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Theoretical Analysis of Critical Marangoni Number for Oscillatory Flows with High Prandtl Number Fluids SHINICHI YODA, SATOSHI MATSUMOTO, Japan Aerospace Exploration Agency, ATSUKI KOMIYA, Tohoku University — Many experiments to determine the critical Marangoni number at the onset of oscillatory flows for high Prandtl number (Pr) fluids have showed a dependence of a characteristic length such as the diameter of the liquid column. This fact contradicts the similarity principle in fluid physics. This paper investigates the reasons why the critical Marangoni number has shown such a dependency by considering the difference in temperature distribution on the free surface that is caused by a difference in Pr. higher Pr fluids form a thermal boundary layer with a steep temperature gradient in the vicinity of both the hot and cold parts for Marangoni convection experiments, although the middle of the free surface between the hot and cold disks has no temperature gradients. This feature was obtained by two-dimensional simulations with container shape Marangoni experiments. By considering the partial temperature distribution on the free surface, a basic model for the understanding of Marangoni number for higher Pr fluids is proposed by introducing a dimensionless parameter, the effective Marangoni number. The most exact experimental results obtained from microgravity experiments were used to evaluate the effective Marangoni number which is not dependent on the characteristic length dependence at the onset of oscillatory flows. This parameter is consistent with the similarity principle in Marangoni convection behavior.

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