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Vibration impact on Marangoni instability in a thin film[1] SERGEY SHKLYAEV, ALEXEY ALABUZHEV, Institute of Continuous Media Mechanics, Ural Branch of the Russian Academy of Sciences, Perm, Russia, MIKHAIL KHENNER, Department of Mathematics, Western Kentucky University, Bowling Green, Kentucky, USA — We study the influence of a vertical vibration on Marangoni instability in a thin film heated from below. Using a multi-scale expansion the film dynamics is considered in a wide range of the vibration frequency ω: from $\omega t_v \gg 1$ to $\omega t_g = O(1)$, where t_v is the time of viscous relaxation across the layer and t_g is the typical time of the longwave surface dynamics. We have shown that for $\omega t_g \gg 1$ there is no interaction between the Faraday instability and the Marangoni convection because of the large differences in the characteristic time- and length scales (see also [Thiele et al. , JFM (2006)]). Therefore, the averaging technique is applied to derive the equation governing the film dynamics in slow time (in comparison with $1/\omega$). We show that the vibration suppresses the Marangoni instability in a confined cavity; however, the branching remains subcritical. This amplitude equation becomes invalid for the ultra-low frequency, $\omega t_g = O(1)$. In this case the standard amplitude equation [Oron et al., Rev. Mod. Phys. (1997)] is obtained, but with the modulated gravity. The vibration does not change the stability threshold; the subcritical excitation leads to the emergence of a limit cycle instead of a film rupture.

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