CHARACTERIZING NOVEL TRANSDUCERS FOR HIGH TEMPERATURE THERMAL MEASUREMENTS USING TIME DOMAIN THERMOREFLECTANCE

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Time domain thermoreflectance (TDTR) is an optical pump-probe technique used to measure thermal properties of material systems. Samples are typically coated with a thin metal transducer layer, such as aluminum or gold. At temperatures approaching 2,000°C, most transducers become limited by melting temperature, chemical reactions, or other phase transitions. Hafnium Nitride (HfN) is a conductive ceramic with a melting point exceeding 3300°C. It is estimated to have a constant reflectance of 17% and 64% at 400nm and 800nm, respectively. Iridium (Ir) has a melting temperature of 2,447°C. Our work characterizes the thermal properties of HfN and Ir, respectively, and investigates their viability as transducers for TDTR measurements at high temperatures to the point of thermodynamically-driven failure. Thermal conductivity is measured as a function of temperature for HfN and Ir, respectively, and thermoreflectance coefficients are measured and compared to that of typical transducers. Thermal conductivities for MgO, Al_2O_3, SiO_2, and diamond substrates are measured using the aforementioned thin films as transducers to test material reliability. Results and implications for future high temperature TDTR measurements are discussed.

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