Fundamental research of 300-Gb/s-class, semiconductor-based, all-optical gate scheme which contains complex-amplitude spectrum synthesizer

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All-optical wavelength converters based on semiconductor optical amplifiers (SOAs) are promising devices for future high-capacity wavelength-division-multiplexing (WDM) networks, due to their ultrafast response, low power consumption, and integration potential. 320-Gb/s wavelength conversion with a delayed-interference (DI) scheme has recently been demonstrated[1]. For ultrahigh-speed signal processing above 320 GHz, pulse width shorter than 1 ps is required. It has been reported that under ultra-short control pulses the gated output waveforms with the DI scheme is distorted since the SOA gain recovery has fast and slow components (Fig. 1) due to carrier temperature relaxation and electron-hole recombination, respectively[2]. Ueno *et al.* had numerically demonstrated a particular optical-spectrum-synthesizer (OSS) design that independently controls the intensity and the phase of spectrum with the expanded DI scheme, by which the gated waveform distortion has successfully been removed[3]. In this talk, we report the progress of experimental demonstration that all-optical gate with OSS removes the gated output waveform distortion.

In advance of experimentally studying the OSS gate scheme, we characterized the spectral resolution and the extinction ratio of one of our proto-type OSS (it is called variable bandwidth spectrum shaper[4] (VBS, Optoquest Co., Ltd.) due to control function). The spectral resolution and the extinction ratio were from 9.7 GHz to 11.6 GHz and 13 dB, respectively. According to these latest results, we have estimated that we'll be able to verify the validity of the above-mentioned new scheme by our experimentally removing most of the waveform distortion with using the existing proto-type OSS. Figure 2 indicates the presently estimated degree of improvement (i.e., from the distortion without VBS in Fig. 2(a), to that with VBS in Fig. 2(b)).

Based on these estimated results, we will try to experimentally observe such significant removals of the ultrafast distortion, and present one typical example in the poster presentation.

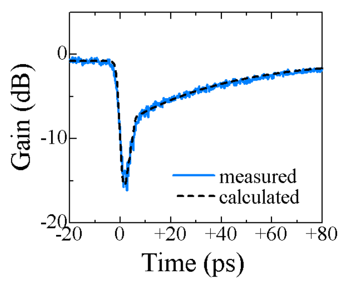

Fig 1. Measured (solid) and calculated (dashed) SOA gain recovery. Input pulses are 2.0-ps 10-fJ at 1.25-GHz. The fast and slow recovery time constants were 6.0 ps and 50 ps, respectively.

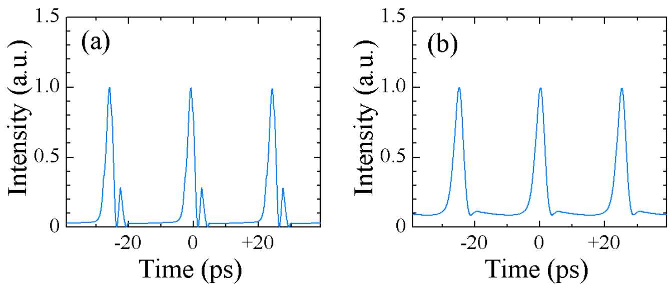

Fig 2. Numerically estimated waveforms at the output of all-optical gates, where 2.7-ps, 40-GHz, 7.6-fJ input pulses were assumed.

(a): assuming the conventional gate scheme.
(b): assuming our planning experiment with an existing proto-type OSS.

References

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