Paper ID: 17357
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MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Science Results from Ground Based Research (4)

Author: Mr. Peng Zhu
Institute of Mechanics, Chinese Academy of Sciences, China

Prof. Li DUAN
National Microgravity Laboratory, Institute of Mechanics, Chinese Academy of Sciences., China
Prof. Qi KANG
National Microgravity Laboratory, Institute of Mechanics, Chinese Academy of Sciences., China

EXPERIMENTAL RESEARCH ON TRANSITION ROUTES TO CHAOS IN THERMOCAPILLARY CONVECTION

Abstract

We present under-ground experiments on transition routes to chaos in a rectangular pool of silicone oil for the same model on International Space Station. The applied temperature difference between the two sidewalls is adjusted in the range of 0 to 43 to observe various dynamic states. The applied temperature gradient along the fluid-gas interface drives shear flow along the free surface from hot to cold and a back flow in the underlying layer. With the increase of the temperature gradient, the thermocapillary convection will transit from steady flow to regularly oscillatory flow, and finally to chaos. A temperature measurement system, which consists of thermocouple, nano-voltmeter and data-acquiring computer, is used to record the temperature of the liquid dynamically. In order to identify the different dynamic regimes from steady flow to chaos, fast Fourier transform and fractal theory are used to analyze the experimental data. The quasi-periodic route and Feigenbaum route were observed for different experimental conditions, and the relationship between oscillatory frequency and Marangoni number Ma has been discussed.