THz air-biased-coherent-detection spectrometer for material sensing

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▶ **Compact** THz platform ▶ **Broad bandwidth** 0.5~35 THz in 32 fs laser ▶ **High peak THz field** >100 kV/cm
▶ **High dynamic range** >2000 ▶ **Time-resolved** spectroscopy ▶ **Absorption-free** material measurement

Abstract

Terahertz (THz) wave sensing and imaging have been the focus of considerable attention within standoff detection in explosives, weapons as well as non-destructive evaluation of products. However, the broad-bandwidth and high-electric field for THz wave sensing and imaging are lagging behind the compelling needs for this technology. We designed a reflective THz air-biased-coherent-detection (ABCD) spectrometer with a pulsed femtosecond laser amplifier.

A usable, continuous bandwidth from 0.5 THz to over 35 THz and a peak THz electrical field greater than 100 kV/cm are demonstrated. In addition, the compact and table-top THz-ABCD spectrometer provides an alternative tool to compete with the Fourier transform infrared (FTIR) spectrometer, which has been a major commercial product for several decades.

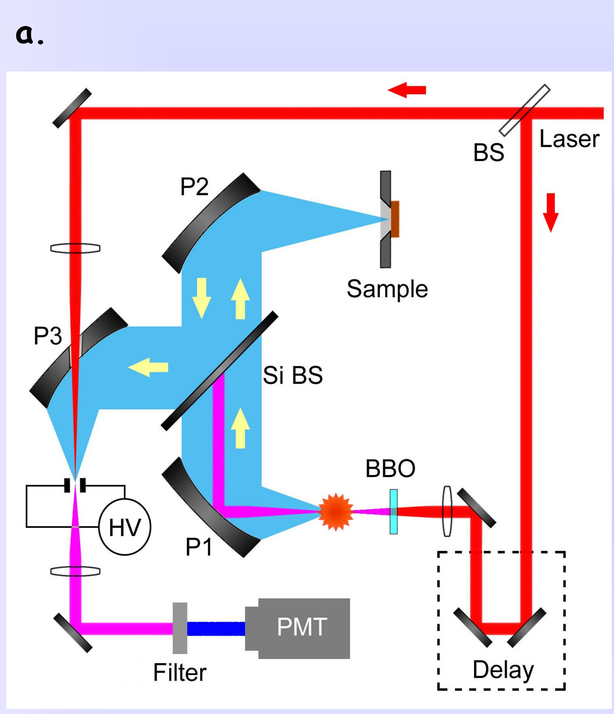


Fig. 1. (a) The schematic setup of R-THz-ABCD spectrometer. **(b)** Measured time-domain waveforms via conventional ZnTe sensor and via THz-ABCD sensor. **(c)** The Fourier transform spectra according to Fig. 1(b). Our group has successfully demonstrated ultra broadband THz spectroscopic measurements, covering a frequency range from 0.5 THz to 35 THz. This is one order of bandwidth improvement in comparison with conventional and commonly-used ZnTe sensor.

Experimental results

a. Explosives

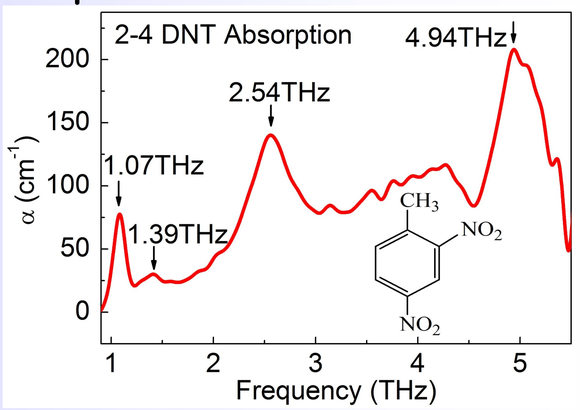


Fig. 2. The absorption spectrum of 2-4 DNT explosive.

b. Semiconductors

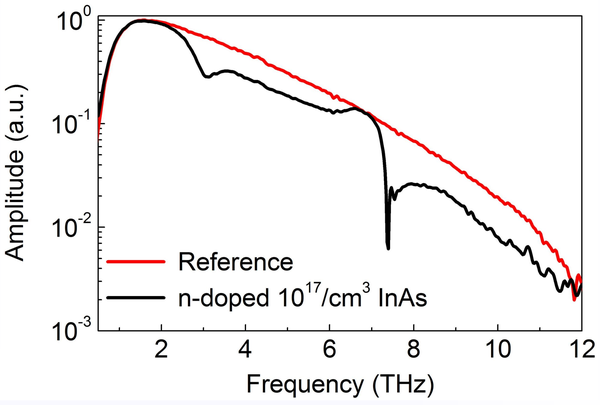
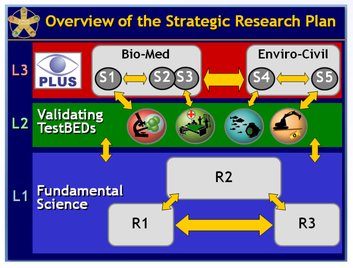


Fig. 3. The reflection spectrum of an n-doped $10^{17}/cm^3$ InAs crystal and the reference measured with an 85 fs pulse laser amplifier.



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References

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