Generation of duration-tunable narrow-bandwidth optical pulses from an injection-locked gain-switched laser diode

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INTRODUCTION Tunable short-pulse lasers in both wavelength and time domains are attractive light sources for various applications such as laser processing or optical communications [1,2]. Stable optical pulses of variable pulse duration and wavelength are required for different laser processing. Therefore, narrow spectral bandwidth is desired for the lasers, which converting wavelength by using nonlinear optical effects is required to obtain optical pulses at visible region. An injection-locked gain-switched was reported to be able to generate duration-tunable narrow-bandwidth optical pulses. However, it was difficult to obtain smooth-shaped optical pulses of different pulse durations due to the complex control of different parameters such as temperature and injection power. This time we report a novel method to realize optical pulse duration-tunable narrow-bandwidth laser source.

EXPERIMENT AND RESULTS CW light from a distributed-feedback (DFB) LD under DC current driving was injected into a Fabry-Perot (FP) LD with long cavity (5mm) generating optical pulses by gain switching operation. An optical circulator was used to connect both LDs for preventing the light reflection from the LD facet. Figure 1 show the temporal waveforms and optical spectrums at different pulse durations of optical pulses generated from the injection-locked gain-switch laser diode (ILGS-LD). An injection power of 4.5mW from DFB-LD was applied to FP-LD to obtain the smooth optical pulses. The pulse durations were controlled under driving the electrical pulses from FP-LD. As a result, output optical pulses remained smooth shapes and narrow bandwidths were obtained at different pulse durations. Therefore, we expect that the present approach can be beneficial for extending the technology toward many applications such as laser micromachining.

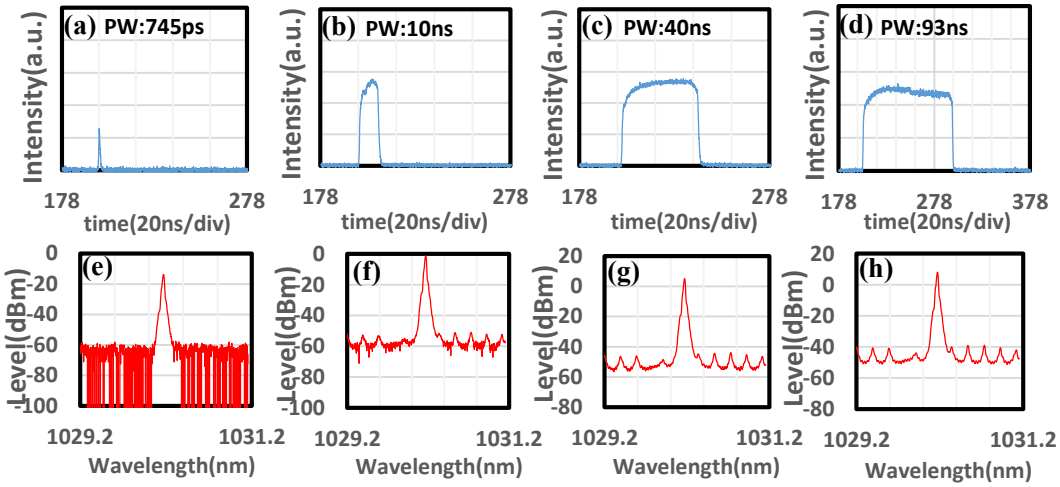

Fig. 1 Temporal waveforms and optical spectra for a IL-GS-LD under injected at different pulse duration. (a), (b), (c) and (d) are temporal waveforms; (e), (f), (g) and (h) are optical spectra; The injection power is 4.5mW; Driving pulse voltage is set to 5V at 1-MHz repetition rate, and pulse duration is set to be 6ns, 16ns, 47ns and 106ns for (a), (b), (c), and (d), respectively.

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References

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