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# MANIPULATION AND EVAPORATION OF COLLOIDAL DROPLET IN SPACE

**Abstract**

The manipulation and drying of biological fluids can be very promising in space applications, such as liquid transport inside experimental and life support system. Besides, the patterns from drying droplet of biological fluids can be used for diagnosing health status of the astronaut. The colloidal suspension, as a simple model system of biological fluids, was chosen to study manipulation and drying behavior of droplet in space.

The colloidal material box (CMB), as one of several experimental boxes aboard the SJ-10 satellite, was proposed to study the complex fluids physics in microgravity. The payload is composed of five parts: a structure unit, an injection management unit, a sample management unit, an optical observation unit, and a drive control unit. Its main functions include management and transportation, ultrasonic agitation, heating and evaporation, and optical observation of complex fluids in space.

Based on the CMB, we have succeeded in realizing the colloidal drop manipulation based on a patterned substrate in space, and the mechanism of the droplet wetting and control on the patterned substrate have been further studied. The droplet shape in normal gravity and microgravity can be described as ellipsoidal cap and spherical cap model, and the patterned substrate could confine aqueous droplets with larger volume under microgravity than in normal gravity. With advantages of simple operation and strong capability to control large drops, this technique exhibited the wide application prospect in microgravity condition in the future.

Experiments of colloidal droplet evaporation has been conducted in both space microgravity and terrestrial normal gravity conditions. We report on the interplay of the interface shrinkage, the gravitational sedimentation and the outward capillary flow in drying droplets. This interaction effect is the inference we draw from deposition patterns of both sessile and pendant droplets, which contain particles in different sizes, evaporating on a patterned substrate. We have proposed two different regimes for the relative motion between the particles and the interface: the pursuit regime (sessile droplet) and the meeting regime (pendant droplet), which furthered the theory of particles deposition in drying droplet. In addition, the rupture of liquid film and rearrangement of particles in the final stage of droplet evaporation has been investigated by utilizing differential interference contrast microscopy. We have revealed the formation mechanism of a network pattern inside a coffee ring. It could be shown that particles aggregation and liquid film dewetting are mutual influenced by each other.