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Experimental Confirmation of Pillar Array Formation in Polymer Nanofilms by Thermocapillary Instability EUAN MCLEOD, YU LIU, SANDRA TROIAN, California Institute of Technology, 1200 E California Blvd, MC 128-95, Pasadena, CA, 91125 — During the past decade, three mechanisms have been proposed to explain the spontaneous formation of periodic fluid elongations in polymer nanofilms confined to closely spaced parallel substrates held at different temperatures. Models suggest linear instability due either to variation in surface charge density at the air/polymer interface, variation in acoustic phonon pressure within the film, or variation in thermocapillary stress along the air/polymer interface. Comparison of theory to experiment requires that the film structuring process be observed at early times in accordance with the assumptions of linear stability analysis. To date, however, all experimental investigations of the most unstable wavelength have been conducted in the solidified state and long after the original molten structures had contacted and reorganized along the cooler substrate. For the first time, we present experimental measurements based on direct observation of in-situ nanopillar growth. Investigation of the fastest growing wavelength as a function of substrate separation distance, temperature difference and initial film thickness indicates excellent agreement with predictions of the thermocapillary model. These studies also make evident how film depletion and contact may have skewed values of the wavelength previously reported in the literature.

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