Comparison of Thermal Conductivity and Thermal Boundary Conductance Measurements Using Continuous-Wave and Ultrashort-Pulsed Thermoreflectance Techniques

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Thermoreflectance techniques are powerful tools for measuring thermophysical properties of thin film systems, such as thermal conductivity, *k*, of individual layers, or thermal boundary conductance across thin film interfaces (TBC). Thermoreflectance pump-probe experiments are common setups to monitor the thermoreflectance change on the surface of a sample, which is related to the thermal properties in the sample of interest. Thermoreflectance setups have been widely used with both continuous wave (cw) laser systems and pulsed laser systems. In analyses with cw systems, the phase of the heating event is monitored, and its response to the heating modulation frequency is related to the thermophysical properties; this technique is commonly termed a Phase Sensitive ThermoReflectance (PSTR) Technique. In analyses with pulsed laser systems, the pump and probe pulses are temporally delayed relative to each other, and the decay in the thermoreflectance signal in response to the heating event is related to the thermophysical properties; this technique is commonly termed a Transient ThermoReflectance (TTR) Technique. In this work, the PSTR and TTR techniques are used to determine the *k* and TBC of thin film on substrate structures. The thermal models used for each technique and their assumptions are compared for the same samples. A new model for PSTR analysis is developed which accounts for the lock-in amplifier output during data collection, and improves data analysis by filtering out measurement errors. The advantages and disadvantages of each technique are elucidated from the results of the thermophysical property measurements.

* Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed-Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.