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Doubly resonant near-infrared optical parametric oscillator with periodically poled Ti:$LiNbO_3$ waveguide

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Abstract: A continuous wave (cw) doubly resonant near-infrared optical parametric oscillator with periodically poled Ti:$LiNbO_3$ waveguide has been developed. The oscillation threshold is 34 mW of coupled pump power; the wavelength tuning range is 1400-1750 nm.

OCIS codes: 190.4410 Nonlinear Optics, Parametric Processes; 130.3730 Integrated Optics, Lithium Niobate

Integrated optical parametric oscillators (IOPOs) are attractive devices to generate tunable coherent radiation in a broad tuning range. Contrary to their bulk counterparts IOPOs promise a low oscillation threshold, low waveguide losses provided. The first near-infrared doubly resonant IOPO with a high finesse Ti:$LiNbO_3$ waveguide resonator was already demonstrated in 1981, using birefringent phase matching. An improved version had a threshold of only 26 mW incident pump power [1].
The advent of the quasi phase matching scheme in periodically poled $LiNbO_3$ should allow a threshold reduction of at least one order of magnitude due to the exploitation of the highest nonlinear coefficient in $LiNbO_3$. However, up to now near-infrared devices with proton exchanged waveguides had a threshold in the W-regime [2]. On the contrary, mid-infrared devices of a threshold of 14 mW only could be recently demonstrated using low loss Ti:$LiNbO_3$ channel waveguides [3].
Using the same technology we report in this contribution the first cw near-infrared IOPO with periodically poled Ti:$LiNbO_3$ waveguide. The microdomain pattern has a period of $\sim 17\mu$m over a total length of 80 mm. Typical waveguide losses are between 0.09 and 0.2 dB/cm. A detailed description of the fabrication processes can be found in [4]. The endfaces of the samples were coated with dielectric mirrors with a high transmission for the pump ($\sim$ 780 nm, T>90%) and a high reflectivity for the signal and idler waves around 1550 nm (R>95%). Oscillation starts near degeneracy at a coupled pump power of 34 mW. Fig. 1. (left) shows the measured output power of signal and idler P_s+P_i as function of the coupled pump power $P_{p,c}$. The slope efficiency is 3.3%. Tuning of the IOPO was determined by the wavelength range of mirror reflectivity exceeding 87% (Fig. 1. (right)).

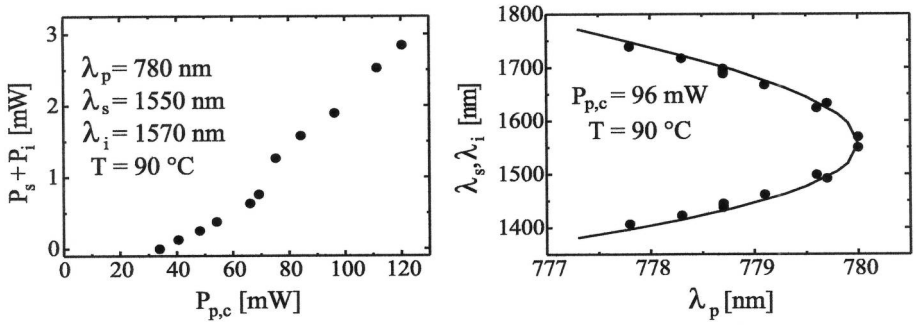

Fig. 1. Left: Signal plus idler power as function of the coupled pump power. Right: Tuning characteristic of the doubly resonant waveguide OPO (dots are measured reults, line is calculated from theory).

References

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