Abstract Submitted
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Spontaneous Formation of Nanopillar Arrays in Ultrathin Viscous Films: Critical Role of Thermocapillary Stresses[1] SANDRA TROIAN, MATHIAS DIETZEL, California Institute of Technology, 1200 E. California Blvd, MC 128-95, Pasadena, CA — Nanoscale structures manifest exceedingly large surface to volume ratios and are therefore highly susceptible to control by surface stresses. Actuation techniques which can exploit this feature provide a key strategy for construction and self-organization of large area arrays. During the past decade, several groups have reported that molten polymer nanofilms subject to an ultra-large transverse thermal gradient undergo spontaneous formation of nanopillar arrays. The prevailing explanation is that coherent interfacial reflection of acoustic phonons causes periodic modulation of the radiation pressure leading to instability and pillar growth. We demonstrate instead that thermocapillary forces play a crucial if not dominant role in the formation process due to the strong modulation of surface tension with temperature. Any nanoscale viscous film is prone to such formations, not just polymeric films. Analysis of the governing interface equation reveals the mechanism controlling the growth, spacing and symmetry of these self-assembling arrays. We discuss how these findings are being used in our laboratory to construct nanoscale components for optical and photonic applications.

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