Nondestructive Evaluation of Semi-insulating Compound Semiconductor Wafer using Terahertz Time Domain Spectroscopy

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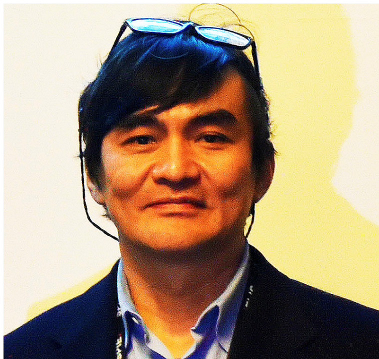
ABSTRACT

Terahertz Time-Domain Spectroscopy (THz-TDS) is a well-known application of the Terahertz spectrum (0.1 THz to 10 THz) for non-destructive material characterization. The THz-TDS system has been widely used for measuring the optical and electrical properties of conductive and non-conductive samples. The increasing demand for high-performance integrated circuits in a variety of applications, including electric vehicles, renewable energy, and 6G communications, has led to the development of semi-insulating compound semiconductor materials. In this paper, we have non-destructively measured the electrical properties such as resistivity and carrier concentration of semi-insulating (SI) Silicon Carbide (SiC) and Indium Phosphide (InP) wafers using the THz-TDS in transmission mode. The Nelder-Mead algorithm is utilized to estimate the electrical properties based on the transmission (S21) measurement data and the simplified Drude model. The estimated resistivity of the SiC and InP samples from the THz TDS measurements are (1.42 ± 0.15) × 105 Ω · cm and (3.0 ± 0.1) × 107 Ω · cm, respectively, and are consistent with the manufacturer specifications. The feasibility of THz-TDS in the transmission mode for non-destructive electrical evaluation of semi-insulating SiC and InP is demonstrated and offering a promising tomographic inspection approach for online monitoring with the potential to enhance production yields in the semiconductor industry.

Keywords: THz-TDS, non-destructive, semiconductor, spectroscopy

Short biography:



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