Wetting Dynamics of Droplets with Interfacial Phase Change: Fundamentals and Implications for Industrial Application

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Phase change heat transfer, represented by condensation and evaporation, plays a paramount role in a series of thermodynamic systems for thermal transport and conversion. A comprehensive understanding of the behaviors of working fluids with interfacial phase change is thus of great importance for enhancing the energy efficiency and securing the stable operation of the systems.

In this talk, I will introduce my recent work on the wetting dynamics of thermofluids with interfacial phase change, *i.e.* evaporation and condensation. I will elucidate the interacting physical mechanisms that govern the droplet kinetics during phase change, which include the capillary effect, the thermal Marangoni effect, the interface motion due to evaporation/condensation, as well as the removal of energy barriers by precursor film. By decomposing the contributions of different effects, it is found that the thermal effect induced by preferential interfacial phase change, *e.g.* thermal Marangoni stress, plays a non-negligible role in the wetting dynamics of the droplet. A phase diagram is subsequently summarized in terms of the Jakob number (interfacial thermal effect) and Biot number (ratio of thermal resistance in the liquid and solid phases), which quantifies the prevalence of the interacting mechanisms.

For practical application, the work indicates the importance of rational design from the heat transfer point of view. Some perspectives will be provided at the end of the talk for the performance enhancement of industrial evaporators and condensers besides typical approaches through low energy surface coatings. The research contributes to the advancement of energy efficient technologies as proposed in I^2CNER milestones.