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**Analytical and Experimental Investigation of Future Hybrid Thermal Control System**

**Abstract:**

A quest for smaller and light-weight architectures in electronic devices and power system has been increased for a past few decades, and heat removal and thermal management have been receiving substantial attention due to harsh design requirement and operating conditions coming along with design and structural issues. Future manned space endeavors will require a new class of vehicles, capable of conducting different types of missions and enduring varying gravitational and temperature environments. Thermal management will play a vital role in these new vehicles and is complicated by the need to tackle both low and high sink temperatures. This presentation is composed of thermodynamic analysis for thermal system design, transport phenomena of two-phase flow boiling in micro-channel and future application of two-phase cooling. Thermodynamic analysis for thermal system design explores the design and thermal performance of a Hybrid Thermal Control System (H-TCS) that would satisfy the diverse thermal requirements of the different missions. It is shown that how specific missions dictate which mode of operation is most suitable, and this information is used to size the radiator for the H-TCS. The transport phenomena study investigates into the two-phase heat transfer characteristics of two large micro-channel heat exchangers that serve as evaporators in the vapor compression and two-phase loop using R134a as refrigerant. Transition from nucleate to convective boiling, correlation between flow patterns and heat transfer mechanisms, impact of vapor back flow on parallel channel instability and intermittent dryout and assessment of previous empirical correlation are specific findings from the experimental results. A new theoretical model for boiling in annular flow provides two-phase mixture velocity profile and predicts heat transfer coefficient and pressure drop with a high accuracy. An application of subcooled flow boiling is presented for an electric vehicle charger active cooling solution that enables the light weight cable carry a high current in a small size wire.

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**Bio:**

Dr. Seunghyun Lee has been a postdoctoral researcher in the mechanical engineering department of Purdue University where he received Ph.D. in Aug. 2017. He received M.S. and B.S. from KAIST and Pusan National University in the department of mechanical engineering in 2009 and 2007, respectively. His research interests are applying classical heat transfer and two-phase flow theories to state-of-art applications *e.g.* aerospace, plant and micro/nano technologies and relating thermodynamics and heat transfer to design and analyze thermal systems *e.g.* refrigeration and power cycles. He has been delving into the relation between heat transfer and instabilities in the large size micro-channel heat sink and electric vehicle charger cooling techniques and its waste heat recovery. He has been publishing internationally renowned peer-reviewed journals specializing in thermal engineering.