

Chillerless High Performance Liquid Cooling for Sustainable Data Centres

Dr. Poh Seng Lee

Department of Mechanical Engineering
National University of Singapore (NUS)
Singapore

The ever-increasing thermal design power (TDP) of GPU and CPU chips has pushed the conventional air cooling solution to its physical limits. As such, there is an urgent need for the development of high performance thermal management solutions for the next generation of electronics. Among these, microchannel liquid cooling is one of the most effective. Despite its potential as a highly efficient compact cooling solution, significant temperature variations across the chip can still persist since the heat transfer performance deteriorates in the flow direction in conventional microchannel as the boundary-layer thickens and the coolant heats up. This talk presents a novel heat transfer enhancement scheme that is developed by the Micro Thermal Systems Group at the National University of Singapore; where miniature oblique fins are deployed to disrupt the otherwise continuous thermal boundary layer development and to induce generation of secondary flow which enhances mixing. The combination of these two effects leads to very significant heat transfer augmentation by as much as 80% with little or negligible pressure drop penalty. These oblique fins can be integrated into high performance cold plates for the effective thermal management of chips (CPUs and GPUs), power electronics (MOSFETs, GTOs, IGBTs, IGCTs) and EV battery etc. A recently concluded test-bedding of chillerless high performance liquid cooling system for a rack of 20 servers data centers yielded very low PUE of ~1.20 (under Singapore's hot & humid climate) along with significant power reduction for the ITE and performance improvement of chips.