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Reanalysis of Incipient Wavelength Measurements in Free Surface Nanofilms Undergoing Benard Instability KEVIN FIEDLER, SANDRA TROIAN, California Institute of Technology, Pasadena, CA — Ultrathin liquid films whose free surface is subject to large thermal gradients are known to develop spontaneous periodic arrays of nanopillars. Theoretical predictions based on linear stability theory in the long wavelength approximation suggest that these formations arise either from fluctuations in the electrostatic forces between the fluid and opposing substrate, acoustic phonon radiation pressure within the film, or Benard instability due to surface thermocapillary forces. Experimental confirmation of the mechanism responsible for such emergent structures requires measurements of the pattern formation process at very early times, a difficult task given that incipient film distortions are of the order of a few nanometers. We reported last year that while our measurements of the dominant wavelength seem to rule out electrostatic effects and acoustic radiation pressure at the source of instability, there remained significant discrepancy between the predictions of the thermocapillary model and measurements of the dominant wavelength obtained from image Fourier analysis. We describe how earlier time analysis and more accurate modeling of the temperature field derived from substrate resistive heating leads to much closer agreement with predictions of the thermocapillary model than previously reported.

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