THz Spectroscopy of ZnTe and GaSe

S. S. Prabhu[a], Alok U. Chaubal[a], and A. S. Vengurlekar[a]
[a]Tata Institute of Fundamental Research, Mumbai, 400005 India

Abstract—**We present a study of Tera-Hertz (THz) radiation obtained by using ZnTe and GaSe crystal. The experimental setup and the THz generation in ZnTe are modeled theoretically and the model is extended to the results obtained from the GaSe crystal. The experimental data for ZnTe is fitted well by appropriately varying its dielectric constant values and similar approach is explored for the case of GaSe crystal.**

I. Introduction And Background

The Tera-Hertz (THz) region of the electro-magnetic wave spectrum offers several new areas of applications. Control of the emitted THz spectrum by shaping the incident IR pulses or angle tuning the crystal like GaSe, has several advantages. Studying the THz pulse emission spectrum from such crystals is important. Attempts have been made in the past to theoretically model the experimental setup for the THz generation, propagation and detection. We present here two distinct studies of different crystals. First, we study the effect of excitation wavelength on the generation and detection crystals. Also, using theoretical model, we fit the observed data for ZnTe. Secondly, we extend the model for GaSe with appropriate modifications as per the experimental conditions.

We use 82MHz repetition rate, 100fs pulsewidth Ti:Sapphire laser for the investigation of the ZnTe crystal. For the GaSe crystals, we use 10fs, 300mW average power Ti:Sapphire laser with 75MHz repetition rate. The THz spectroscopy setup is the standard one described in the literature. The thickness of the ZnTe crystals used for the generation is 2mm and for detection is 0.5mm. The thickness of GaSe crystals used for generation is 2mm, 1mm, 90microns and 30mirons and for detection is 30microns, 90microns and 1mm.

II. Results

We generate the THz radiation by Optical Rectification process in ZnTe and GaSe. Calculation of the THz electric field generated from the ZnTe crystal and modeling the propagation of the THz radiation through the experimental setup [1,2] are known. The model fits the experimental data for ZnTe well. Fig.1 shows the experimental data with the theoretical fit. We extend this model appropriately for the GaSe crystal. In Fig.2 we show the experimental results for the GaSe with 780nm excitation with 10fs pulses at 6 degrees angle of incidence. We see all the low energy excitation of water vapor molecules. However, as the angle is changed, the curve completely changes its character and very high frequency oscillations are seen. The Fig.2 inset shows high frequency signal from GaSe. We extend the model for ZnTe to GaSe, with appropriate modification and the fits look promising (not shown here).

Figure 1: The experimentally measured temporal evolution of the THz electric field for ZnTe and theoretical fit.

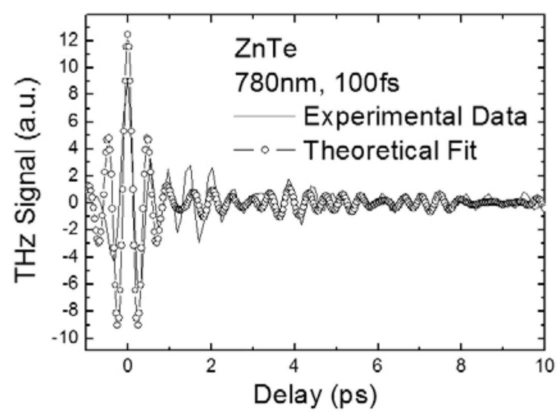
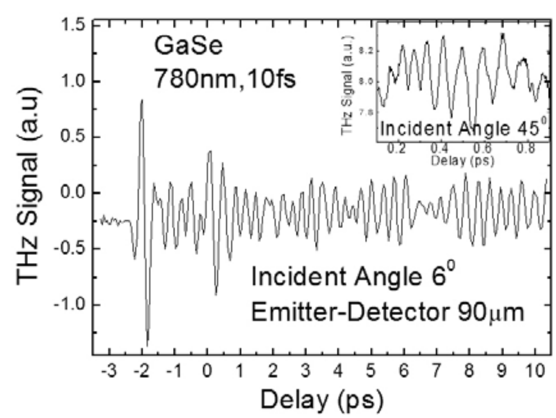


Figure 2: The experimentally measured temporal evolution of the THz electric field is shown from 90 micron thick GaSe (6Degrees) and the inset shows the curve obtained at a different angle (45Degrees).



References

[1] J. Faure, J. van Tilborg, R. A. Kaindl and W. P. Leemans, "Modelling laser-based table-top THz sources, optical rectification, propagation and electro-optic sampling" *Opt. and Quant. Electron.* vol. 36, pp. 681-697 (2004).

[2] J. Ahn, A. V. Efimov, R. D. Averitt and A. J. Taylor, "Terahertz waveform synthesis via optical rectification of shaped ultrafast laser pulses" *Optics Express*, vol. 11, pp. 2486-2496 (2003).

978-1-4244-2120-6/08/$25.00 ©IEEE.