High Efficiency SESAM Mode-locked Nd:YVO₄ Laser with Direct In-Band Pumping at 914 nm

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BODY OF ABSTRACT

Diode-pumped continuous wave passive mode-locked lasers with high efficiency and high output power are used in multiple fields such as micromachining, telecommunications, and other scientific researches. Diode-pumped Nd:YVO₄ lasers have received a lot of attention due to recent development in laser diode technology which made the pumping scheme at the longer wavelength more economically viable. Moreover, by choosing longer pump wavelength than the traditional pump wavelength at 808 nm, the quantum defect is reduced resulting in lower thermal effect which is the main factor which limits the output power. So far, mode-locking results from 808, 880, and 888 nm pumping have been reported.

In this paper, a passively mode-locked operation of Nd:YVO₄ laser under in-band pumping at 914 nm is reported. A 20-mm long a-cut 1.5% doped Nd:YVO₄ crystal was pumped with up to 16.8 W at 914 nm by a fiber-coupled diode laser. A Semiconductor Saturable Absorber Mirror (SESAM) with 1.2% modulation depth and 90 μJ/cm² saturation fluence was used as one of the end mirrors of a 4-mirror laser cavity. A stable, self-starting, continuous-wave mode-locked output was achieved with a 15% output coupler (OC). At 11.0 W of absorbed pump power, the maximum output powers of 6.7 W was obtained with 60.7% optical-to-optical efficiency and 77.0% slope efficiency which are both higher than those of the commonly used pumping scheme at 808 nm. The slope efficiency shows no sign of decreasing at the highest output power which suggests that the current highest output power are not limited by the instability of the optical resonator but by the available pump power. The pulse duration (FWHM) was measured to be 17 ps which translates to 4.6 kW peak power and pulse energy of 78.8 nJ.

In conclusion, we demonstrated passively mode-locked Nd:YVO₄ laser with optical-to-optical efficiency up to 60.7% and slope efficiency of 77.0% under the new pumping wavelength at 914 nm. The maximum average output power of 6.7 W was achieved with pulse duration of 17 ps.

REFERENCES


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