Noncritical phase-matched THz generation in GUHP molecular crystal

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Abstract— A narrow-band coherent terahertz radiation source based on a semi-organic molecular crystal GUHP is presented. The unique resonant spectral features of the transmission in the terahertz frequency range make it possible to achieve the duration of generated THz pulses up to ~300 ps at a temperature of 10 K with a stable oscillation frequency of the electromagnetic field.

Keywords— terahertz, molecular crystal, semi-organic crystal

I. Introduction

Semi-organic molecular crystal guanylurea hydrogen phosphite $(NH_2)_2CNHCO(NH_2)H_2PO_3$ (GUHP) is an object of great interest due to the resonant response of the lattice in the THz frequency range. The new formation of this crystal was recently grown [1,2] and has unique properties different from the previous formation.

The purpose of this work is to investigate terahertz dielectric properties of GUHP crystals under different conditions and to control these properties by fs laser pumping. The results show the prospects of the crystals' application in terahertz photonics.

II. Discussion

The spectra of generated in GUHP crystal THz radiation were measured on a standard time-domain terahertz spectrometer. To excite the molecular phonon subsystem of the crystal we used two wavelengths of the pump radiation: 1325nm and 797 nm. The pulse energy of 0.7 nJ and 6.2 GHz peak FWHM were achieved. For the simulation of spectral features of THz radiation generated in GUHP crystal the classical nonlinear optical formalism was used in the constant and plane wave approximation in the case of noncritical phase matching. There are two contributions to the generation of THz radiation in GUHP crystal: fast, electronic nonlinearity (broadband radiation) and slow, ionic nonlinearity (narrow generation band) (Fig 1). The results of simulation are in a good agreement with the experimental results.

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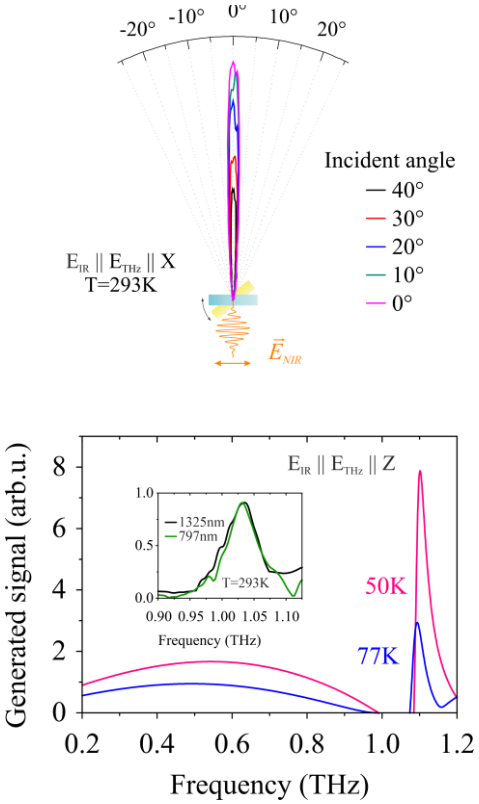

Fig. 1. The room temperature radiation directional diagrams as a function of the pump radiation incident angle and the simulated Z-mode THz generation spectra at 50 and 77 K. The inset represents the experimental comparison of two pump wavelengths.

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