Switching between single- and dual-wavelength generation in passively mode-locked Nd: YAG waveguide laser

M.V. Ponarina*, A.G. Okhrimchuk, P.A. Obraztsov

Prokhorov General Physics Institute of RAS, Moscow, Russia

**E-mail: ponarinamariya@gmail.com*

Dual-wavelength lasers are interesting for various applications, such as optical communication, laser location, generation of THz radiation [1]. One of the methods for producing a laser with two wavelengths is the use of crystals with several nearby emitting transitions. Nd:YAG crystal is one of such crystal and the most widely used active medium due to its excellent optical and mechanical properties.

We present a compact diode-pumped Nd:YAG solid-state laser with novel waveguide architecture. The diameter of a waveguide created in an active crystal by direct recording with a femtosecond laser beam [2] is 20 μm. Passive mode-locking is carried out by a graphene-based saturable absorber deposited on the output mirror of the cavity [3]. Precise tuning of the intracavity interferometer formed between the active medium and the output mirror makes it possible to control the spectral and temporal parameters of the output radiation [4]. The laser operation of single- (Fig. 1 (a) and dual-wavelength (Fig. 1 (b) generation, as well as the possibility of switching between them by using a precision change of the cavity length, is demonstrated.

In addition, we demonstrate the possibility of controlled switching between the generation regimes of a waveguide Nd:YAG laser by changing the polarization of the pump radiation. When horizontal polarization of the pump radiation is used, the laser operation is close to the stable passive mode-locking. When vertical polarization of pump radiation is used, the output power is higher than with horizontal polarization, but mode-locking is not observed.

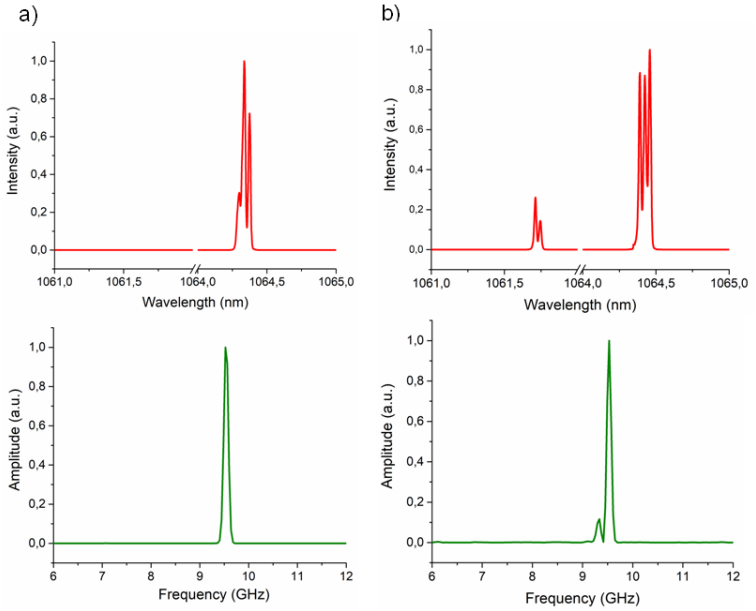

Fig.1. Optical and radio frequency spectra obtained at single- (a) and dual-wavelength (b) generation of a waveguide Nd:YAG laser.

By combining the advantages of each linear component of the pump polarization and controlling the value of intracavity losses, a passive mode-locking with a pulse repetition rate of 9.5 GHz was obtained at a wavelength of 1064 nm.

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References

[1] B.M. Walsh, Laser Phys. 20, 622–634 (2010)
[2] A. Okhrimchuk, V. Mezentsev, et al, Opt. Express, 20 (4), 3832–3843 (2012)
[3] A. Okhrimchuk, P. Obraztsov, Sci Rep 5, 11172 (2015)
[4] M. V. Ponarina, A. G. Okhrimchuk, et al, Quantum Electron, 49 (4), 365–370 (2019)