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Linear Stability Analysis of Convective Flow in a Confined Layer of Volatile Liquid Driven by a Horizontal Temperature Gradient ROMAN GRIGORIEV, TONGRAN QIN, Georgia Institute of Technology — Convection in layers of nonvolatile liquids with a free surface driven by a horizontal temperature gradient is a fairly well-studies problem. It is described by several nondimensional parameters: the Prandtl number Pr, the Marangoni number Ma, and the Rayleigh number Ra (or the dynamic Bond number $Bo_D = Ra/Ma$). Previous studies mostly focused on characterizing the critical Ma and the nature of the convective pattern (e.g., stationary rolls or traveling waves) as a function of Pr and Bo_D. To understand convection in volatile liquids one also has to consider the transport of heat and mass in the gas layer above the liquid. In confined geometries, the composition of the gas phase plays a very important role, since air tends to suppress phase change at the interface and thereby the amount of latent heat released or absorbed at the interface as a result of evaporation or condensation. Linear stability analysis of the problem based on a two-sided model shows that, for $Bo_D = O(1)$, both the critical Ma and the critical wave length of the pattern increase as the average concentration of air decreases. The predictions of linear stability analysis are found to be in good agreement with previous experimental and numerical studies of both nonvolatile and volatile fluids.

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