Abstract Submitted
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Bifurcation Leading to Periodic Structuring of Nanofilms By External Modulation of a Thermocapillary Instability[1] YI HUA CHANG, SANDRA TROIAN, Caltech, 1200 E. California Blvd, MC 128-95, Pasadena, CA 91125 — While temporal modulation of a driving field provides an effective means to control fluid systems, far less attention has been focused on spatial modulation to enforce a high degree of uniformity in pattern and growth rate, especially in phenomena triggered by noise. Here we explore the nonlinear dynamics accompanying spatial modulation of a thin slender film prone to an intrinsic long-wavelength thermocapillary instability arising from noise. The frequency of the spatially periodic modulation can either be close or far from the frequency characterizing the instrinsic instability. The modulation can be enforced either by substrate thermal control or periodic features patterned into the substrates used to heat and cool the film. Here we present results of a combined analytic and numerical study to probe early, intermediate and late time behavior of an evolving film in the linear, weakly nonlinear and fully nonlinear regime. Frequency analysis coupled with simulations of the governing nonlinear interface equation elucidate the mechanism leading to bifurcation, whose behavior changes with modulation amplitude and frequency. Based on our findings, we provide estimates of various experimental quantities useful to the thermocapillary design of micro-optical arrays.

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