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EDITORIAL

Special Issues on Advanced Heat Transfer Technologies: Fundamentals and Applications

Lixin Cheng[a,b], Ke Wang[c], Guodong Xia[a] and Afshin J. Ghajar[d]

[a]*Beijing Key Laboratory of Heat Transfer and Energy Conversion, Beijing University of Technology, Beijing 100124, P. R. China*

[b]*Department of Engineering and Maths, Sheffield Hallam University, Sheffield, S1 1WB, United Kingdom*

[c] Beijing Key Laboratory of Process Fluid Filtration and Separation, China University of Petroleum-Beijing, Beijing 102249, China

[d]*School of Mechanical and Aerospace Engineering, Oklahoma State University, Stillwater, Oklahoma, 74078, USA*

Advanced heat transfer technologies are the key to tackling the big challenges of energy shortage, global warming, environmental issues, clean energy, energy storage and sustainable development for human beings. Development and application of advanced heat transfer theory and knowledge are crucial in developing innovative technologies to improve the energy utilization efficiency, harness renewable energy and reduce environmental pollutions and carbon footprint.

Advanced heat transfer is the fundamental to a wide range of engineering subjects such as energy, power, energy saving and storage, renewable energy, combined heating, cooling and power generation, nuclear energy, hydrogen production and utilization, automotive, mechanical engineering, aerospace engineering, materials engineering, chemical engineering, environmental engineering and others, and interdisciplinary subjects such as net zero carbon technologies, micro- and nano-fluidics, high heat flux cooling technologies, advanced thermal energy and power cycles and so on. Innovative heat transfer technologies require the breakthrough of advanced heat transfer knowledge and theories. Furthermore, the complexity of issues and challenges relating to energy shortage and environmental issues require an interdisciplinary nature across many engineering disciplines. Therefore, it is urgently needed to develop advanced heat transfer knowledge, new theory and innovative technologies through interdisciplinary research.

With the rapid development of various relevant interdisciplinary subjects and emerging subjects and technologies, research of advanced heat transfer is growing very fast nowadays than ever before. Just to name several examples here, due to the rapid development in fabrication techniques, the miniaturization of devices and components is ever increasing in many engineering applications. Studies and applications of micro- and nano- heat transfer technologies involved in traditional industries and highly specialized fields such as micro-fabricated fluidic systems, microelectronics, micro heat transfer and high heat flux cooling etc. have been becoming particularly important since the late 20th century. Heat transfer enhancement technologies are the key to developing sustainable energy technologies and reduction of emissions and pollutants. All attempts to achieving high efficiency, low emissions and low costs in various thermal processes and thermodynamic cycles include advanced heat transfer theory and knowledge, heat transfer equipment and enhancement of heat transfer to a large extent. Sustainable energy development can be achieved by reducing final energy consumption, improving overall conversion efficiency and making use of renewable energy sources through applying advanced heat transfer enhancement and heat exchanger technologies. Using CO_2 as a working fluid becomes important in thermal energy and power generation becomes an important research topic and engineering practice in recent years. Research on CO_2 evaporation heat transfer, supercritical CO_2 heat transfer for cooling and heating processes, thermal and power generation and high performance heat transfer elements is extensively conducted.

In order to reflect the recent research progress in the fundamentals and applications of advanced heat transfer and technologies, we have edited this special issue on this important research field. The SI is aimed at providing the state-of-the-art research on advanced heat transfer and the relevant cutting-edge and interdisciplinary subjects. It covers a variety of topics: (1) Recent progress on high temperature and high pressure heat exchangers for supercritical CO_2 power generation and conversion systems; (2) A critical review on heat transfer of supercritical fluids; (3) Numerical investigation on two-phase water density wave oscillations in a pipe under various heating conditions; (4) Numerical study of heat transfer in a two-dimensional rarefied hydrogen gas moved jet impingement using direct simulation Monte Carlo-finite difference coupled method; (5) Numerical study on heat transfer and performance of seasonal borehole thermal energy storage system; (6) Drag reduction and Leidenfrost effect on submerged ratcheted cylinder; (7) Thermal and mechanical properties of plain woven ceramic matrix composites by the imaged-based mesoscopic model; (8) Heat transfer enhancement of partially serrated twisted finned tube banks; (9) Experimental study on the transient behaviors of mechanically pumped two-phase loop with a phase change energy storage device for short time and large heat power dissipation of spacecraft; (10) Compact thermal modelling of magnetic components using an admittance matrix approach; (11) Numerical study on heat transfer and flow characteristics of zigzag-type printed circuit heat exchangers with different channel widths for supercritical CO_2 Brayton cycle; (12) Subcooled flow boiling heat transfer of R141b in sintered porous tubes"; (13) Similarity analysis of droplet evaporation trajectory in high-temperature gas flow.

It is our great pleasure to present the recent frontier and progress of research in advanced heat transfer to the community. We would like to express our great thanks to all authors who have contributed to the SI and all reviewers who helped to review the papers for the SI. It is our greatest wish that readers can benefit from the state-of-the-art research in various topics of advanced heat transfer in the SI.

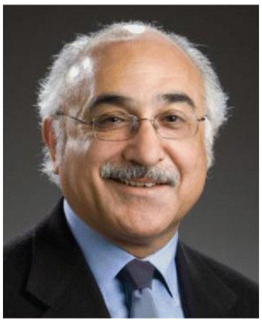
Address correspondence to Dr. Lixin Cheng, Department of Engineering and Mathematics, Sheffield Hallam University, Howard Street, Sheffield S1 1WB, UK, E-mail: lixincheng@hotmail.com

Notes on contributors

Lixin Cheng has worked at Sheffield Hallam University since 2016. He obtained his Ph.D. in Thermal Energy Engineering at the State Key Laboratory of Multiphase Flow at Xi'an Jiaotong University, China in 1998. He has received several prestigious awards such as Alexander von Humboldt Fellowship in Germany in 2006, an ERCOFTAC Visitor Grant in Switzerland in 2010 and a Distinguished Visiting Professorship of the City of Beijing, China in 2015. His research interests are multiphase flow and heat transfer and thermal energy engineering. He has published more than 100 papers in journals and conferences, 9 book chapters and edited 10 books. He has delivered more than 60 keynote and invited lectures worldwide. He has been the chair of the *World Congress on Momentum, Heat and Mass Transfer* (*MHMT*) since 2017. He is one of the founders and co-chair of the *International Symposium of Thermal-Fluid Dynamics* (*ISTFD*) series since 2019. He is associate editor of *Heat Transfer Engineering*, *Heat Transfer Research* and *Journal of Fluid Flow, Heat and Mass Transfer*, and international advisor of *Thermal Power Generation* (a Chinese journal).

Ke Wang is currently an Associate Professor at China University of Petroleum-Beijing (CUPB). Prior to joining CUPB, he worked at Royal Institute of Technology (KTH) and Nanyang Technological University (NTU) as postdoc researchers during 2012-2016. He received his Ph.D. degree in Engineering Thermal Physics from Xi'an Jiaotong University in 2012. His research focus on multiphase flow in petroleum engineering, heat transfer in heat exchanger, etc.

Guodong Xia is a leading professor in Thermal Energy Engineering at Beijing University of Technology, China. He received his Ph.D. in Thermal Energy Engineering at the State Key Laboratory of Multiphase Flow of Xi'an Jiaotong University, China in 1996. He was a visiting professor in the Institute of Process Engineering at the University of Hanover, Germany in 2000 -2001. His research interests include fundamentals and applications of microscale heat transfer, multiphase flow and heat transfer, waste energy recovery, thermal energy system, heat exchanger design and enhanced heat transfer. He is a member of the multiphase flow committee of the Chinese Society of Engineering Thermophysics and a member of the multiphase flow committee of the Chinese Society of Theoretical and Applied Mechanics. He has published more than 150 papers in journals and conferences.



Afshin J. Ghajar is Regents and John Brammer Endowed Professor in the School of Mechanical and Aerospace Engineering at Oklahoma State University, Stillwater, Oklahoma, USA and an Honorary Professor of Xi'an Jiaotong University, Xi'an, China. He received his B.S., M.S., and Ph.D. all in mechanical engineering from Oklahoma State University.

His expertise is in experimental heat transfer/fluid mechanics and development of practical engineering correlations. His current research is in two phase flow heat transfer/ pressure drop studies in pipes with different orientations, heat transfer/pressure drop in mini/micro tubes, and mixed convective heat transfer/pressure drop in the transition region (plain and enhanced tubes). He and his co-workers have published over 200 reviewed research papers and 10 book/handbook chapters. He has delivered numerous keynote and invited lectures at major technical conferences and institutions. He has received several outstanding teaching/service awards over the years. His latest significant awards are the 75thAnniversary Medal of the ASME Heat Transfer Division "in recognition of his service to the heat transfer community and contributions to the field", awarded in 2013, the ASME ICNMM 2016 Outstanding Leadership Award, this award recognizes a person whose service within the ICNMM (International Conference on Nanochannels, Microchannels, and Minichannels) is exemplary; the recipient of the award contributed significantly to the lasting success of the conference, and the 2017 Donald Q. Kern Award "in recognition of his outstanding leadership in the field of heat exchangers and two-phase flow, book and archival publications, and service to the academic and industrial professionals". Dr. Ghajar is a Fellow of the American Society of Mechanical Engineers (ASME), Heat Transfer Series Editor for CRC Press/Taylor & Francis (he has edited nine books to date), and Editor-in-Chief of Heat Transfer Engineering. He is also the co-author of the 5th Edition of Cengel and Ghajar, Heat and Mass Transfer - Fundamentals and Applications, McGraw-Hill, 2015. The 6th edition is under preparation and will be available in 2020.