

M.I.M.E. Fall 2009 Graduate Seminar Series

Friday, October 2, 2009
12:00—1:00 PM
Nitschke Auditorium (NA 1000)

***RECENT INVESTIGATIONS OF LIQUID COOLED SMALL-SCALE
HEAT SINKS FOR HIGH FLUX HEAT REMOVAL: A CRITICAL SUMMARY OF EXPERIMENTAL DATA AND MODELING APPROACHES***

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ABSTRACT:

Heat dissipation from electronic devices is increasingly encountered in the range from 100 to 1000 W/cm² in devices ranging from processors to power modules to concentrated solar photovoltaics. In that range, cooling with air is increasingly difficult. Indirect liquid cooling, in which liquid is circulated through a small scale heat exchanger or “heat sink” attached to the heat source, is one of the most common emerging thermal management solutions. Over the past five years, the authors’ research group has experimentally and computationally investigated the behavior of a broad class of single and multi-layer single pass parallel flow heat sinks, with single phase and two-phase flow of water. The experimental devices were fabricated from Silicon Carbide using an innovative extrusion free form (EFF) fabrication technique and in copper using conventional machining techniques. In this talk, I will discuss the experimental techniques used and the data obtained in order to characterize their behavior. I will then offer a critical summary of conventional and emerging techniques that have been used for modeling the devices. The conventional techniques include uncoupled finite-resistance or finite volume approaches and coupled conjugate finite volume approaches. It will be shown that conjugate effects are important, but not overwhelmingly so. As such, the data from these studies was used to support the development of a general modified effectiveness-NTU approach that allows the evaluation of these types of heat sinks using well-accepted heat exchanger methodologies.

BRIEF BIO:

Alfonso Ortega is the James R. Birle Professor of Energy Technology at Villanova University and Associate Dean for Graduate Studies and Research for the College of Engineering. He received his B.S. in 1976 from University of Texas-El Paso, and his M.S. and Ph.D from Stanford University in 1978 and 1986 respectively, all in Mechanical Engineering. Dr. Ortega is a Fellow of the ASME and is currently Associate Editor of the ASME Journal of Heat Transfer.



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