Standing and Traveling Waves in Two-Layer Systems with Heat Release/Consumption at the Interface

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Abstract

Convective phenomena in systems with interfaces have been a subject of an extensive investigation in the past few decades (for a review, see I. Simanovskii, A. Nepomnyashchy, Convective Instabilities in Systems with Interface (Gordon and Breach, London, 1993); A. Nepomnyashchy, I. Simanovskii, J.C. Legros, Interfacial Convection in Multilayer Systems, Second Edition (Springer, New York, 2012)).

We consider a system of two horizontal layers of immiscible viscous liquids with different physical properties. A constant heat release is set on the interface.

Nonlinear oscillatory convective regimes, developed under the joint action of buoyant and thermocapillary effects in a two-layer system with periodic boundary conditions on the lateral walls, have been investigated. The computational regions with different lengths, have been considered. It is shown that in the case of periodic boundary conditions we get completely different nonlinear regimes than those, which have been obtained in the case of closed cavities by I. Simanovskii, Phys. Fluids, 25, 072106 (2013). Specifically, regimes of traveling waves and modulated traveling waves, have been found. It is shown that for sufficiently small values of the modified Grashof number, corresponding to the case of heat sinks, the phase velocity of the traveling wave changes in a non-monotonic way. Nonlinear oscillatory flows exist in a finite interval of the Grashof number values, bounded from below and from above.

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