laser design. We present the results of a detailed study, considering the effect on thermal lensing in Nd:YVO_4 of neodymium concentration, heat-sinking arrangement and laser configuration.

The thermal lens powers in end-pumped Nd:YVO_4 were determined by measuring the induced phase difference as a function of transverse position using a Mach-Zehnder interferometer, figure 1. The interferometer was also equipped with a set of mirrors to form a stable non-collinear resonator for the Nd:YVO_4 crystal to allow thermal-lensing to be investigated under lasing and non-lasing conditions.

Figure 2 shows the results obtained for 1% and 0.3% Nd-doped YVO_4 crystals with cooled faces perpendicular to the c-axis and probe beam polarization parallel to the c-axis. The thermal lens power is ~5 times greater under non-lasing than for the lasing conditions for the 1% doped crystal, which we attribute mainly to additional heating from ETU, further compounded by reduction of thermal conductivity at higher temperature. The much smaller corresponding value for the 0.3% doped crystal indicates the potential benefits to (~2) be achieved with lower Nd concentrations. The results for the perpendicular heat-sinking direction and the orthogonal probe beam polarization, which suggest that thermally-induced stresses play a role in thermal lensing behaviour will also be presented.

The results provided by this study allow formulation of a design strategy for further power-scaling of Nd:YVO_4 lasers and amplifiers whilst maintaining good output beam quality.

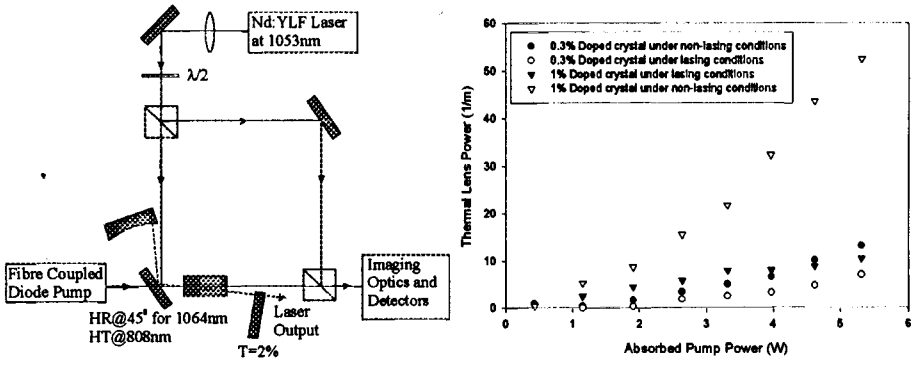

Figure 1 The interferometer set-up and figure 2 example results.