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Effective CW and quasi-CW LBO frequency doubled Nd:YAG lasers

S.F. BOGDANOV, V.G. BONDARENKO, A.A. FOMICHOV, P.G. KONVISSAR and
S.R. RUSTAMOV

Moscow Institute of Physics and Technology, Institutsky per. 9, 141700 Moscow Region, Dolgoprudny, Russia

Lithium borate (LBO) is one of the nonlinear crystals for second and third harmonic generation of the Nd:YAG lasers. It has the most acceptable physical, optical and nonlinear optical properties [1]. High conversion efficiency of Q-switch Nd:YAG lasers was achieved (more than 70% for Type I, and more than 80% for Type II doubling). In the last time second harmonic output power up to 10 W with pump power about 4 kW in CW regime was obtained by us [2]. It was shown that LBO can use for creation powerful CW pumped and frequency doubled lasers.

At present we elaborate series of CW pumped frequency doubled lasers working in different regimes with pump power up to 3 kW. This new series is distinguished by good stability, small sizes, reliability, excellent Gaussian structure of the output beam.

The specific of laser resonator is in the using of special Z-form spherical cavity with active rod 4x80 mm. The mirror's radii and the distance between the optical elements are optimized to achieve the stability of laser operation independently from change of thermal lense and optical wedge in laser rod. Spectral effects which are in particular connected with selective properties of intracavity elements have great influence on second harmonic radiation stability. To stabilize output power we put into the cavity frequency and polarization selectors that suppress appearance of additional generation lines for which phase-matching is absent.

Heated crystals LBO with critical and noncritical type of phase-matching were used in our experiments. The best results was obtained with heated crystals when temperature was 70-90 °C.

The main parameters of high power lasers with intracavity frequency doubling in LBO are quoted below.

- CW laser with intracavity frequency doubling pump power - 2,5 kW, output power - 2...3 W.

- Q-switch laser with intracavity frequency doubling pump power - 2,5 W, output power - 3...5 W, pulse repetition rate about 10 kHz.

- Q-switch laser with extracavity frequency doubling: pump power - 2,5 kW, output power - 3...4 W with doubling efficiency up to 40%, pulse repetition rate - 3...5 kHz.

- Q-switch mode-locked laser with extracavity frequency doubling: pump power - 2 kW, output power - 0,5...0,7 W with doubling efficiency up to 55% train repetition rate - 1 kHz, ultrashort pulse repetition rate - 160 MHz, pulse length - 50 ps.

References

1. S.P. Velsko, M. Webb, L. Davis, C. Huang. IEEE J. Quantum Electron., v. 27, pp. 2182-2192, 1991.
2. V.G. Bondarenko, P.G. Konvissar, S.R. Rustamov. CLEO-93, CThSI6.