Improving Thermal Interfaces and Heat Dissipation in Wide Bandgap Electronics

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12:30 PM
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MAE Seminar Series

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Wide bandgap semiconductors made from GaN, AlGaN alloys, and Ga2O3 have promise for future rf electronics and power switches. One of the key issues that arises in developing future electronics from these materials is the desire for high power operation which will place more demands on managing the heat dissipation from these devices. This is especially true when using ternary nitride alloys and Ga2O3 since they possess an intrinsically low thermal conductivity. This requires careful design of the device architecture and layout in order to yield effective heat dissipation pathways for wide bandgap semiconductor systems.

In this talk, we will present results on the integration of high thermal conductivity materials with wide bandgap semiconductors as a viable pathway to improve heat dissipation. We will discuss the important role that interfaces play in enabling the integration of materials such CVD diamond, AlN, and SiC while supporting enhanced heat dissipation. We will present results on the use of new interlayers to reduce the thermal boundary conductance between diamond and nitride semiconductors. Finally, we will demonstrate the important role that surface activated bonding plays in materials integration, providing both improved thermal interfaces between GaN and diamond while lowering stress gradients in the active layers. Finally, we will discuss the improvements in measurement techniques that allow for the characterization of these complex interfaces being developed for advanced nitride and oxide rf and power electronics.

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, the Department of Navy S&T Board, and the Advisory Committee for the Engineering Directorate of NSF. His research expertise is in the thermal characterization and reliability of wide bandgap semiconductor technologies and the packaging of organic and flexible electronics.

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