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OSCILLATION CHARACTERISTICS OF BUOYANT-THERMOCAPILLARY CONVECTION IN AN OPEN ANNULAR POOL

Abstract

Temperature oscillation characteristics and free surface deformation are essential phenomena in fluids with free surface. We report experimental oscillatory behaviors for hydrothermal wave instability in thermocapillary-driven flow in an open annular pool of silicone oil. The annular pool is heated from the inner cylindrical wall with the radius 4mm and cooled at the outer wall with radius 20mm, and the depth of the silicone oil layer is in the range of 0.8mm-3mm.Temperature difference between the two sidewalls was increased gradually, and the flow will become unstable via a super critical temperature difference. In the present paper we used T-type thermocouple measuring the single-point temperature inside the liquid layer and captured the tiny micrometer wave signal through a high-precision laser displacement sensor. The critical temperature difference and critical Ma number of onset of oscillation have been obtained. We discussed the critical temperature difference and critical Marangoni number varies with the change of the depth of liquid layer, and the relationship between the temperature oscillation and surface oscillation has been discussed. Experimental results show that temperature oscillation and surface oscillation start almost at the same time with similar spectrum characteristic.