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Multicycle THz pulse generation enhancement by Gires-Tournois etalons

The use of high-energy multi-cycle THz pulses is increasingly important in fields such as imaging, spectroscopy, and particularly particle acceleration [1]. Optical rectification in periodically poled lithium niobate is a method for generating such pulses [2]. Instead of utilizing a periodically poled crystal, it is feasible to pump a wafer stack where the z-axis of consecutive wafers points in opposite directions. The size of the wafers can be significantly larger than that of the periodically poled crystals, which allows for the use of much higher pump energies and also results in greater generated THz energy. Although pumping the resulting wafer stack structure with a single pulse [3] has been demonstrated, to the best of our knowledge, the employment of the output from a Gires-Tournois etalon to create a multi-pulse pump has been explored only with tilted-pulse-front THz source [4].
In a Gires-Tournois etalon –wafer-stack system the thickness of the etalon has to be selected so that the delay between two consecutive reflections matches the inverse of the THz frequency: $d = c/(2n_g)$. To achieve the same intensity for the first two output pulses, the reflectivity of the etalon is adjusted to approximately 38%. According to numerical calculations, under identical pumping pulse intensities, using a GT etalon leads to almost twice higher peak electric fields.

In our experiments, two wafer stacks, consisting of layers having different thickness, have been assembled using commercially available x-cut lithium niobate wafers with anti-reflection coating on both sides. The wafers were pumped by a laser with a central wavelength of 1030 nm, pulse duration of 175 fs, and pulse energy of 1 mJ. The efficiency of THz generation and the obtained waveforms and spectra were characterized using electro-optical sampling. Measurements involving the use of Gires-Tournois etalons in the pump are ongoing, with completion planned by the end of March 2024. The results and discussions will be presented on the poster.

References

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Primary authors: Mr GENRE, Andres Leva (University of Pécs); Mr ILLÉS, Gergő (University of Pécs); Mr KRIZSÁN, Gergő (University of Pécs, HUN-REN-PTE High Field Terahertz Research group, Szentágothai Research Center); Dr TÓTH, György (University of Pécs, HUN-REN-PTE High Field Terahertz Research group); Dr HEBLING, János (University of Pécs, Szentágothai Research Center); NASI, Luis (University of Pécs); Dr PÁLFALVI, László (University of Pécs, HUN-REN-PTE High Field Terahertz Research group); Mr KISS, Mátyás (University of Pécs, Szentágothai Research Center); Dr TURNÁR, Szabolcs (University of Pécs, HUN-REN-PTE High Field Terahertz Research group, Szentágothai Research Cented)

Presenter: NASI, Luis (University of Pécs)

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