Paper ID: 17285
oral
student

MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

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THE SUPERCRITICAL FLOW OF MARANGONI-BÉNARD CONVECTION

Abstract

The Marangoni-Bénard convection happens in a single liquid layer with a free interface, which is heated uniformly bellow. We focus on the supercritical flow investigation, when the temperature difference is continued increasing beyond the onset. Supercritical flow usually experiences steady flow (Bénard cell convection), time dependent flow and turbulence as the temperature difference increase. To fully observe the convection, many flow visualization techniques are used. The velocity field is measured by particle image velocimetry (PIV) and laser Doppler velocimetry (LDV), and the temperature field is measured by infrared thermograph camera and thermocouple. The flow fields of hexagonal and irregular Bénard cells are obtained. When temperature exceeds a threshold, traveling wave in the Bénard cells is found. The wavelength and wave speed are analyzed. The sub-cell is also found in the supercritical condition. It is a time dependent structure, which generates in the corner of the cell and diminishes near the centre of the cell. This dynamic process is occurred quasi-periodically with increased frequency as the temperature difference increased. When the sub-cell generate frequency increasing higher, the time-dependent convection become highly irregular and finally develop into turbulence.