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INSTABILITY STUDY ON SURFACE-TENSION-DRIVEN BÉNARD-MARANGONI CONVECTION IN ONE LIQUID LAYER

Abstract

We described experimental investigations of surface-tension-driven Bénard-Marangoni convection in a rectangular cell with its length 100mm and width 40mm (an aspect ratio of Γ=25). In order to visualize the convection pattern we observed its square planform by means of shadowgraph technique with a particular bottom of the liquid cell, which was able to be not only heated but also perfectly reflected. Since the liquid layer with free surface was heated from below and the depth of the liquid layer was small enough, the thermocapillary forces are typically dominant to buoyancy forces, the surface tension gradients drive the well known Bénard–Marangoni convective motion. The measurements were performed with different silicon oils (1cS1.5cS2cS), once the liquids have been selected, the applied temperature differenceΔT different heating rate dT/dtand the depths of the layerd were the only independent control parameters. In our experiments, we observed the transition process of the developments of convection cells by different conditions: typical hexagonal array of convection cells above a critical temperature difference developed at the onset of the primary instability, and then lose stability, were gradually replaced by square convection cells, sometimes was mediated with pentagons. At the last of the paper, analysis of the experimental results was presented in detail.