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

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INTRODUCTION Optical pulse generation from semiconductor laser diodes are widely used for many applications such as laser machining and bio-imaging [1][2]. Although it is easy for a gain-switched laser diode (GS-LD) to generate optical pulses, it is difficult to obtain duration-tunable smooth-shaped pulses because of the relaxation oscillation feature of an LD. In this report, we describe a method to solve this problem by incorporating GS-operation under CW laser light injection.

EXPERIMENT AND RESULTS It is predicted by a simple rate-equation analysis that the relaxation oscillation can be suppressed when a proper CW laser light is injected into an LD. This feature is attractive for generating smooth-shaped duration-tunable optical pulses. Based on the analysis, we have carried out experiments to confirm the expected operation properties. In our experiment, we used a distributed-feedback LD (DFB-LD) to generate CW laser light under constant DC current excitation, and a Fabry-Perot LD (FP-LD) for GS operation. By choosing proper operation conditions, we could observe single-mode duration-tunable optical pulses. Figure 1 shows examples for temporal waveforms indicating optical pulses generated from an injection-locked GS-LD (ILGS-LD). The results shown in Fig.1 show that the present method is promising for generating sub-nanosecond to hundreds of nanosecond duration-tunable narrow-bandwidth smooth-shaped optical pulses. We expect the ILGS-LD method will be a real-world technology for very broad applications.

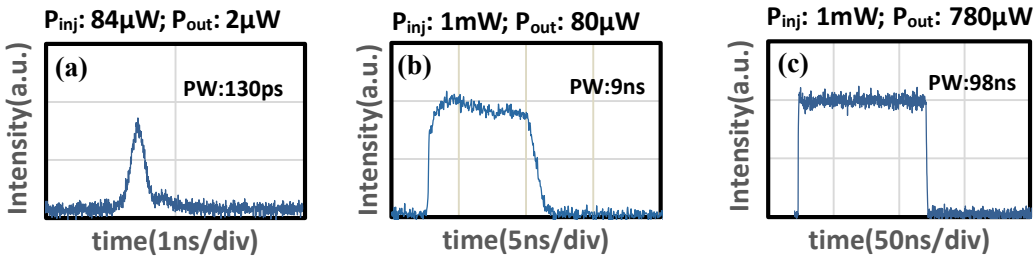

Fig. 1. Three examples for ILGS-LD optical pulse with different electric pulse durations. Repetition rate: 5MHz. Electrical pulse duration: 300ps for (a), 10ns for (b), 100ns for (c), electrical pulse voltage: 10.6V for (a), 3V for (b)(c). P_{inj} is the averaged power for the CW injection laser, P_{out} is the averaged optical pulse output power, and PW is the optical pulse width.

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References

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