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Self Directed Growth of Nanopillar Arrays in Molten Polymer Films: Theory versus Experiment KEVIN FIEDLER, SANDRA TROIAN, California Institute of Technology, MC 128-95, Pasadena, CA 91125 — It has been known for over a decade that molten polymer films exposed to a large uniform thermal gradient can develop spontaneous arrays of nanopillars. Theoretical predictions based on linear stability theory in the long wavelength approximation suggest that such formations arise from fluctuations either in the electrostatic attraction between the fluid and opposing substrate, acoustic phonon radiation pressure within the film, or thermocapillary forces along the air/polymer interface. 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 initial thickness fluctuations are of the order of a few nanometers. Here we report results of in-situ microscopy measurements of the dominant wavelength as a function of the applied thermal gradient and initial film thickness. Comparison to all three models indicates closest agreement with the thermocapillary mechanism. However, there remain discrepancies between theory and experiment with regard to the dominant wavelength observed and its corresponding growth rate. We discuss possible origins for the discrepancies, including non-stationary effects and simplified assumptions of the thermocapillary model.

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