

# SEMI-THERM<sup>®</sup> 35

Embedded Tutorial  
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## MODELING TWO-PHASE HEAT TRANSFER SYSTEMS, PUMPED AND PASSIVE DESIGNS

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Two-phase heat transfer systems utilize the latent heat property of a coolant fluid to transfer heat loads to regions or components where it could be efficiently dissipated to the ambient environment. The development of two-phase cooling for both two-dimensional (2D) and three-dimensional (3D) integrated circuits using pumped dielectric coolant and passive designs such as heat pipes, vapor chambers, thermosyphons, etc., has gained recent attention due to the ability to manage high heat densities, compatibility with electronics and above ambient temperature operation to achieve very low cooling energy usage. Development of this approach requires high fidelity and computationally manageable conjugate thermal models both at the device level as well as at the system level. This talk will describe a few modeling methodologies demonstrating the process of design and development of both passive and pumped two-phase heat transfer systems.



**George Meyer** is a thermal industry veteran with over three decades of experience in electronics thermal management. He currently serves as the CEO of Celsia Inc., a design and manufacturing company specializing in custom heat sink assemblies using heat pipes and vapor chambers. Previously, Mr. Meyer spent twenty-eight years with Thermacore in various executive roles including Chairman of the company's Taiwan operations. He holds over 70 patents in heat sink and heat pipe technologies and serves as a chairperson for the SEMI-THERM thermal conferences in the San Francisco area.



**Pritish R. Parida** received the B.Tech. degree in mechanical engineering from IIT Guwahati, Guwahati, India, in 2006, the M.Sc. degree in mechanical engineering from Louisiana State University and Agricultural and Mechanical College, Baton-Rouge, LA, USA, in 2007, and the Ph.D. degree in mechanical engineering from the Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA, USA, in 2010. He is currently a Research Staff Member at IBM T. J. Watson Research Center, Yorktown Heights, NY, USA, where he develops new techniques and innovative solutions, offering fundamental breakthroughs in the state of the art to provide market differentiating technology for IBM's portfolio of products and services in the field of information technology. He addresses the thermal challenges in computer systems to achieve highly energy-efficient thermal designs to reduce the cooling energy used by computers in data centers. He has co-authored over 50 peer-reviewed publications and holds over 40 issued patents.



**Sobo Sun** is a 20 year thermal industry veteran with 80 patents in this field and expertise in heat sink modeling and design for manufacturability. Prior roles include various senior management positions with CoolerMaster and Thermacore. Masters Mechanical Engineering, National Chung-Hsing University and Ph.D. ME candidate, National Chiao Tung University.