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Influence of Shear Stress Jumps in Self-Assembly and Growth of Nanopillars by Thermocapillary Forces SANDRA TROIAN, NAN LIU, California Institute of Technology, 1200 E. California Blvd. MC 128-95, Pasadena, CA — Recent theoretical and experimental studies have confirmed how thermocapillary forces can spontaneously generate periodic, 3D nanopillar arrays in viscous nanofilms exposed to a very large and uniform transverse thermal gradient [1,2]. These formations are quite sensitive to local growth conditions and exhibit variations in location, in-plane symmetry and growth rates. Here we explore the role of shear stress jumps in localizing and self-assembling pillar arrays for more rapid and regular formations. Finite element simulations and Fourier analysis of growing waveforms are used to quantify trends observed when a molten viscous nanofilm is held adjacent to a cold protrusion with sharp sidewalls. The sidewalls enforce a jump in the lateral thermal gradient along the free surface of the film which triggers formation of nanopillar trains. We investigate their number, height, spacing and growth rate as a function of the magnitude in shear stress jump and initial noise amplitude. We discuss why the characteristic wavenumber closely matches predictions from linear stability theory despite the large amplitude perturbation.

[1] M. Dietzel and S. M. Troian, Phys. Rev. Lett. 103, 074501 (2009); J. Appl. Phys. 108, 074308 (2010)
[2] E. McLeod, Y. Liu, and S. M. Troian, Phys. Rev. Lett. 106, 175501(2011)

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