Continuous-wave, two-crystal, singly-resonant optical parametric oscillator: Theory and experiment

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Abstract: We present theoretical and experimental study of a continuous-wave, two-crystal, singly-resonant optical parametric oscillator (T-SRO) comprising two identical 30-mm-long crystals of MgO:sPPLT in a four-mirror ring cavity and pumped with two separate pump beams in the green. The idler beam after each crystal is completely out-coupled, while the signal radiation is resonant inside the cavity. Solving the coupled amplitude equations under undepleted pump approximation, we calculate the maximum threshold reduction, parametric gain acceptance bandwidth and closest possible attainable wavelength separation in arbitrary dual-wavelength generation and compare with the experimental results. Although the T-SRO has two identical crystals, the acceptance bandwidth of the device is equal to that of a single-crystal SRO. Due to the division of pump power in two crystals, the T-SRO can handle higher total pump power while lowering crystal damage risk and thermal effects. We also experimentally verify the high power performance of such scheme, providing a total output power of 6.5 W for 16.2 W of green power at 532 nm. We verified coherent energy coupling between the intra-cavity resonant signal waves resulting Raman spectral lines. Based on the T-SRO scheme, we also report a new technique to measure the temperature acceptance bandwidth of the single-pass parametric amplifier across the OPO tuning range.

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References and links