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THE MULTI-PHYSICAL FIELDS MEASUREMENT OF DROPLET THERMOCAPILLARY MIGRATION

Abstract

Droplet thermocapillary motion is a complex classical problem, on which research has been carried out for several decades from the discovery of the YGB theory until now. In this paper, we use digital holographic interferometry to investigate the thermo-capillary migration of droplets in ground experiments, and analyze the velocity and temperature fields during the droplet migration process accordingly. However, there are more issues in this field that need to be further investigated. We construct a physical model of droplet migration in various multi-physics fields, and set up a synchronized optical measurement platform by using digital holographic interferometry and particle image velocimetry based on the development of the fluid physics experimental cabinet on the Chinese space station, in order to observe the thermo-capillary migration of droplets in temperature gradient field in real time, and to study the coupling mechanism of multi-physics fields from a new viewpoint. The temperature and velocity fields of single-droplet migration, same-phase two-droplet migration, and different-phase two-droplet migration are measured experimentally, and the mechanism of droplet thermal wake is discussed and analyzed. By measuring the velocity field of droplet migration, phenomena such as a region with zero velocity field at the rear of the droplet, four vortex cell structures, and the off-axis behavior of double-droplet migration are found for the first time and verified by numerical simulation. The physical phenomena are analyzed and discussed from the mechanical point of view, and the coupling correlation of multi-physics fields and the influencing factors are analyzed. The study of droplet thermo-capillary migration due to uniform temperature field is of great significance in revealing the role of thermo-capillary force in the interfacial behavior, and lays theoretical and experimental foundations for the use of thermo-capillary force to lead the interfacial behavior.