573 nm External Cavity CVD-Diamond Raman Laser

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We report an external cavity Raman laser based on a single diamond crystal grown by chemical vapour deposition. When pumped with 10ns pulses of 532 nm, output pulse energies up to 0.2 mJ were obtained at 573 nm with a slope efficiency of conversion of 18%.

Solid-state Raman lasers are a practical and robust technology for targeting wavelengths falling outside the main domain of more conventional types of lasers. To date, the more common Raman laser materials used include single crystals of metal tungstates, metal nitrates, and silicon. Diamond has long been sought after due its high Raman gain coefficient in combination with other extraordinary material properties, but the poor availability of large low-impurity crystals has severely inhibited development. Recent advances in chemical-vapor-deposition (CVD) growth of diamond has seen manufacture of large samples (eg., longest dimension >5mm) with good optical transmission [1].

In this paper, we report a characterization of a diamond external cavity Raman laser pumped by a Q-switched frequency-doubled Nd:YAG laser. The Raman laser consisted of an uncoated CVD-grown single crystal of dimensions 5 x 5 x 1.47mm oriented so that the laser beam axis traversed the approximately the longest dimension of the crystal and intersected the faces at Brewster's angle (refer Fig. 1). An input-coupling mirror transparent at the 532nm pump wavelength and reflective at the Stokes wavelengths, and a highly reflecting end-mirror, formed the Raman laser resonator. The Raman laser was pumped with 10ns pulses of 532nm at energies up to 2.5mJ and in a beam of diameter approximately 0.3mm.

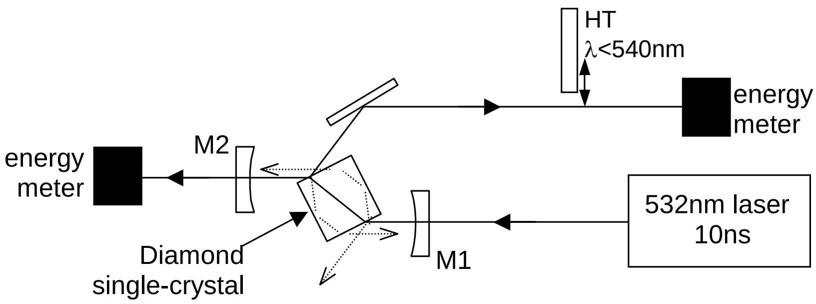

Fig. 1. Experimental arrangement for the diamond Raman laser. A short-pass filter was used to remove the residual pump beam from the output.

The threshold for first Stokes generation (573nm) was observed at the pump energy 1.2mJ. In the configuration of Fig. 1, the Raman output consisted of four beams corresponding to two reflections from each facet. Low energy output was also observed visually at the 620nm second-Stokes at the highest pump energy. The overall conversion efficiency from the pump to the four output beams is 8% at the maximum pump energy with slope efficiency 18.5%.

The results foreshadow significant potential for further optimizing and scaling performance. Potential directions for creating compact devices at high average output powers will be discussed.

[1] Turri G., Chen Y., Bass M., Orchard D., Butler J.E., Magana S., Feygelson T., Thiel D., Fourspring K., Dewees R.V., Bennett J.M., Pentony J., Hawkins S., Baronowski M., Guenthner A., Seltzer M.D., Harris D.C. and Stickley C.M., Opt. Eng. **46**, 064002 (2007).

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