NUS National University of Singapore | Department of Mechanical Engineering
Faculty of Engineering

You are cordially invited to our:
Department Seminar

Topic: **Microchannel Heat Exchangers**

Speaker: **Prof. Sarit Kumar Das**
Professor and Dean of Academic Research
Indian Institute of Technology

Date: **Monday, 22 July 2013**

Time: **2pm to 3pm**

Venue: **E3-06-04** *(map of NUS can be found at http://map.nus.edu.sg/)*

Abstract

Microchannel flows find immense applications in a wide spectrum of flow and thermal systems, from micro compact heat exchangers to micro-reactors and Lab-on-Chip systems. Among the wide variety of microchannel systems, parallel microchannel heat exchangers are of extreme importance in modern micro-cooling systems, ranging from processor chips to pulsing femto-second LASERs. One of the foremost aspects that hinder the cooling performance of a parallel microchannel heat exchanger is the flow and thermal maldistribution induced. For a critical analysis and optimization of the system, pressure drop and thermal transport across each channel must be evaluated. The established maldistribution quantification parameters are based on the flow maldistribution due to fluid inertia and due to friction loss within the manifolds respectively. However, these models are found to be accurate only in the case of macrochannels of conventional heat exchangers. In the microchannel regime, both momentum and frictional losses become dominant factors in governing flow distribution. As a result, precise mathematical models, aided with accurate experimental and numerical investigations into the phenomenon of flow maldistribution in parallel microchannels are the need of the hour.

Parallel microchannel systems have been fabricated onto Silicon wafers using MEMS technology so as to mimic modern micro-processors. The complete study focusses on in-house cooling of the processor chip using fluid coolants. The factors affecting the phenomenon of maldistribution have been quantitatively identified and the effect of the hydraulic diameter has been investigated. The effects of different channel geometries and flow configurations on maldistribution have been studied. Experimental thermal analysis is carried out to understand the consequences of flow maldistribution on the temperature profile of the heater and the hot-spot temperatures. For conclusive closure to the study, an optimization strategy has been devised to predict the optimal microchannel system in terms of minimal flow and temperature maldistribution, minimum hot-spot temperature and maximum heat transfer per unit pumping power. The complete study of the problem at hand provides interesting and novel findings in the area of microchannel heat exchanger systems and its applications in the electronic industry.

About the Speaker

Dr. Sarit Kumar Das is a Professor of Mechanical Engineering and the Dean of Academic Research at the Indian Institute of Technology, Madras. He has published four books and more than 200 research papers. He is the editor-in-chief of the International Journal of Micro-Nano Scale Transport and also an associate editor of Journal of Heat Transfer Engineering. His research interests include heat transfer in nano-fluids, micro-fluidics, super-hydrophobicity, biological heat transfer, nano particle mediated drug delivery in cancer cells, heat exchangers, boiling in mini/micro channels, fuel cells, jet instabilities, heat transfer in porous media and computational fluid dynamics. He is the recipient of DAAD and the Alexander von Humboldt Fellowship of Germany and the 'India Citation Awards 2012' conferred by Thomson Reuters. He is a Fellow of the Indian National Academy of Engineering and National Academy of Sciences, India. He is also the recipient of the Award and Medal for Excellence in Research, conferred by the Indian Society for Heat and Mass Transfer in 2006. He has been awarded the Peabody Visiting Professorship at the Mechanical Engineering Department of Massachusetts Institute of Technology (Cambridge, USA), 2011. He has also held the positions of Guest Professor at MIT, Cambridge, University of BW, Hamburg, Germany and Lund University, Sweden.

Admission is free. All are welcome to attend.