Microscale Phase Change Promotes the Rational Design of Energy Systems

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Microscale phase change is of paramount importance both in fundamental science and in the practical application of different kinds of energy systems. This talk will take the vapor absorption process as an example, and indicate how microscale investigations can promote the rational design of practical vapor absorption systems.

The vapor absorption is one kind of vapor uptake process by hygroscopic liquids. With optical imaging, high-resolution IR thermography and microPIV, we investigate the vapor absorption phenomena into single hygroscopic ionic solution droplets. We reveal the important factors that govern the droplet dynamics and conduct an in-depth analysis of the heat and mass transfer process. A lubrication-type model is subsequently developed with direct numerical simulation (DNS) and solved with finite element method (FEM). The simulation results indicate a qualitative agreement with respect to the overall droplet behaviour in our experimental observations, and quantitatively with respect to the spreading rates at the dominating stages. The experimental and numerical results demonstrate the crucial role of thermal and solutal Marangoni effects on the droplet dynamics and on the rate of vapor absorption. In practical applications, the Marangoni effects can be properly utilized to enhance the performance of various dehumidification and energy conversion systems, *e.g.* with surfactant addition, *etc*. Several other examples are also given regarding the significance of microscale phase change on system-scale innovation.