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Study of Pattern Evolution in Nanoscale Viscous Films Subject to Pillar Instability by Thermocapillary Stresses SANDRA TROIAN, MATHIAS DIETZEL, California Institute of Technology, 1200 E. California Blvd., MC 128-95, Pasadena, CA 91125 — Nanofilms of molten polymer subject to a large transverse thermal gradient are known to undergo instability to arrays of elongated pillars separated by a few microns. The simplicity with which such large area patterns can be formed offers a new type of resistless, non-contact lithography in which pillar spacing and amplitude can be controlled by plate separation distance, initial film thickness and thermal gradient. Here, we investigate the evolution of pillar formation from the linear to non-linear regime by examining an unexplored limit of Benard instability accessible to films of nanoscale dimensions. Given the small plate spacings used in experiment, we examine the influence of initial conditions on the wave number selection process. For intermediate values of plate separation, the pillar spacing is well predicted by linear stability analysis and unaffected by the type of initial disturbance applied. For larger plate separation, the pillar arrays evolve toward hexagonal symmetry while subsequent depletion of fluid in the interstitial regions leads to formation of subharmonic protrusions. These bifurcations are suggestive of cascade processes observed in other thin film evolution equations.

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