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Application of Stress Jumps in Free Surface Films for Noise-Free and Controlled Growth of 3D Microarrays NAN LIU, SANDRA TROIAN, California Institute of Technology, MC 128-95, Pasadena, CA 91125 — Linear stability analysis of a nanoscale, free surface viscous film exposed to a large and uniform transverse thermal gradient has revealed how a flat interface deforms spontaneously into a large area, periodic array consisting of elongated protrusions. These formations, however, are extremely sensitive to noise and exhibit substantial variation in position, shape and growth rate, unacceptable for film patterning strategies based on fluid instability. In this talk, we demonstrate how patterned thermal fields can be used to induce large amplitude stress jumps which help better localize periodic formations and trigger more rapid growth. In particular, we present results of finite element simulations in which waveform trains develop in response to thermocapillary stress jumps induced by an adjacent cooled protrusion with sharp sidewalls. We compare the shapes and growth rates of two different regions of the film, one grown by linear instability and the other by a large amplitude stress jump. In general, stress jumps lead to more rapid and regular formation of pillar arrays insensitive to noise. Despite the large amplitude perturbation, the wavelength remains close to the value predicted by linear stability, a significant advantage for technological applications.

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