

Generation of duration-tunable narrow-bandwidth nanosecond optical pulses from a semiconductor laser

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INTRODUCTION Pulsed semiconductor laser sources have received significant attention in recent years for many applications including optical communication and bio-imaging[1, 2]. Gain-switched laser diode (GS-LD) have their own distinct advantages such as simple and flexible operation properties. In this report, we describe an advanced method to provide duration-tunable narrow-bandwidth and high-peak-power optical pulses from a GS-LD.

EXPERIMENT AND RESULTS It is predicted by a simple rate-equation analysis that relaxation oscillation can be suppressed when a proper CW laser light is injected into a GS-LD. In our experiment, a Fabry-Perot LD (FP-LD) was under the gain-switched operation and the CW laser light was provided by a distributed-feedback LD (DFB-LD). Figure 1 shows examples of optical pulse waveform and spectrum with and without CW laser light injection. As shown in Fig.1 (c), because of the injection locking, there was no relaxation-oscillation feature in the temporal waveform, and the optical spectrum became sharp. At 1-MHz repetition rate, the averaged output power was 2.3mW, and the peak power was currently up to 0.6W. The duration of the output optical pulses was flexibly controlled by electrical pulses. Figure 2 shows a few examples of temporal waveforms for optical pulses generated from an injection-locked GS-LD by changing the electric pulse duration. All of the waveforms were smooth and the optical spectra were quite similar for all the cases. Based on the results obtained, we expect that the present approach can be beneficial for extending the technology toward many applications such as laser micromachining and laser microscopy.

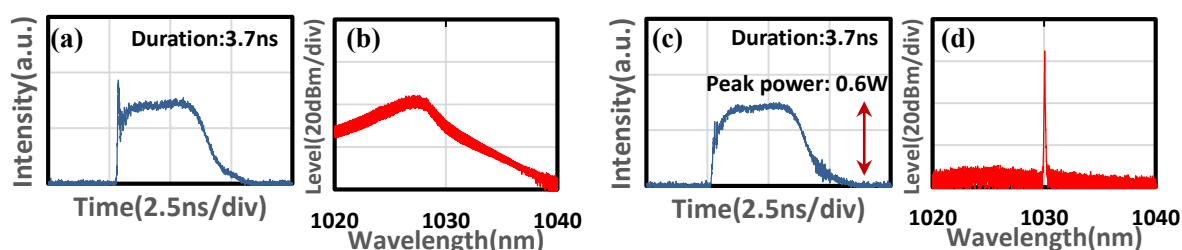


Fig. 1. Oscilloscope temporal waveforms and optical spectra for a GS-LD. (a) and (b) are without laser light injection, (c) and (d) are under the complete injection-locking condition. Electric pulse duration is 4.7ns, and pulse voltage is 31V.

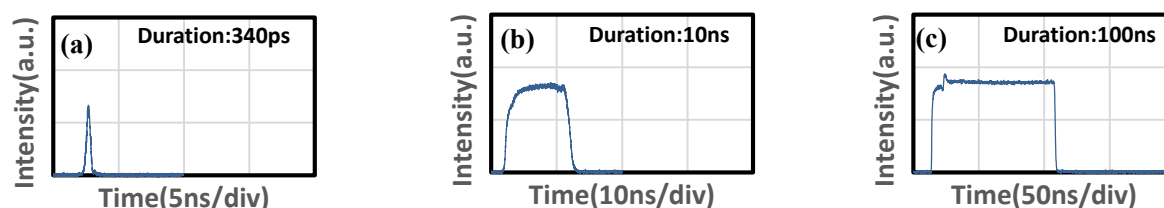


Fig. 2. Optical pulse temporal waveforms for the injection-locked GS-LD with three different electric pulse durations. Pulse voltage is 5V at 1-MHz repetition rate, and pulse duration is set to be 6.7ns, 16ns, and 106ns for (a), (b), and (c) respectively. Optical pulse peak power is evaluated to be approximately 50mW for all the cases.

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References

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