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Nonlinear dynamics of a binary liquid layer heated from above[1]
ALEXANDER NEPOMNYASHCHY, Technion – Israel Institute of Technology, Haifa, Israel, SERGEY SHKLYAEV, Institute of Continuous Media Mechanics, Ural Branch of Russian Academy of the Sciences, Perm, Russia — It is well known [Pearson, JFM, 1958] that for the Marangoni convection the critical wavenumber k_c scales as $B^{1/4}$ as the Biot number B characterizing the heat flux from the free surface tends to zero. In a layer of binary mixture [Podolny et al., Phys. Fluids, 2005], for heating from above another longwave mode, with $k_c = O(\sqrt{B})$, is important. In this work we study the nonlinear evolution of the latter mode. It is shown that the amplitude of steady convection is governed by a solvability condition for a certain linear nonhomogeneous problem. This makes possible an analytical study of finite-amplitude regimes of convection, with perturbations of the temperature and solute concentration of order unity. It is shown that up-hexagons and squares are selected on hexagonal and square lattices, respectively. On the superlattice combining both square and hexagonal lattices multistability takes place: at the Marangoni number larger than a certain critical value both squares and up-hexagons are stable.

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