サブ 100 ピコ秒 Nd:YVO_4 マイクロチップ MOPA システム

Sub-100 ps Nd:YVO_4 microchip MOPA system

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Microchip lasers (MCLs) using a combination of Cr^{4+}:YAG saturable absorber for a high damage threshold and quasi-cw pumping for an effective heat management are enlarging their application field with energy scaling over mJ (with < 1 ns pulse width and < 10 kHz repetition rate) [1], such as laser ignition [2], remote laser induced breakdown spectroscopy (LIBS) [3], high power THz generation [4], and so on. However, the combination makes an operation with a shorter pulse and a higher repetition rate difficult because of a long cavity and discontinuity. Here, we demonstrate a MCL with a short cavity generating short pulses with a width of 82 ps at a high repetition rate of 297 kHz and master oscillator power amplifier (MOPA) systems for energy scaling. The MCL was composed of a 0.5 mm-long a-cut 1 at. % Nd:YVO_4 crystal and a semiconductor saturable absorber output coupler (SESOC) [Fig. 1(a)]. The SESOC (Batop GmbH) had a thin saturable absorber and partial reflection layers at the front side, allowing a short cavity length of ~0.51 mm. Its modulation depth, saturation fluence, and relaxation time constant was 13%, 500 μJ/cm^2, and ~20 ps, respectively. A cw Ti:Sapphire laser was used to end-pump at a wavelength of 808 nm. The laser characteristics such as pulse repetition rate, duration, and energy were depended on pump power and diameter. Shortest pulses with a FWHM width of 82 ps having an average power of 54.5 mW were generated at a repetition rate of 297 kHz using a pump power of ~0.6 W and a pump diameter of ~60 μm. For energy scaling, we compared MOPA systems with single- and double-pass schemes using a 10 mm-long a-cut 0.3 at. % Nd:YVO_4 crystal and a fiber tailed pump LD (808 nm, 20 W), where the polarization of seed light was adjusted to match the c-axis of Nd:YVO_4 for a higher gain [Fig. 1(b),(c))]. Double-pass scheme resulted in about 12 times amplification at the pump power of 20 W, showing about 2 times larger amplification than single-pass scheme [Fig. 1(e)]. This work partially supported by JST-Mirai Program Grant Number JPMJMI17A1 and JST-CREST of Japan.

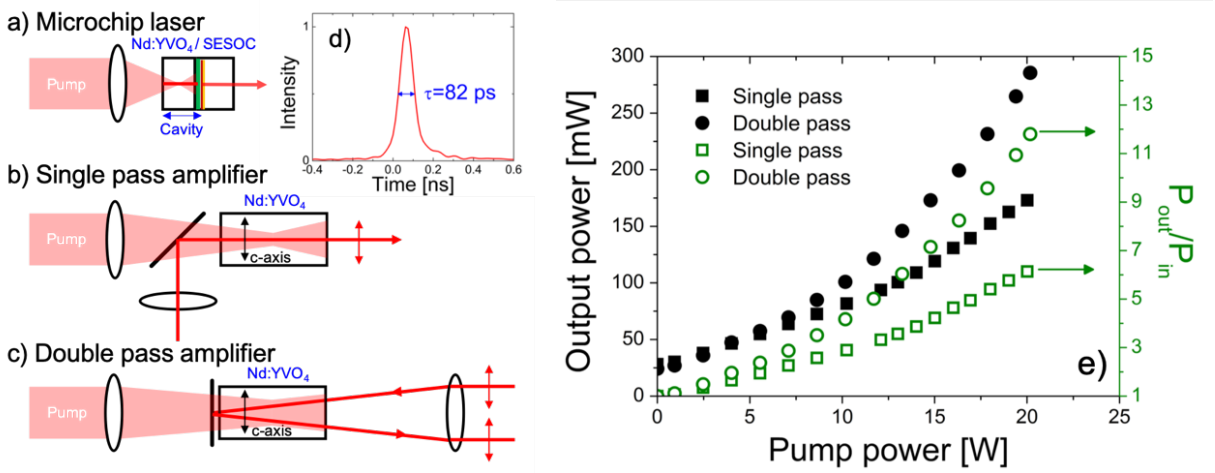

Fig. 1. Schematic of experimental setup for microchip laser (a) and MOPA with single (b) and double (c) scheme. The measured pulse shape (d), and output power and amplification ratio as a function of pump power (e).

Reference

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