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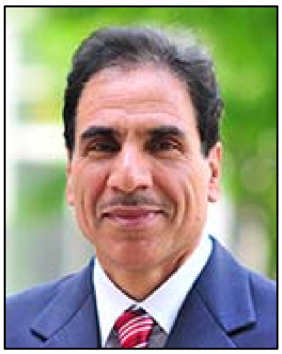
RICHARD CHU ITherm AWARD FOR EXCELLENCE

THERMAL MANAGEMENT OF HIGH FLUX ELECTRONICS UTILIZING FILM EVAPORATION AND ENHANCED FLUID DISTRIBUTION SYSTEM (FEEDS)

AWARD LUNCHEON TALK, WEDNESDAY, JUNE 1, 12:00 PM – 1:30 PM, FAIRBANKS BALLROOM

Presented by 2022 Awardee Prof. Michael Ohadi (U. of Maryland)



Abstract:
The increasing power densities of electronic devices due to more compact packaging requirements presents new opportunities and challenges for thermal management of electronics. Adequate cooling of the emerging high flux devices is required to increase the reliability and operational capabilities. Over the past few decades, microchannel heat sinks among other solutions have been implemented to dissipate high heat fluxes. Furthermore, convective heat transfer coefficients have been increased by using two-phase flow and by reducing hydraulic diameters of the channels. However, this can incur increases in pressure drop and pumping power requirements. To tackle this limitation, a novel cooling technique, film evaporation with enhanced fluid distribution system (FEEDS) has been demonstrated to simultaneously enhance the heat transfer coefficient while avoiding increased pressure drop and pumping power requirements. The FEEDS cooler is a manifold-microchannel system in which an array of manifolds is positioned perpendicularly on a system of parallel microchannels. In this work, a FEEDS cooler was designed and developed to manage high heat fluxes of electronic components. The designed manifold geometry was additively manufactured out of Inconel 625 by means of a direct metal laser sintering (DMLS) printer. Two-phase tests were performed with R-245fa refrigerant as the working fluid at three different mass fluxes (350, 700, and 1050 kg/m2-s), and the respective heat transfer and pressure drop characteristics were measured. The proposed manifold-microchannel configuration was able to dissipate heat flux of 1365 W/cm2 at 44% outlet vapor quality. Additionally, this FEEDS cooler has shown a relatively constant heat transfer coefficient over the surface, suggesting a stable liquid film.

Michael Ohadi is a Minta Martin Professor of Mechanical Engineering and a co-founder of the Center for Environmental Energy engineering (CEEE) at the University of Maryland, College Park. Ohadi's research has focused on heat transfer enhancement of single phase and two-phase flows through process intensification utilizing multi-scale design optimization, materials, and manufacturing techniques. For more than 25 years he has led an industrial consortium in Advanced Heat Exchangers and Process Intensification techniques with member companies from the U.S., Asia, and Europe. From 2016 to 2020, Ohadi served as Program Director (PD) at the U.S. department of energy, Advanced Research Project Agency-energy (ARPAE), where he led the development of programs in thermal management and energy conversion systems, including lightweight and ultra-efficient electric motors, and associated power electronics for de-carbonization/electrification of aviation. Ohadi received his Ph.D. in mechanical engineering from the University of Minnesota and joined the University of Maryland in 1990. He is a fellow member with both ASME and ASHRAE. He has published more than 300 peer reviewed technical articles in his fields of expertise and is the recipient of the 2021 ASME Heat Transfer Memorial Award.