Property of amplifier using Yb:YAG thin-rod

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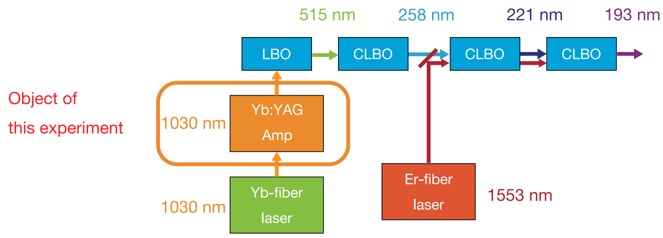
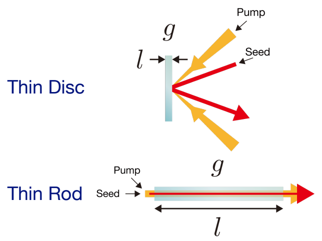
1. Background

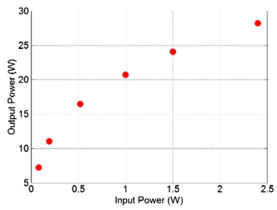
The wavelength is converted by a nonlinear optical crystal, and ultimately, it is possible to obtain 193 nm light of high quality (high beam quality, narrowband spectrum). For a hybrid 193-nm laser, we develop the compact solid-state laser system as an oscillator.



2. Promising method for compact amplifier

【Method example】Thin Disc or Thin Rod 【Example of high output by thin rod】





[1] I. Kuznetsov *et al.*, Opt. Lett. **43**, 3941 (2018).

3. Objective

We develop a 6-kHz, high average power laser using a 3-cm long Yb:YAG thin rod.

4. Property of ns-seed laser pulse

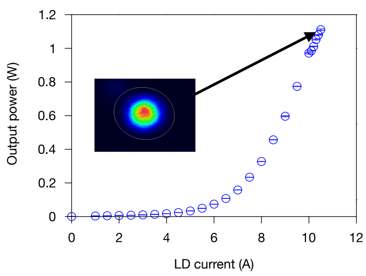


Fig. 4-1. Output power and beam profile of the seed pulse from a fiber laser oscillator. The maximum power was 1.13 W.

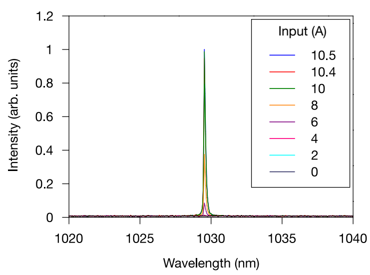


Fig. 4-2. Spectra of a fiber laser amplifier.

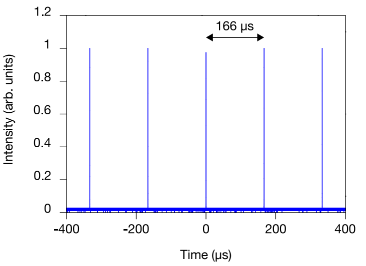


Fig. 4-3. The repetition rate of the fiber laser was 6 kHz.

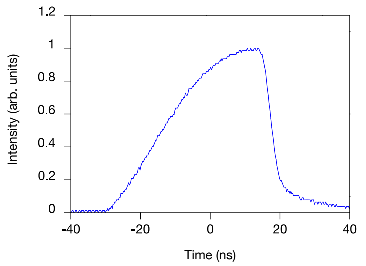


Fig. 4-4. The pulse width was 30 ns (FWHM).

5. Comparison & summary

- **Comparison:** Previous report [1]
- Gain: 3 under 2-passes at the pulse width of 300 fs.
- Output power: 28 W (Input power: 2.8 W, Pump power: 120 W)

- **Summary:** We have improved the Yb:YAG thin rod pre-amplifier.
- Gain: 7.7 under 2-passes at the pulse width of 30 ns
- Output power: 15.2 W (Input power: 250 mW, Pump power: 100 W)

6-(a). Counter excitation amplification (1-pass)

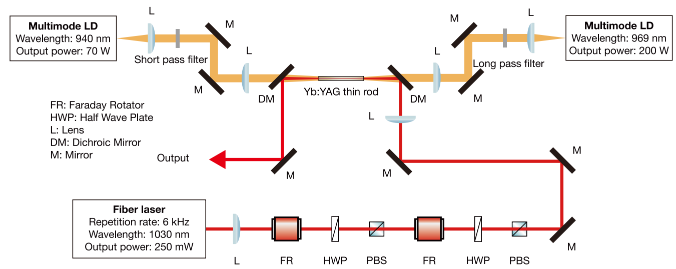


Fig. 6-1. Optical layout of Yb:YAG rod amplifier by two wavelengths (940 & 969 nm) pumping.

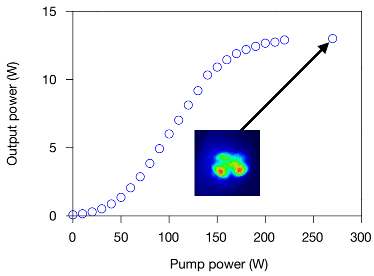


Fig. 6-2. Output power and beam profile of the seed after the Yb:YAG rod amplifier. The maximum power was achieved to be 13 W.

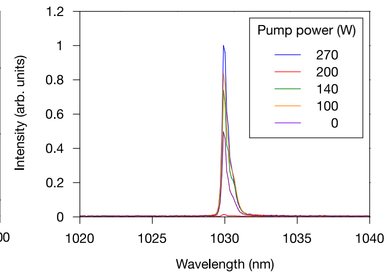


Fig. 6-3. Spectra of Yb:YAG thin-rod amplifier.

6-(b). Counter excitation amplification (2-passes)

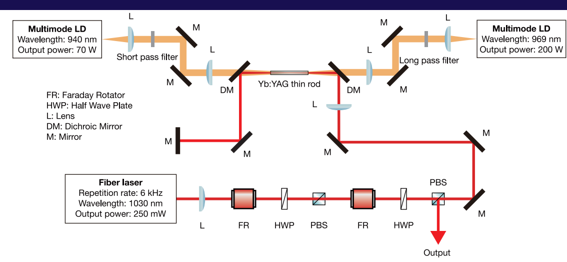


Fig. 6-4. Optical layout of Yb:YAG rod amplifier by two wavelengths (940 & 969 nm) pumping.

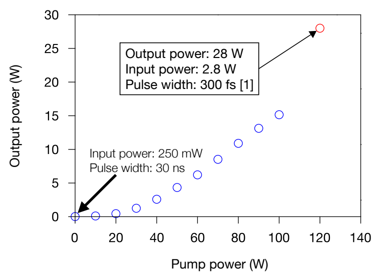


Fig. 6-5. Output power after the Yb:YAG rod amplifier. The maximum power was achieved to be 15.2 W.

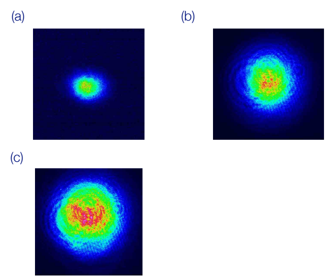


Fig. 6-6. Beam profiles at (a) without pump, (b) 50-W pump, and (c) 100-W pump at 940-nm and 969 nm CW LDs.