Selected Papers from the 2nd International Symposium on Thermal-Fluid Dynamics (ISTFD2021) (Guest Editorial)

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EDITORIAL

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Nowadays, human beings are facing big challenges of energy shortage, environmental issues and sustainable development. Rapid development in technology and industry causes increase in environmental problems. One of our most important needs of which consumption increases continuously and will definitely continue to increase in future is undoubtedly the sustainable energy and new zero carbon technologies. The environmental issues such as global warming, climate change and waste pollution etc. in parallel to energy consumption, industrialization and urbanization have been an important environmental problem. The scientific consensus on global warming and climate change is that it is caused by anthropogenic greenhouse gas emissions, the majority of which comes from burning fossil fuels. In the meantime, con-

ventional fossil energy resources are depleting. Therefore, it is essential to develop new technology to improve energy utilization efficient, sustainable energy and low carbon/zero carbon technology to reduce carbon footprint.

Thermal-Fluid Dynamics is the fundamental to a wide range of engineering subjects such as energy, power, environment, energy saving and storage, renewable energy, aerospace, astronautics, combined heating, cooling and power technology, nuclear energy, hydrogen energy, automotive, mechanical engineering, emerging and interdisciplinary subjects such as net zero carbon technologies, micro- and nano-fluidics, advanced thermal processes and others. It plays a crucial role in the development and breakthrough of scientific theories, innovative technologies and revolution of industry, clean energy and environmental issues and human society systems. Furthermore, the complexity of issues and challenges relating to energy shortage and environmental issues require an interdisciplinary nature across many engineering disciplines. It is essential to develop advanced knowledge, new theory and innovative technologies through interdisciplinary research. With the rapid development of various relevant interdisciplinary subjects and technologies, the research of thermal and fluid dynamics is growing very fast nowadays than ever before. For instance, due to the rapid development in fabrication techniques, the miniaturization of devices and components is ever increasing in a wide range of engineering applications. Applications of microscale and nanoscale fluid flow and thermal phenomena 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. However, microscale and nanoscale fluid flow and heat transfer phenomena are quite different from those in macroscale and conventional systems. Over the past decades, a large number of studies have been conducted to understand the very complicated thermal and fluid phenomena and to propose the relevant new mechanisms, models and theory. There are still many issues to be clarified from

both theoretical and applied aspects. Furthermore, interdisciplinary research and newly emerging research areas require the understanding of fundamentals, mechanisms and applications of the microscale and nanoscale fluid flow and thermal transport phenomena. Furthermore, very complicated multiphase and thermal processes are the core stone in modern industry, high technology development, energy conversion and utilisation, renewable and sustainable energy technologies, just to name a few here.

In order to foster an environment conducive to exchanging new research ideas and progress in fundamental and applied aspects of rapid developing thermo-fluid dynamics. An annual series of International Symposium on Thermal-Fluid Dynamics (ISTFD) was founded by Prof. Bofeng Bai of Xi'an Jiaotong University, China, Dr. Lixin Cheng and Dr. Qinling Li of Sheffield Hallam University, UK and Prof. Liangyu Zhao of Beijing Institute of Technology, China in 2019. The ISTFD series is aimed at becoming one of the leading international annual symposiums in the fields related to Thermal-Fluid Dynamics including the relevant cutting-edge and interdisciplinary subjects. The inaugural symposium (ISTFD2019) was held in Xi'an, China in 2019. Following the great success of ISTFD2019, the 2nd International Symposium on Thermal-Fluid Dynamics (ISTFD2021) was successfully held in Beijing, China on 31 July to 3rd August 2021. Due to the effect of Covid'19, hybrid modes of onsite and online were adopted with attendance of more than 200 scientists, researchers, industrial engineers and research students from 14 countries. The topics cover Aerodynamics, Multiphase Flow, Heat and Mass Transfer, Combustion, Particle, Bubble and Drop Dynamics, Spray and Mixing, Cavitation and Cavitating Flow, Experimental Methods/Techniques, Computation Methods, Engineering Applications and interdisciplinary Research. To reflect the recent research progress in Thermal-Fluid Dynamics and its interdisciplinary research and applications, this special issue contains fifteen peer reviewed articles selected from ISTFD2021. It covers various topics: (1)

High heat flux cooling technologies using microchannel evaporators: fundamentals and challenges; (2) Performance analysis of heat exchangers and integrated CO_2 supercritical Brayton cycle for varying heat carrier, cooling and working fluid flow rates; (3) A numerical study on heat and mass transfer coupled with respiration reaction within stacked spherical postharvest produce: Spatial distribution and temporal variation; (4) Experimental investigation of the isothermal pressure drops in mini-elbows; (5) Molecular dynamics study of CO_2 phase change transport in the near-critical region: Model parameter optimization; (6) Jet impingement boiling on monocrystalline silicon surfaces with open microchannels; (7) Numerical simulation of mixing characteristics in a split-and-recombine microchannel; (8) Instability of low-velocity and high water-cut oil-water two-phase flow based on microwave signals; (9) Heat transfer enhancement with Ni-water nanofluid flowing through a prismatic glass louver for solar energy harvest and illumination; (10) Numerical analysis on the flow instability of a 700℃ ultra-supercritical tower boiler; (11) Ground test and on-orbit verification of a mechanically pumped two-phase loop using for thermal control of spacecraft; (12) Design and simulation of the solar optical guide lighting and ventilation system in a building; (13) The effect of reduced pressure on the prediction methods for flow boiling heat transfer of CO_2 inside horizontal macro- and micro-channels; (14) Experimental investigation on performance of multi-stage dehumidification heat pump tower corn drying system in high cold regions; (15) Influence of the refrigerant on the performance of a heat pump with gas bearings.

It is our great pleasure that this special issue can exchange recent frontier and progress research in thermal-fluid dynamics to the community. We would like to express our great gratitude to all authors who have contributed to this special issue and all reviewers who helped to review all manuscripts. It is also our greatest wish that readers can benefit from the state-of-the-art research in various topics of Thermal-Fluid Dynamics.

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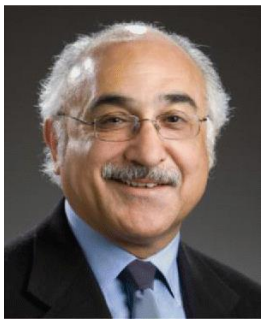
Lixin Cheng has worked at Sheffield Hallam University since 2016. He obtained his Ph.D. in Thermal Energy Engineering at the State Key Laboratory of Multiphase Flow at Xi'an Jiaotong University, China in 1998. He has received several prestigious awards such as Alexander von Humboldt Fellowship in Germany 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).

Bofeng Bai is a distinguished professor and the deputy director of the State Key Laboratory of Multiphase Flow in Power Engineering at Xi'an Jiaotong University, China. He obtained his Ph.D. in thermal energy engineering at Xi'an Jiaotong University, China in 1999. He was awarded Distinguished Young Scholars by the National Science Fund of China in 2014. His research interests

focus on fundamentals of multiphase flow and heat transfer, multiphase flow in propulsion systems, thermal engineering, petroleum engineering. He has published more than 400 papers in journals and conferences, and delivered numerous keynotes and invited lectures worldwide. He is one of the founders and co-chair of *International Symposium of Thermal-Fluid Dynamics* (*ISTFD*) series and the chair of the *First International Symposium of Thermal-Fluid Dynamics*, Xi'an, China in 2019 (ISTFD'19). He is associate editor of Measurement, Measurement: Sensors and Journal of Mechanical Engineering Science -Proc. IMechE, Part C.



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.