High-power widely tunable solid-state lithium triborate optical parametric oscillator

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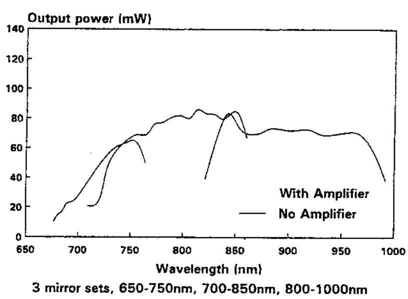
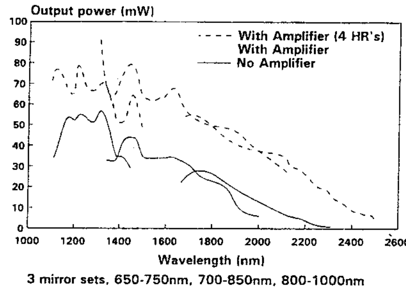
Optical parametric oscillators (OPOs) have seen a resurgence of interest with the availability of new materials and high-quality crystal manufacture. Synchronously pumped OPOs are potentially the ideal source for the many applications requiring widely tunable ultrashort pulses. For stability in both amplitude and frequency it is highly desirable to have only one of the two generated waves being resonated in a singly resonant oscillator (SRO). It has been shown previously[1] that the average powers required to achieve threshold can be in the tens of milliwatts range, and are thus ideally suited for pumping by frequency-doubled diode-pumped mode-locked lasers. The OPO described here is based on a Brewster angled lithium triborate crystal. The advantages of using this crystal are Type I temperature-tuned noncritical phase-matching, which allows tight focusing and high intensities to be maintained over a very broad range of signal and idler wavelengths. Using an optional diode-pumped single pass Nd: YLF amplifier for the 1.047 μm light we have shown improvements in the average power of 60% without any degradation in the time-bandwidth product of the pulses. Average powers of the second harmonic have been improved to 480 mW in pulses of 1.9 psec at 105 MHz, giving a peak power of 2.4 kW. The LBO OPO has a threshold of 170 mW with pump depletions of 75% at 2.5 times threshold. Tuning is achieved over the ranges 0.65 to 1.0 μm (signal) and 1.1 to 2.65 μm (idler) using three mirror sets for the signal wave. A maximum output power of 110 mW with slope efficiency of 40% has been achieved at ~800 nm. Power output for the various configurations and mirror sets is shown in Figs. 1 and 2. Pulse durations of 1.5 psec are observed with time-bandwidth products of ~0.9. Further improvements to the power performance of the OPO are discussed as well as more detailed characterisation of the OPO. Preliminary attempts to control the spectral content as well as long term stabilisation of the absolute wavelength of the OPO pulse train is reported.



CWA3 **Fig. 1.** Output power for resonated wave versus wavelength tuning.



CWA3 **Fig. 2.** Output power for nonresonated wave versus wavelength tuning.

1. M. J. McCarthy, *et al.*, Opt. Commun. **102**, 297 (1993).