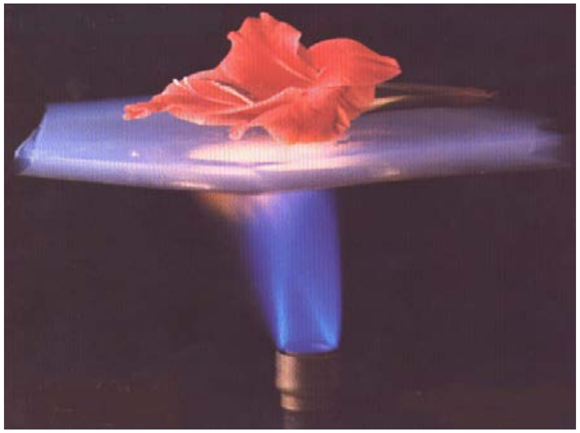

As technology progresses, many industries are now learning to manage the resulting thermal energy as increased power is being generated in ever decreasing volumes. This, along with an increased dependence on electrical power sources, makes management of unwanted thermal energy a major area of current research. My laboratories at UVA are addressing this issue in three ways:

- Efficient interfacial thermal transport--tuning interfacial transport with thermal interface materials or interstitial layers;
- Isolation of heat affected regions with thermal insulation—aerogels;
- Dissipation of unwanted thermal energy through efficient heat transfer—heat pipes.

This work all fits into the broader "Thermal Management and Diagnostics Group" in SEAS. http://www.mae.virginia.edu/NewMAE/research/uva-thermal-management-diagnostics-group/

Norris Research Group

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"Pushing the boundaries in state-of-the-art thermal management research."

UNIVERSITY of VIRGINIA ENGINEERING

Nanoscale Heat Transfer Laboratory

As device dimensions shrink, it becomes more likely that energy carriers will scatter at an interface between two adjacent materials than in the materials that form the interface. As a result, heat transport around active regions in these devices is restricted by the presence of interfaces between the materials and the structures surrounding them. Thus, critical to thermal management of next generation nanodevices is the interfacial thermal transport. Thermal applications affected include thermoelectric power generation and cooling, heat dissipation from electronics, phase change memory, quantum cascade lasers, and thermal barrier coatings. This laboratory houses a state-of-the-art facility for optical techniques in nanoscale heat transfer and performs experimental, computational (molecular dynamics), and theoretical (first principles) investigations of interfacial thermal transport. The lab conducts a mixture of fundamental and applied research.

Aerogel Research Lab

Aerogels are the lightest solids ever produced. Highly porous and almost wispy in appearance, aerogels produced from silica, alumina, or zirconia can have densities as low as just three times that of air. Aerogel is an extremely adaptable material and the standard sol-gel production process offers the ability to tailor the material properties for specific applications. The Aerogel Research Laboratory at UVA is an internationally recognized lab which explores the fundamental properties as well as cutting-edge applications of aerogels. Recent research activities and capabilities include: thin film aerogel coating for thermal and electrical insulation in MEMS and MMIC devices; measurement of the thermal properties of thin film aerogels; organometallic aerogel/xerogel materials for catalysts and catalytic supports; micro and nano-patterning and filtering.

Thermal Management and Diagnostics Group

This group includes a diverse set of faculty and students working on an amazingly diverse range of applications, at an even more amazing range of length scales, from nano structured thermal interface materials for nanoscale electronics to jet-blast deflectors for next generation aircraft carriers. This group integrates first-principle modeling, simulations, computations and experimentation in a unique way to advance the field of thermal management. The team includes material scientists, physicists, mechanical engineers, electrical engineers, and computer scientists. Diverse in composition, but all united in vision. The UVA Thermal Management and Diagnostics Group offers access to a team with capabilities unrivaled elsewhere. Please feel free to contact individual researchers directly, or if unsure of the best initial contact, email the team at thermal@virginia.edu.

RECENT RESEARCH DEVELOPMENTS

- Computational modeling of interfacial mixing and an added interstitial layer have revealed that these methods may offer an effective method for tuning thermal boundary conductance and hence interfacial thermal transport, as confirmed experimentally.
- Delivered the Ohanian lecture at Florida State College of Engineering "Engineering Energy Solutions: From Atoms to Agriculture" http://128.227.245.34/_Specials/OhanianLecSeries/Ohanian319_01-hh.mp4

RECENT GRANTS

- DOD/Air Force – Modeling Interfacial Thermal Boundary Conductance of Engineered Interfaces
- NSF – Thermal and Electronic Transport Processes in Monolayer-Scale Chemically Ordered Semiconductor Films
- ONR – Simulations of Ultrafast Mass and Heat Transfer at Solid-Vapor Interfaces
- ONR – System-Level Approach for Multi-Phase, Nanotechnology-Enhanced Cooling of High-Power Microelectronic Systems

SEAS Research Information
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