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Field Intensity Detection of Individual Terahertz Pulses at 80 MHz Repetition Rate

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Abstract We present a new approach to detect the intensity of individual terahertz pulses at repetition rates as high as 80 MHz. Our setup comprises a femtosecond fiber laser, an InGaAs-based terahertz emitter, a zero-bias Schottky detector, and a high-speed data acquisition unit. The detected pulses consist of two lobes with half-widths of 1–2 ns, which is much shorter than the inverse repetition rate of the laser. The system lends itself for high-speed terahertz transmission measurements, e.g., to study wetting dynamics in real time.

Keywords Ultra-high-speed terahertz transmission measurements · InGaAs photoconductive switch · Zero-bias Schottky diode · Time-domain terahertz · Wetting dynamics

1 Introduction

Since the invention of photoconductive switches in 1984 [1], time-domain terahertz (TD-THz) instrumentation has undergone a remarkable performance boost. Applications for TD-THz systems range from fundamental studies of nanostructures and metamaterials to non-destructive testing of plastic composites and paint layers, from security screening of parcels and envelopes to water-level monitoring in plants, and from semiconductor inspection to the identification of hazardous chemicals [2, 3]. As of today, a plethora of TD-THz platforms is commercially available, the one common principle being a pump-probe approach: On the transmitter side, a terahertz emitter “translates” a short laser pulse into terahertz radiation, which—on the receiver side—is sampled with a time-shifted copy of the laser pulse. This concept usually includes a time delay, which is either realized with a mechanical stage or by synchronizing the pulse trains of two lasers. Whilst mechanical delays achieve measurement rates of 10–500 Hz (i.e., pulse traces per second) [4, 5], systems based on synchronized

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