Editorial

Special Issue: 6th Micro and Nano Flows Conference - Journal of Heat Transfer Engineering

The 6th Micro and Nano Flows Conference was held at the Georgia Institute of Technology, Atlanta, USA, between 9-12 of September 2018, see http://mnf2018.com. The conference Local Organising Committee was chaired by Professor Srinivas Garimella. The MNF Conference series originated in Strathclyde University in 2006 and was followed by meetings at Brunel University London in 2009, the Aristotle University Thessaloniki in 2011, the University College London in 2014 and the Politechnico Di Milano in 2016. A total of 100 papers were presented by colleagues from around the world at MNF2016. Plenary and keynote lectures were presented by leading experts highlighting recent research developments in thermofluid and biomedical micro flows. Seven papers were selected for this special edition and were reviewed according to the criteria used by the Journal of Heat Transfer Engineering.

In the first paper of this special issue Joseph and co-workers present an analysis of single-phase performance of complex microchannels. They introduced wire-net and S-Shaped structures and used a Reduced Order Modelling approach to help them assess the entire heat exchanger performance. They also carried out an experimental study. They found that the wire-net gave higher thermal performance but has significant pressure loses compared to the S-Shaped fins. The computational fluid dynamics results compared well with their experiments. Mashali et al. carried out an evaluation of the thermophysical properties, such as thermal conductivity and viscosity of de-aggregated fully functional diamond nanofluids. A microstructure characterisation of the nanodiamond powder was also performed. The stable suspension of the water-diamond nanofluid was subsequently studied to assess its suitability as a cooling liquid in high heat flux applications. The fluid viscosity was found to increase by less than 4% for the highest concentration studied (0.1 wt %). The corresponding thermal conductivity increase was 13%. The increase in the turbulent flow Nusselt number in a tubular geometry was 18.3% at 0.05 wt %. The researchers reported that the nanofluid remained stable for more than 20 months. They recommended further studies to elucidate the effect on adding nano particles, since the heat transfer enhancement was higher that the conductivity increase.

The following two papers in this Special Issue are on flow boiling in microchannels. In the first paper, Ozdemir et al. presents experimental results of flow boiling of water in single horizontal microchannels made of oxygen-free copper. The three microchannels examined had the same hydraulic diameter and different aspect ratios (width/height) of 0.5, 2.56 and 4.94. The main flow patterns observed were bubbly, slug, churn and annular flow. The aspect ratio was found to affect the bubbly flow regime. The results demonstrated that the channel with the smallest aspect ratio had a better heat transfer performance up to 500 kW/m^2. The researchers reported that the aspect ratio had no effect at higher heat flux values. Comparison with correlations proposed for small/micro diameter tubes and channels demonstrated good agreement. Instabilities in a microchannel evaporator were studied by Jin et al. A combination of lumped dynamic and static models were developed for the components of a Vapour Compression Cycle (VCC). The numerical results demonstrated that flow instability can be predicted by knowing the system operating conditions. This allows the development of a control strategy for the thermal management of the transient heat loads. The study demonstrated the prediction of system stability using model linearization through knowledge of the inputs and disturbances (e.g. setting of expansion valve, compressor speed, accumulator load and the load at the evaporator). The above can lead to the design of an active controller for the VCC through determination in advance of optimum operating conditions, which ensure stability, low evaporator temperature and high coefficient of performance.

Hague and co-workers present work on condensation and freezing on a Titanium nanopillared glass surface and a similar surface coated with Teflon, i.e a hydrophobic surface. Condensation and freezing tests were conducted in the presence of non-condensable gases (air). The experiments demonstrated that the droplet growth occurs in the following stages: initial nucleation, direct growth and coalescence. The researchers reported that coalescence can be suppressed by pinning droplets for the Ti-nanopillared surface altering the size distribution of the droplets and accelerating the freezing process significantly.

Heat transfer enhancement using jet impingement was examined by Hobby and co-workers. They designed a jet impingement cooling device with jet-adjacent fluid extraction ports distributed throughout the impingement array. Innovative manufacturing techniques were used, i.e. the cooling device was fabricated from a photopolymer material using 3D printing. The authors carried out parallel computational simulations. They reported that their computational and experimental results for the pressure drop were in excellent agreement once the manifold pressure drops were properly accounted for. The corresponding heat transfer results demonstrated reasonable agreement, but exhibited different trends. The authors propose possible reasons and suggestions for better predictions. They also propose a strategy for developing generally applicable heat transfer and pressure drop correlations.

Our last paper by Toto et al. reports on a prototype compact wireless vacuum sensor based on the Pirani principle and Surface Acoustic Waves. This was designed, simulated and finally manufactured. The manufacturing processes were clearly identified and organised, representing, as reported by the authors, a step further towards the development of a completely miniaturised wireless vacuum sensor that can operate between vacuum and atmospheric pressure. The authors conclude that the quality of the manufacturing process is critical in the sensor performance.

As guest editors and on behalf of the MNF Conference Committee we would like to thank Professor Srinivas Garimella and his colleagues at Georgia Tech for organising an excellent meeting and Professor Afshin Ghajar, Editor-in-Chief of Heat Transfer Engineering, for proposing this special issue and his help in completing it. Thanks are also due to the authors that contributed to this edition and our reviewers for their constructive and useful comments.

The 7th Micro and Nano Flows Conference will be held at Imperial College London, see
https://www.micronanoflows.com/mnf2020

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