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Energy and Mass Transfer at Evaporative Droplet Interface

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Extended Abstract

Evaporation from the liquid phase to vapor phase of droplet are broadly existing in advanced manufacturing, thermal management, medical diagnosis, and many other engineering and scientific applications. The fundamental interfacial mechanisms of phase-change droplets, however, are not sufficiently understanding. This talk firstly covers the interfacial temperature measurement at steady-state experiments in droplet evaporation to demonstrate the occurrence of thermocapillary convection driven by the surface tension gradient and the contribution of the interfacial fluid convection on energy transportation for droplet evaporation. Secondly, the hydrothermal waves are demonstrated in the droplets under the steady-state and transient evaporation conditions. The explanation of the hydrothermal waves is conducted with linking to the fluid flow patterns through the measurements of particle image velocimetry and thermographic techniques. Thirdly, the deposition of particle-laden droplets is shown on the flat and structured substrates in the drying process. The transition of the particle aggregation is introduced from ring-shape, uniform and mixed patterns from the droplets. The diffusion-limited cluster-cluster aggregation model is developed to understand the depositions from coffee ring, uniform coverage, to disk-ring shape in the pinned sessile nanofluid droplets, while the kinetic Monte Carlo model is proposed to explain the branched particle self-assembly in drying the depinned droplets. Lastly, noncircular wetting on the patterned substrates is briefed through experiments and simulations.