

Two bifurcation processes for onset of oscillatory thermocapillary convection in a floating half zone

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Abstract An overview on the onset of thermocapillary oscillatory convection in a floating half zone is provided, and it is a typical subject in the microgravity sciences related to the space materials science, especially the floating zone processing, and also to the microgravity fluid physics. The main interests are focused around the process for onset of oscillatory thermocapillary convection, which is known also as the bifurcation transition from quasi-steady convection to oscillatory convection. The onset of oscillation depends on a set of critical parameters, such as the Marangoni number, Prandtl number, geometrical parameters, and heat transfer parameters. Recent studies show that, there exists the bifurcation transition from steady and axial symmetric convection to the steady and axial non-symmetric convection before the onset of oscillation in cases of small Prandtl number fluids and in cases of larger Prandtl number fluids of fat liquid bridge with small aspect ratio. The transition process is a strong non-linear process because the velocity deviation has the same order of magnitude as that of an average flow after the onset of oscillation, and unsteady 3-D numerical simulation is suitable to do in depth analysis on strong non-linear process, and leads generally to a better comparison with the experimental results.