Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Interfacial instability of thin liquid films at the walls of a parallel-plate channel, sheared by pressure-driven gas flow MIKLÓS VÉCSEI, MATHIAS DIETZEL, STEFFEN HARDT, Technische Universität Darmstadt —

Gas flow between liquid films is a commonly used model system for flows in the respiratory system and is also present during flow boiling in microchannels. The emergence of long-wavelength interfacial instabilities due to viscous stresses is a well-known property of these systems. We show that its description is often reducible to two coupled partial differential equations. Thus the characteristic quantities, such as the most unstable wavelength and the marginally stable wavenumber, can be obtained in a straightforward manner from the linear stability analysis. The analysis of the weakly nonlinear equations shows that if the material properties of the liquid films and their undisturbed thicknesses are identical, their interfaces should only be destabilized by the inertial forces. Moreover, for this configuration the emerging patterns on the two interfaces are found to be identical in the long-time limit. A different setup, where the liquid films have identical material properties, but their undisturbed thicknesses differ, is studied numerically. The results show that even for this configuration the interfacial deformations of the two films remain closely correlated for a broad range of parameters.

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Date submitted: 16 Jul 2015 Electronic form version 1.4