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Rupture of thin films with resonant substrate patterning[1] JUSTIN KAO, ALEXANDER GOLOVIN, STEPHEN DAVIS, Northwestern University —
We study the stability and rupture of thin liquid films on patterned substrates. It is shown that striped patterning on a length scale comparable to that of the spinodal instability leads to a resonance effect and an imperfect bifurcation of equilibrium film shapes. Weakly nonlinear analysis gives predictions for film shapes, stability, growth rates, and rupture times, which are confirmed by numerical solution of the thin-film equation. Film behavior is qualitatively different in the resonant patterning regime, but with sufficiently large domains rupture occurs on a spinodal length scale regardless of patterning. Instabilities transverse to the patterning are examined and shown to behave similarly as disturbances to films on uniform substrates. We explain some previously reported effects in terms of the imperfect bifurcation.

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