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EXPERIMENTS ON THERMOCAPILLARY INSTABILITIES IN LIQUID BRIDGE WITH A VOLATILE LIQUID.

Abstract

The study of thermocapillary convection in liquid bridges is aimed at understanding the floating-zone crystal-growth process. The convective flow is initiated by thermocapillary forces even for very small applied temperature differences and evolves under the combined action of two effects: buoyancy and thermocapillarity. There are many factors that influence Tcr the most evident among them are the Prandtl number, the aspect ratio, the liquid bridge shape, and the heat exchange with the environment. The available results of the role of the heat transfer on onset of instability and critical parameters are contradictive. Additional experimental studies of these instabilities with various heat transfer options are desirable.

In theoretical studies the liquid bridge is usually assumed to be thermally insulated or a Biot number (Bi) takes the heat exchange at the free surface into account. There are only a few ways to control Bi experimentally: by changing the surrounding gas, by blowing gas along the interface with different velocities or evaporation from the free surface.

In the present work, Marangoni and buoyancy convection experiments have been conducted using n-decane with Pr = 12, which is a volatile liquid and involves significant heat and mass transfer at the liquid surface due to evaporation. Because of the latent heat involved, the magnitude of heat loss is expected to be much greater than that for convection alone, thus it enables possibility to study the effect of free surface heat and mass transfer on the transition from steady to oscillatory convection. The presentation will provide further insight into heat transfer and the stability of deformable liquid bridges through systematical experimental studies and their careful analysis.