Advances in Thermocapillary Droplet Migration

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Abstract

In microgravity environment, a droplet/bubble placed in an ambient fluid will move in the direction of temperature gradient due to interface tension. This phenomenon called as thermocapillary migration is an important topic in both fundamental hydrodynamics and practical applications. In this paper, advances in theoretical analysis and numerical simulation of thermocapillary droplet migration in microgravity are reported[1,2]. By using the frant tracking method, it is observed that the thermocapillary migration of a planar non-deformed droplet with an uniform temperature gradients is steady at moderate Marangoni numbers, but unsteady at large Marangoni numbers. The numerical results at large Marangoni numbers qualitatively agree with of those of experimental investigations. From the overal steady-state energy balance in the flow domain, a non-conservative integral thermal flux across the surface for a steady thermocapillary droplet migration at large Marangoni numbers is found by using the asymptotic analysis. It presents that the thermocapillary droplet migration at large Marangoni numbers cannot reach any steady states and is thus a unsteady process. **We thank the IMECH/SCCAS SHENTENG 1800/7000 research computing facilities for assisting in the computation. This work was partially supported by the National Science Foundation through the Grant No. 1172310.**

Keywords: Droplet; Surface tension; Thermocapillary migration; Marangoni numbers; Microgravity

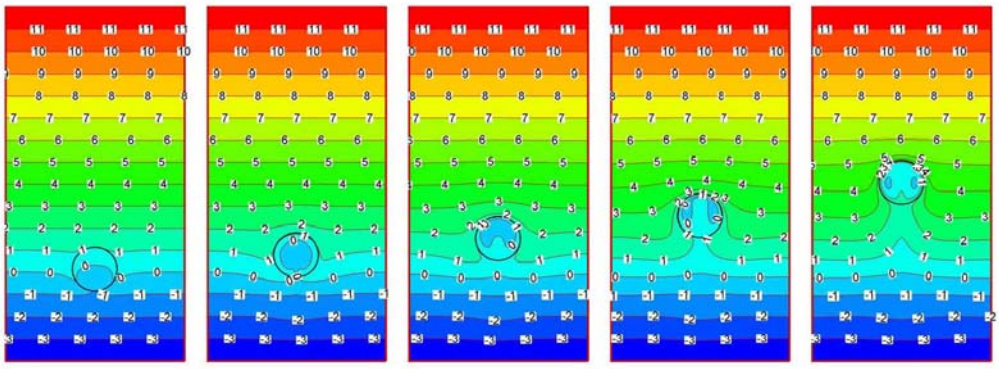

Fig. 1 Isotherms in a laboratory cooredinate frame are selected from the computation of the droplet migration under Re=5.93 and Ma=402.5.

References:

[1] Z. Yin, Z.-B. WU and W. R Hu, Thermacapillary migration of drops and bubbles, *Advances in Microgravity Sciences*, ed. W. R. Hu, Transworld Research Network, India (2009) 35-52.

[2] Z.-B. WU and W. R. Hu, Thermocapillary migration of a planar droplet at moderate and large Marangoni numbers, *Acta Mechanica*, 223, 609-626, (2012).