Generation of burst optical pulses from a gain-switched laser diode by CW laser light injection

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INTRODUCTION The burst-mode pulsed lasers are finding extensive applications in material processing [1] and fluorescence imaging [2]. This is because that the burst-mode pulsed laser can reduce the thermal damage on targets by separating the single-shot pulse energy to burst pulses. For the generation of optical pulse bursts, the conventional way is to utilize external modulators to gate the high repetition rate seed pulses. A more cost-effective method is to use a directly modulated laser diode (LD) as the seed laser for burst mode operation, and this approach can remove external modulators [3]. However, in this method, properly-designed and high-speed electronic systems are needed to control the inter-burst and intra-burst repetition. In the present report, we demonstrate a novel method that can generate burst-mode optical pulses by a combination of gain-switching (GS) of an LD and continuous wave (CW) laser injection.

EXPERIMENT AND RESULT The basic scheme is the injection of an external CW laser light into a gain-switched laser diode (GS-LD). Figure 1 shows the experimental configuration. CW laser light from a DC-driven 1064-nm distributed feedback (DFB) LD was coupled into a pulse-driven Fabry-Perot (FP) LD through an optical circulator. The generated optical pulse was observed at the circulator output (denoted as port 3 in Fig. 1). Figure 2 shows a couple of oscilloscope waveforms for optical pulses obtained without and with CW laser light injection. Without CW light injection, the typical GS optical pulse shape was observed, and the pulse width was < 40 ps. On the other hand, when the CW laser light was injected, we observed the burst-like optical pulse generation with pulse width of ~130 ps. We also confirmed that by increasing the CW laser light power, the pulse width and the pulse period were changed. The dynamics of GS-LD under CW light injection was demonstrated and analyzed previously [4]. However, in view of the application of burst optical pulses, this method has a potential to become a real-world technology.

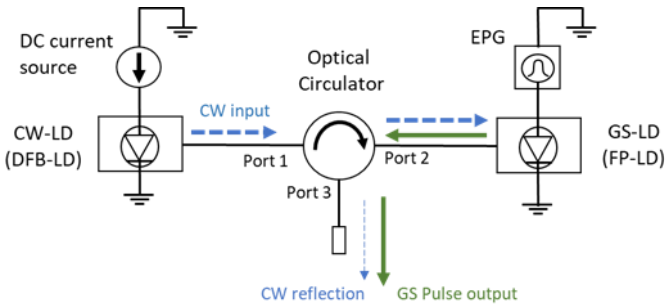

Fig. 1. Schematic of the experimental setup. LD: laser diode, DFB: Distributed feedback, FP: Fabry Perot, GS: Gain-switched, EPG: Electrical pulse generator.

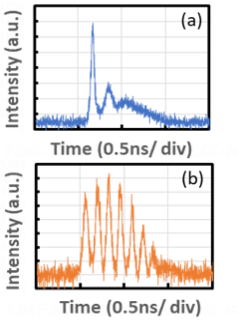

Fig. 2. The gain-switched pulse shape without CW injection (a) and with CW injection (b).

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