7. Reliable Integrated Thermal Packaging for Power Electronics

Course Leader: Patrick McCuskey – University of Maryland

Course Description:

Power electronics are becoming ubiquitous in engineered systems as they replace traditional ways to control the generation, distribution, and use of energy. They are used in products as diverse as home appliances, cell phone towers, aircraft, wind turbines, radar systems, smart grids, and data centers. This widespread incorporation, and the fact that power electronics have become key components of heterogeneous integration, have made it essential that the reliability of power electronics be characterized and enhanced. Furthermore, increased power levels combined with increased packaging density have led to higher heat densities in power electronic systems making thermal management more critical to performance and reliability of power electronics. This course will emphasize approaches to integrated thermal packaging that addresses performance limits and reliability concerns associated with increased power levels and power density. Following a quick review of active heat transfer techniques, along with prognostic health management, this short course will present the latest developments in the materials (e.g., organic, flexible), packaging, assembly, and thermal management of power electronic modules, MEMS, and systems and in the techniques for their reliability assessment.

Course Outline:

1. Motivation for Heterogeneously Integrated Thermal Packaging for Reliable Power Electronic Systems
2. Simulation and Assessment of Active Thermal Management Techniques
3. Application of Thermal Management Techniques to Commercial Power Systems
4. Durability Assessment (Failure Modeling, Simulation, Testing, and Health Monitoring)
5. Reliability and Thermal Packaging of Active Devices and Interconnects
6. Reliability and Thermal Packaging of Switching Modules, including organic encapsulants
7. Reliability in Rigid Assembly Packaging
8. Flexible Materials, Packaging, and Thermal Management
9. Reliability of Additive Manufactured and Embedded Power Electronics

Who Should Attend:

This PDC is aimed at both new and veteran practicing engineers and technical managers who seek to incorporate thermal management into heterogeneously integrated power electronics packaging for use in a wide variety of power and energy generation and distribution applications

Dr. Patrick McCluskey is a Professor of Mechanical Engineering at the University of Maryland, College Park and the Department’s Director of Undergraduate Studies (Ph.D., Materials Science and Engineering, Lehigh University). He has over 25 years of research experience in the areas of thermal management, reliability, and packaging of electronic systems for use in extreme temperature environments and power applications. Dr. McCluskey has co-authored three books, 5 US Patents, and over 200 peer-reviewed technical articles with nearly 4000 citations. He is an associate editor of the IEEE Transactions on Components, Packaging, and Manufacturing Technology, a member of the board of governors of the IEEE Electronic Packaging Society, a fellow and member of the Executive Council of IMAPS, and a member of ASME.