Development of a fast wavelength switchable external cavity semiconductor laser

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1. Introduction

In an injection-seeded terahertz (THz) wave parametric generator (is-TPG), pump and seed beams shine a $MgO:LiNbO_3$ crystal to generate THz waves [1]. High-speed spectroscopy can be achieved if the seed laser can switch wavelengths rapidly; however, there are currently no commercially available lasers with these characteristics. In this work, we have developed a fast wavelength switchable external cavity diode laser (ECDL) with a digital micromirror device (DMD) as a wavelength selector.

2. General Instructions

The experimental setup is shown in Fig.1. The beam output from a diode laser (OE-1040TA; Spectra Quest Lab) was diffracted by a grating, and then each wavelength was focused onto the DMD surface. In the DMD, micromirrors are arranged in an array as shown in the upper right corner of the figure, and each mirror can be controlled individually. Thus, the oscillation wavelength could be selected by tilting the micromirrors placed at the desired wavelength position.

We introduced a ring cavity as a resonator to suppress spatial hole burning, which leads to unstable oscillation. Since only the selected wavelength was output, an ASE-free laser with a high signal-to-noise ratio of more than 75dB was achieved. In previous works, damage to the DMD prevented higher power output [2-3]. In this laser, the damage was suppressed by introducing a cylindrical lens to focus the beam onto the DMD. This allowed us to increase the output power by one order of magnitude to over 300 mW. However, the use of the cylindrical lens narrowed the wavelength tunable range due to diffraction by the DMD. To address this, the direction of the DMD was changed from the conventional portrait alignment to landscape alignment, which has less diffraction. As shown in Fig.2(a), the tunable wavelength range was expanded from 2.6nm to 10.6nm.

Fig.2(b) shows the change in output when the wavelength was varied. Switching between two wavelengths occurred at a switch rate of 6.55kHz. Even during high-rate wavelength switching, the oscillation was stable and reproducible.

3. Conclusions

We developed a discrete and fast wavelength switchable external cavity diode laser using a DMD for wavelength selection.

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References

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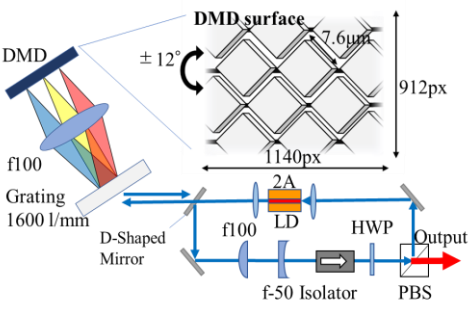
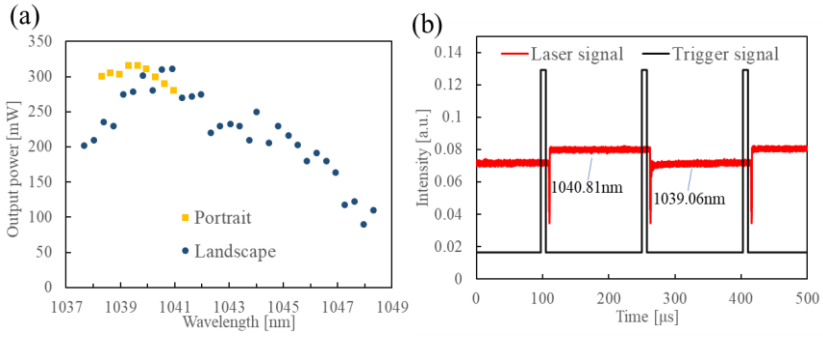


Fig. 1 Experimental setup of external cavity diode laser using a DMD.



ependence. (b) Switching between two wavelengths at switch rate of 6.55kHz.