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AN ALL-SOLID-STATE SYNCHRONOUSLY PUMPED OPTICAL PARAMETRIC OSCILLATOR

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The synchronously pumped optical parametric oscillator (OPO) is potentially the ideal source for the many applications requiring widely tunable ultrashort pulses. For high stability, cw pumped operation is required, with only one of the two generated waves being resonated in a singly resonant oscillator (SRO). For an efficient and compact device, an all-solid-state pump source is favourable. Lithium triborate (LBO) has the attractive property of temperature-tuned exact noncritical phase matching over much of its transparency range. Robertson *et al.* achieved the impressive tuning range of 0.65-2.7μm from an LBO OPO, but little other information for the SRO was reported (1). We recently reported the efficient operation of a similar device, including temporal and spectral data for the SRO (2). However, in that work we only coupled out the nonresonated wave from the OPO. Here, we report the operation of an LBO OPO accessing both of the generated waves as outputs.

The OPO cavity is shown schematically in figure 1. As an improvement on the work reported in (2), we opted to use a Brewster angled crystal. This avoids the restrictions on efficiency and tuning range imposed by spectral roll-off in the antireflection coatings. The 13mm long Brewster crystal was cut for temperature-tuned type I noncritical phase matching propagating along the crystallographic x axis. The LBO crystal was mounted in an oven which could vary the crystal temperature between ambient and ~200°C with a stability of ±0.1°C. The crystal used was of rather poor quality, with a total single pass loss of 0.8% and the crystal having definite sweet spots. The reflection loss from each Brewster surface contributed only 0.1% loss. Using two different mirror sets, the threshold pump power was measured at three different resonated wavelengths to be 170mW average power. The slope efficiency for the resonated wave was 40%, giving rise to an average output power of up to 89mW at 850nm for a pump power of 340mW. The resonated wave could be tuned over the range 978-816nm and 853-721nm, with the nonresonated wave tuning over the range 1126-1460nm and 1355-1911nm. The resonated wave output through the output coupler was >50mW over the range 978-744nm as shown in figure 2, with the nonresonated wave output through the rear curved mirror being >30mW over the range 1164-1813nm. The output pulses from the OPO at 780nm are ~1.5ps duration and exhibit excess bandwidth, with a time-bandwidth product of ~0.9 as in (2). Effective control of the OPO bandwidth should result in transform-limited subpicosecond pulse generation across the entire tuning range.

References

1. A. Robertson, G. P. A. Malcolm, M. Ebrahimzadeh, and A. I. Ferguson, *Conference on Lasers and Electro-optics,* Anaheim CA, 1992, paper CPD15.
2. S. D. Butterworth, M. J. McCarthy, and D. C. Hanna, *Topical Meeting on Advanced Solid State Lasers,* New Orleans LA, 1993, paper PD10.

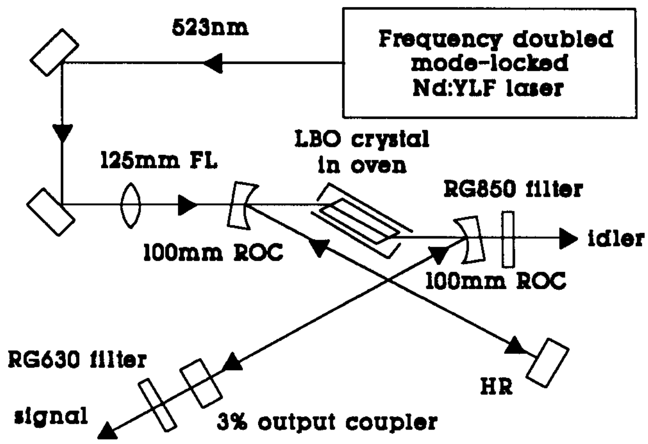

Figure 1. Schematic diagram of the Brewster angled LBO OPO

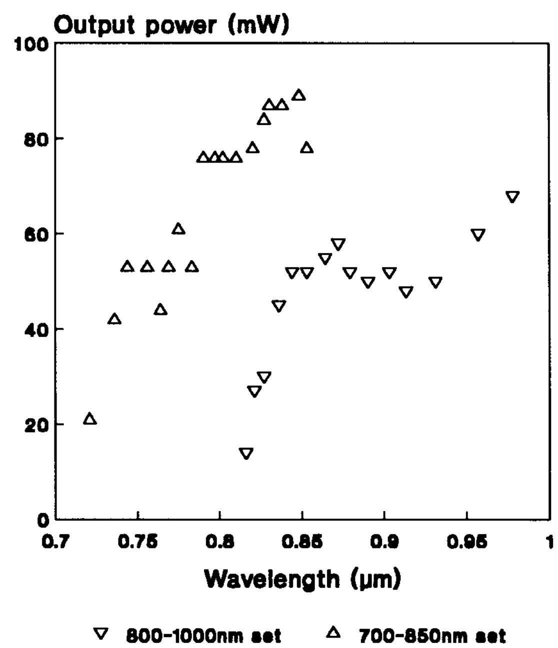

Figure 2. Variation of the resonated wave output power across the tuning range.