

**Department Of Mechanical and Aerospace Engineering Seminar
University of Virginia, Charlottesville, VA**

Speaker: Patrick Hopkins

Scattering processes affecting thermal boundary conductance at metal-dielectric interfaces in nanomaterial systems

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ABSTRACT:

The ongoing trend of miniaturization on the nanoscale has created many new thermal challenges for device engineers and scientists. In many solid state devices, increased power densities in combination with continued size reduction is giving rise to thermal processes that can not be predicted by traditional macroscopic laws and models. For example, as transistor gate lengths are continuously decreasing in an effort to uphold Moore's Law, power dissipation is becoming a growing concern. As transistors shrink to length scales on the order of carrier mean free paths, the interfaces between solid materials in transistors and packaging systems are responsible for the major thermal resistances that are impeding power dissipation. An understanding of processes that contribute to thermal boundary conductance (h_{BD}) continues to be a major research effort in nanoelectronic system design and engineering.

The goal of this study is to examine the scattering processes that contribute (h_{BD}) at metal-dielectric interfaces. Thermal boundary conductance measurements are conducted on a variety of metal-dielectric thin film samples using the transient thermoreflectance (TTR) technique. The TTR technique is a pump-probe measurement technique that employs ultrashort pulsed laser pulses (~100 fs) to observe a temporal reflectance change on the surface of a material which in turn can be related to the transient temperature change to determine h_{BD} . Thermal boundary conductance as a result of interfacial mixing is examined at the Cr/Si interface. Temperature trends in h_{BD} are observed on a wide array of acoustically matched metal-dielectric samples, and results suggest the occurrence of inelastic scattering of phonon between two materials at temperature approaching the acoustically softer material's Debye temperature. New models based on experimental results