Generation of THz radiation via polariton scattering in a rectangular $LiNbO_3$ waveguide

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Terahertz radiations are electromagnetic waves ranging from 0.1 to 10 THz. These waves are of significant interest for applications like imaging and spectroscopy. A promising method for generating coherent THz radiations involves polariton scattering in polar crystals, such as Lithium Niobate (LN) [1]. This process has been mostly investigated to deliver tuneable narrow-band THz radiation [2] when a long pulse pumps the material. A significant challenge hindering this technique lies in the generation of a THz spectrum centred at frequencies exceeding 2 THz, primarily due to the gain spectrum of LN, and the important absorption coefficient at higher frequencies [3]. In this submission, we highlight the possibility to overcome this limitation by pumping a rectangular LN waveguide with an ultra-short pulse. An Ytterbium-based ultra-fast laser with a 400fs pulse at 85 kHz repetition rate pumped a 500 × 500 μm $LiNbO_3$ waveguide (15 mm length) at room temperature. Figure 1 shows an example of a temporal trace recorded through electro-optic detection (EO) when the average power is set at 600 mW. The fast Fourier spectrum of the EO sampling measurement (Figure 2) shows a broadband peak with a width of ~ 4 THz (at full-width at half maximum) centred at 3 THz. Our results agree with the theoretical phonon polariton dispersion curve and the diffraction modified Schwarz-Maier plane wave model [4]. In this case, the mode area mismatch between the optical and the THz fields together with the unique waveguide structure which minimizes the diffraction-induced absorption lead to a modification in the gain spectrum, centred at 3 THz. Given the compatibility of waveguides with on-chip fabrication and their compact footprint, this research is a good step forward to develop an elegant platform for realizing on-chip THz radiation generation through nonlinear conversion processes.

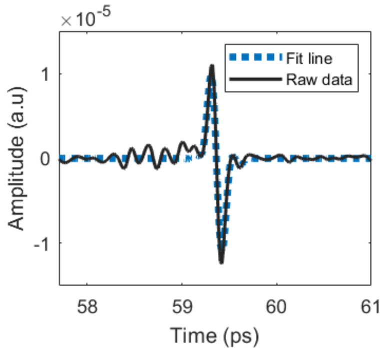

Figure 1 : Temporal wave form of the detected THz pulse

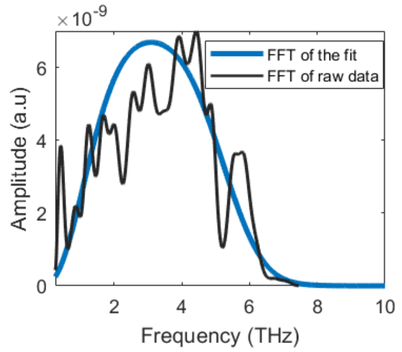

Figure 2 : Corresponding spectra obtained by FFT

References:

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