

## **Preface: Phase Change Heat Transfer**

A total of 8 papers have been selected for publication in this special issue on phase change heat transfer. Being a broad but important topic in the field of thermal/fluid science, the enhancement, utilization, and modeling of phase change heat transfer has implications for many applications — ranging from the design of efficient energy systems to the evolved thermal management of electronic components or systems. As provided by the papers selected for this special issue, there have been paramount advances in this field — resulting in the thermal enhancement of boiling processes and in the refined understanding of novel phase change heat transfer devices, including: enhanced phase change heat transfer, oscillating heat pipes, capillary pumped loops and rotating miniature heat pipes. The discussed applications are of societal importance and range from the thermal management of high-power LEDs, cloud-based server CPUs, and gas turbine rotor blades/disks. Unique analytical and numerical approaches are also introduced — such as a numerical parameter study for entropy generation in oscillating heat pipes and real-time visualization of two phase flows in oscillating heat pipes via neutron radiography.

The enhancement of boiling heat transfer is discussed in two of the papers. Specifically, the experimentally marked thermal enhancement, as measured via the significant increases in critical heat flux and heat transfer coefficient, for pool boiling on a copper surface by nanostructure-modified nucleation sites and contact angles. The bubble formation and distribution along a coated copper wire with a superhydrophobic-patterned surface was also visualized and discussed in detail.

The oscillating (a.k.a. pulsating) heat pipe (OHP) is a two-phase heat transfer device that operates passively via a temperature difference. It consists of either a closed-loop tube or channel structure of capillary dimension that is partially filled with a working fluid such as water or acetone. During operation, the internal working fluid oscillates due to pressure variation along the tube/channel as a result of cyclic evaporation and condensation. It is a relatively new heat transfer device that is not fully understood but has demonstrated to have a lot of potential for thermal management applications. This special issue contains four papers focused on the OHP. One paper introduces the unique application of oscillating heat pipes for fin-assisted, natural convection cooling of high-powered LED lights. Another paper provides results from a unique numerical investigation for the parameters that affect entropy generation within specific regions of an OHP. Two papers provide results from using the novel technology of neutron radiography — which allows users to see directly through the heat pipe walls for real-time visualization of the internal working fluid. One of these papers discusses the two-phase flow distribution within a novel-designed, "hybrid" OHP with a wicking structure. The

other paper discusses results obtained from directly analyzing the images produced from neutron imaging of an OHP. This described image analysis technique provides for a unique quantitative assessment of the internal, two-phase distribution along the length of an OHP during its operation.

In addition to the oscillating heat pipe, two other heat transfer devices are discussed within this special issue. This includes Capillary Pumped Loop (CPL) heat pipes for the thermal management of cloud-based server CPUs and rotating miniature/sector heat pipes for gas turbine blade cooling. Both of these papers provide unique results that aid in the further optimization of their respective heat pipe design and application.

The study of phase change heat transfer is an international effort; this special issue includes authors from the United States, Taiwan, China, and South Korea.

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