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THE WAVENUMBERS SELECTION OF SUPERCRITICAL MARANGONI-BÉNARD CONVECTION

**Abstract**

The wavenumbers selection of supercritical Marangoni-Bénard convection has been studied experimentally in a single liquid layer at a large aspect ratio, which has been heated uniformly below. The surface temperature and the temperature difference have been measured by the infrared thermography camera and the thermocouple, respectively. The two dimensional Fourier transformation has been carried on the thermographic image to analyse the wavenumbers of the temperature field. The fundamental frequency corresponds to the cell size of the convection, and the harmonic wave corresponds to the emergence of sub-cell on high supercritical convection. (1) It has been observed that the cell size decreases when the Marangoni number (Ma) slightly beyond the critical Ma number of the onset, while the increase of cell size begins when Ma number is over a threshold. The spectra of 2D Fourier transformations show the fundamental wavenumber of the flow increases first before it decreases as the Ma increases linearly, since the fundamental wavenumber is in inverse proportion to the cell size. As the supercritical convection cell shape changes from hexagon to irregular polygon, the spectra of 2D Fourier transformation give more precise results of fundamental wavenumber than the traditional method of counting the number of the cell tediously. (2) When the Ma reaches a large number, the cell becomes larger but breaks into several half size sub-cells. The boundary of the sub-cell is weaker than the one between larger cells, though it strengthens at a higher Ma. The emergence of the sub-cells can be attributed to higher harmonic effect which is the nonlinear behavior of the convection. The spectra analysis shows that the higher harmonic waves become stronger when Ma increases. Also the time-dependency and quasi-periodicity of the sub-cell's generating and vanishing occur when the Ma is large enough. The minimum wavenumber exists, likely due to the oversized cell breaking into sub-cells and splitting off from the large cell.