Recent Advances in Terahertz Technology

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Abstract — this talk presents short overview for students, that are not very much familiar with the topic, covering briefly main aspects and applications of Terahertz (THz) technology.

Keywords — terahertz generation; terahertz generation; terahertz application

I. BEGINNING OF TERAHERTZ

Photoconductive antennas (PCAs) were the first successful technique for coherent THz signal generation and detection [1]. Since this initial demonstration, thirty years have passed, other methods of THz generation and detection with femtosecond laser pulses, have appeared and developed [2-5].

II. GENERATION

Several main methods of pulse THz radiation generation include 1) photoconductive antennas [1], 2) non-linear crystals [3], 3) semiconductor surface photo-Dember effect generation [6] 4) laser filament generation is gases [2]. All these methods involve femtosecond lasers as pump sources.

![Fig. 1. Typical THz time-domain profiles of reference (dashed blue line) beam and beam passed through highly transmitting teflon (solid red line) (a), their corresponding spectra (b) and teflon refractive index derived from these measurement (c).](image)

III. DETECTION

THz radiation can be detected both coherently and incoherently. Coherent detection allows to get the whole information on amplitude and phase, and thus reconstruct the full set of optical properties, like absorption coefficient and refractive index, of a sample. For incoherent detection pyroelectric detectors, bolometers and Golay cells are used. Coherently, THz radiation can be detected by the use of the same photoconductive antennas [1], electro-optic crystals [4], and the most recent and sophisticated method — Air Breakdown (Biased) Coherent Detection [5], involving gas as a sensing matter. All coherent methods use femtosecond probe beam and delay line to scan the profile of a THz pulse.

IV. APPLICATIONS

The main applications of THz radiation are THz spectroscopy and THz imaging. THz spectroscopy allows to tell optically close materials from each other, if they have any spectral features in THz range, and many of drugs and explosives, as well as biological samples do have them [7]. Terahertz radiation passes through clothing, paper, wood, plastic, ceramics, and other dielectric materials, thus allowing to use THz imaging as a tool for remote sensing and radioscopy and biological, medical and security applications.

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REFERENCES