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STUDY ON SUPERCRITICAL TRANSITION IN BÉNARD-MARANGONI CONVECTION

Abstract

Bénard-Marangoni convection is a kind of themocapillary flow. It is an important form of natural convection in both terrestrial and microgravity environment. Our experimental work mainly focus on transition process, to study the supercritical transition of the convection, we divide the Bénard-Marangoni convection into 3 different states by the supercritical parameter ε. 1) Critical convection ($\varepsilon = 0$). The convection is at the critical state of the onset of the Bénard cell. The threshold and wavenumber of experiment are in good agreement with theoretical results. The harmonic wave effect is studied experimentally, and the amplitudes and components of the harmonic waves are consistent with the weakly nonlinear analysis. 2) Moderate supercritical convection ($0 < \varepsilon < 10$). the convection is quasi-steady flow. The supercritical condition of the appearing of imperfect patterns are determined, the parameter range of the secondary instability is located and the transition from the hexagonal cells to square cells is observed, the convective form of third instability is defined as the transition from square cell to the spatiotemporal chaos flow and the cell drift at long time scale. 3) Highly supercritical convection ($\varepsilon > 10$). The flow is transiting to the turbulence at the region $10 < \varepsilon < 30$. The hydrothermal waves and subcells appear in the previous large cells which is oscillatory flow, therefore, the convection develop to a time-dependent quasi-periodic state.