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The Nanoworld Beyond Bénard Instability: Comparison Between Theory and Experiment KEVIN FIEDLER, SANDRA TROIAN, California Institute of Technology, MC 128-95, Pasadena, CA 91125 — The spontaneous growth of fluid elongations in a viscous nanofilm whose free surface is held in close proximity to a cooler substrate has been attributed to three different mechanisms. Linear stability analyses in the long wavelength approximation indicate that such formations arise either from fluctuations in the electrostatic attraction between the fluid interface and the opposing substrate, the acoustic phonon pressure acting on the film, or thermocapillary stresses along the free surface. The latter mechanism represents the long wavelength limit of the Bénard-Marangoni problem in the absence of a critical number. Model validation requires direct comparison between experiment and linear stability theory, which necessitates that the film structuring process be analyzed at very early times. Previous measurements in our group of the fastest growing wavelength exceeded theoretical predictions of the thermocapillary model by a factor of 2 to 3. More detailed studies of the formation process highlight the importance of obtaining measurements at very early times. Recent data obtained by varying the substrate separation distance, initial film thickness and overall temperature difference indicate much improved agreement with the thermocapillary model.

Sandra Troian
California Institute of Technology, MC 128-95, Pasadena, CA 91125

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