

Hawkins Memorial Lecture:

Sam Graham

**Dean of Engineering
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Seminar: Thursday, October 6th - 11:30 AM, WALC 2007



From Materials to Manufacturing: Strategies to Enable the Thermal Management of Wide Bandgap Electronics

Abstract:

Wide bandgap electronics are currently under development due to their potential to create some of the most advanced RF, optoelectronic and power electronics in the world. Applications include visible and UV LEDs and laser diodes, 5G communications, radar systems, and inverters and converters for electrical power systems. The growth of materials based on gallium nitride and more recently gallium oxide is expected to help create technological advancements in each of these areas. As these nitride and oxide semiconductors are being developed, there are a number of new materials, manufacturing techniques, and thermal and mechanical metrology methods that must be concurrently created to help ensure the transition of these materials to their intended applications. Key concerns are scalable methods for growing and packaging the devices, materials and architectures needed to ensure efficient thermal management, and the control of stresses to prevent device failure.

In this talk, we will discuss a range of materials and device architectures that are being developed to enable efficient heat dissipation from both GaN and Ga₂O₃ devices starting at the device level. We will also cover a range of thermal and stress metrology methods that we have developed to enable the measurement of temperature and stresses in the devices both under steady state and transient operation. Finally, an actively cooled power substrate that is being developed for packaging power devices will be presented. At each step, we will show how considerations for materials development, metrology techniques, and methods for scalable manufacturing are necessary to help transition these advancements to applications.

Biography:

Dr. Samuel Graham is the Nariman Farvardin Professor and Dean of Engineering at the University of Maryland. Prior to joining the University of Maryland, he was a professor and chair of the Woodruff School of Mechanical Engineering at the Georgia Institute of Technology. He holds a joint appointment with the National Renewable Energy Laboratory, serves on the Emerging Technologies Technical Advisory Committee for the U.S. Department of Commerce, and the Engineering Science Research Foundation of Sandia National Laboratories. His research expertise is in the thermal characterization and reliability of wide bandgap semiconductor technologies for power electronics and advanced rf communications. In addition, his group works on strategies for energy thermal energy storage using phase change materials for build energy systems.