Study on Interfacial and Heat Transfer Behaviors of Evaporating Liquid Drops in Microgravity

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Motivated by growing applictions in natural and practical fields, such as thermal management mechines, combustion system, painting and gene mapping, evaporating liquid drop has attracted more and more scientific interests. Many expeimental and simulated works have been performed to study liquid drop behaviours owing to its broad applications (Shahidzadeh-Bonn et al. 2006), while yet evaporating process of drops, especially the mechanisms of which in microgravity are still absent of comprehensive understanding. Recently, developing applictions of liquid drops in space also demand clear knowledge and full identification of the physical mechanisms in microgravity environment.

In present paper, we consider the evaporting liquid drops attached to solid substrates, to study the interfacial and heat transfer behaviors during drop evaporting process in microgravity, which was also performed in the framework of future planned space experiments. Experiments in microgravity were performed in the parabolic flight of France and Drop Tower of Beijing. Different coating of solid substrates and liquids with varying volatility were applied to allow the study of influence on the wettabity and thermal conduction. Evolutions of the drop interface and interfacial temperature fields were record during evaporating progress(David Brutin et al. 2010). Synchronously, heat flux was measured to study the influence of gravity variation and buoyance vanishment on the drop inner heat transfer behaviors. Additionally, simulations on the drop spreading in microgravity were also carried out for comparison.

The contact angles varying with drop diameters in microgravity is plotted on Figure 1. It could be seen that no matter sessile water drops in parabolic flight and pendant ethanol drops in Drop Tower experiments, contact angles of drops in microgravity showed to be approximately changeless with increasing drop diameters, only the results in parabolic were a little dispersed induced by g-jitter in the flights. While for drops under terrestrial gravity, different trend was found due to gravity influence.

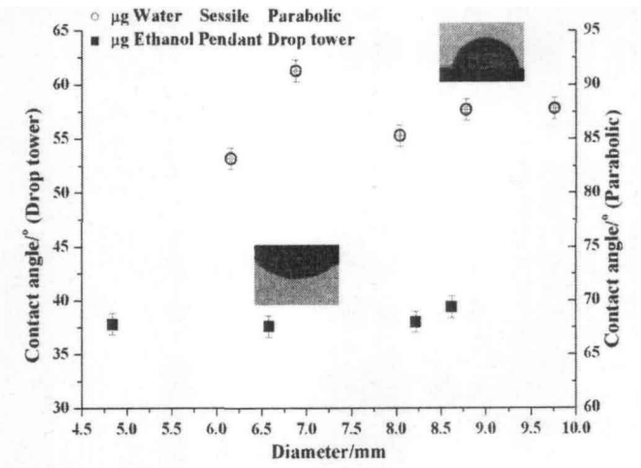

Figure 1: Variation of contact angle for different drop diameters in microgracity.

References

[1]Shahidzadeh-Bonn N., et al, Evaporating droplets/J. Fluid Mech., **549**: 307-313 (2006)

[2]David Brutin, Zhi-Qiang Zhu, et al, Evaporation of ethanol drops on a heated substrate under microgravity conditions/Microgravity Sci. Technol., **22**: 387-395 (2010)