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Editorial

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In this special issue, we present a series of interesting reviews that cover all facets of applications concerning droplets or sprays. In particular, we focus on phenomena like droplet combustion, droplet level colloidal transport, condensation, flash boiling, spray breakup, droplet actuation and general areas of interfacial transport. The issue focuses on the state-of-the-art in these fundamental areas and tries to emphasize on certain niche applications.

The first article of the issue by Raghavan involves a detailed review of the transport processes as encountered during evaporation or combustion of an isolated droplet. An understanding of both the experimental as well as the numerical side is crucial, since droplets form the building blocks in sprays. In the second article, Santanu et al. focuses on the state-of-the-art in numerical simulation of reactive sprays especially highlighting phenomena like turbulence–droplet interactions, mixing and dispersion. The author has highlighted the different turbulent models and their applications in spray combustion. The third paper in the series concerns a special category of droplet combustion involving nanoparticles. The usage of nanoparticles shows high potential especially in reducing emission and increasing combustion efficiency. The review article by Nwabueze highlights the practical challenges plaguing nanofuel combustion. The review also highlights several interesting physics in nanofuel combustion like microexplosion and particle agglomeration.

The next three articles are in-depth reviews on three aspects of sprays. Review by Achintya Mukhopadhyay focusses on the atomization of a liquid sheet in a high-speed flow. The review highlights the linear and non-linear interfacial processes that lead to such breakup. The work by Gaurav Tomar mainly studies the mechanism of secondary atomization of droplets in high-speed flows compared to the primary breakup modes as narrated by Achintya et al. Gaurav Tomar provides a critical review of the different secondary breakup processes and the associated numerical models. This review also puts forward the state-of-the-art numerical techniques that can handle the complete breakup mechanism in such droplets. The third article in this series introduces a new emerging problem in sprays namely flash boiling. The review by Ashoke De et al. considers the numerical algorithms and lacunae of the same in addressing the problem of flash boiling in the context of combustion engines. The article offers the various techniques and associated challenges in capturing the flash boiling mechanism in sprays.

The next two articles cover the state-of the-art discussion in droplet actuation and transport under electric fields. The review by Purbarun Dhar offers detailed insights into the complexity of interfacial transport in the presence of electromagnetic stimulus. The study covers the practical aspects of such systems. The review by Arup Kumar Das details the means of droplet actuation using electrostatics in the context of microfluidics. He particularly focuses on low-cost techniques that can be used for droplet actuation outside standard cleanroom facilities. The architecture as reviewed by Arup et al. highlights the emerging area of drop manipulation for various applications including biomedical engineering.

Rajneesh et al. presents an in-depth review concerning the problem of flow-coupled evaporation in sessile droplets seeded with nanoparticles. The problem of sessile droplet evaporation is cornertone across a multitude of applications ranging from biomedical engineering to surface patterning. Rajneesh showcases the problem of flow-induced particle self-assembly and the different morphological patterns that emerge automatically. He also highlights the detailed physics that can be tuned to control the self-assembly.

The last article in the special issue is dedicated towards an in-depth review of the problem of drop condensation. The review by Bahga et al. highlights the developments made in the area of mathematical modeling of drop condensation and the different challenges associated with the same. Droplet condensation is an important

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practical problem that hitherto remains notoriously difficult to solve. Bahga et al. highlights the development made in this context.

The special issue encompasses a significant set of problems across various domains which involve analysis of transport processes at various lengths and timescales. The eclectic mixture of problems ranges from high-speed flow droplet coupling to diffusion-driven sessile droplets containing particles. Thus, each area poses its own set of problems and solution methodologies of the same discovered through experiments or high fidelity numerics.

Publisher's Note

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Prof. Saptarshi Basu is currently the DRDO Chair Associate Professor in the Department of Mechanical Engineering at IISc, Bangalore. He works in the area of multiphase transport particularly systems involving droplets and sprays. His research domains span across several verticals like swirling flows and flames, atomization, engineering of interfacial processes and thermal storage. Prof. Basu has published more than 125 journal articles. He also is the founder director of a technology startup that manufactures burners for furnace oil. Prof. Basu is a Fellow of the Indian National Academy of Engineering and ASME. He is also an Associate Fellow of AIAA and holds the prestigious DST-Swarnajayanti Fellowship in Engineering Sciences. His research is funded by DRDO, DST, CSIR, ISRO and various private industries. He has led spray and multiphase combustion-related efforts under National Center for Combustion Research and Development. He has also led the thermal storage-related effort under Indo-US Clean Energy Center.