Ultra Broadband THz Time-Domain Spectroscopy Using Air Photonics

by

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ABSTRACT

THz time-domain spectroscopy (THz-TDS) is a novel technique to characterize material properties with broadband terahertz wave. A traditional THz-TDS employing a photo-conductive antenna or electro-optic (EO) crystal has a bandwidth limited within 5 THz, which is not sufficient to cover the entire THz gap (0.3~10 THz). Recently, broadband THz generation and detection techniques using air photonics has been developed. These innovations make it possible to build THz-TDS systems with remarkable bandwidth, and provide much higher THz electric field. The work presented in this thesis is mainly focused on the development of broadband THz time domain systems based on THz air photonics.

A brief introduction of THz time domain systems is presented in this thesis. The commonly used THz emitters, detectors, and the background of THz air photonics are reviewed. Based on the designing, constructing and testing of different THz air photonics systems, several critical problems have been identified and solved. The experimental data is analyzed and simulated theoretically. Finally, spectroscopy measurements are performed utilizing these broadband THz air photonics systems. Taking the advantages of the new techniques, we're able to observe some absorption features that cannot be obtained previously with regular THz-TDS.