Up-Conversion Cross-Correlation for Characterization of Sub-Nanosecond Terahertz-Wave Pulses

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Over the last decade, there has been a growing interest in the development of semiconductor-based THz-wave detectors with high-speed responses for many applications, such as non-destructive sensing and wireless communications. It has been demonstrated recently that InGaAs-based grating-gate plasmonic THz-wave devices are capable of detecting monochromatic THz-wave pulses from an injection-seeded THz-wave parametric generator (is-TPG) with sub-nanosecond temporal resolution [1]. In this work, for accurate characterization of the response speed of such semiconductor-based detectors, we measured the pulse duration of THz-wave pulses from is-TPG by using an optical cross-correlation technique.

Fig. 1 shows a schematic of the experimental setup for up-conversion cross-correlation in trapezoidal MgO-doped lithium niobate (MgO:$LiNbO_3$) crystal [2]. The MgO:$LiNbO_3$ crystal was excited by 1064-nm pump pulses, whose pulse duration was characterized as 351 ps by standard second-harmonic-generation autocorrelation. The monochromatic THz-wave pulses from is-TPG were focused into the MgO:$LiNbO_3$ crystal to generate up-converted waves which were measured by NIR photodetector.

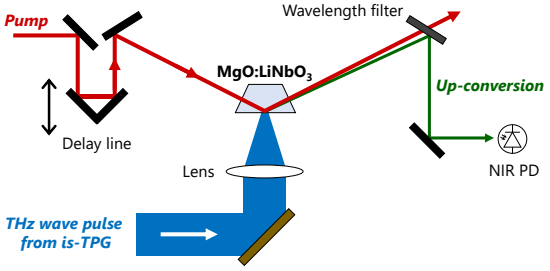

Fig. 1. Schematic experimental setup.

Fig. 2 shows the measured up-conversion signal at 1.50 THz versus delay time between pump and THz-wave pulses. The cross-correlation width at FWHM was measured to be 399 ps, corresponding to the THz-wave pulse duration of 190 ps.

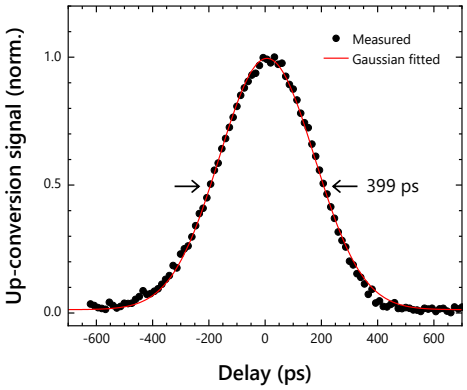

Fig. 2. Measured up-conversion cross-correlation result at 1.50 THz with Gaussian fitting curve.

References:

[1] T. Negoro *et al.*, IRMMW-THz 2020, Online (Nov., 2020).

[2] Y. Takida *et al.*, Opt. Express **25**, 5389 (2017).

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