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Fabrication of Converging and Diverging Polymeric Microlens Arrays By A Thermocapillary Replication Technique[1] SOON WEI DANIEL LIM, KEVIN R. FIEDLER, SANDRA M. TROIAN, California Institute of Technology, 1200 E. California Blvd. MC 128-95, Pasadena, CA — Thermocapillary forces offer a powerful method for sculpting air/liquid interfaces at microscale dimensions. Here we demonstrate how square arrays of slender chilled pins in close proximity to a molten nanofilm enforce periodic distributions of thermocapillary stresses suitable for fabricating microlens arrays with ultrasmooth surfaces and excellent focusing capability. We applied this technique to shape and then solidify polystyrene films on quartz to form converging and diverging microlens arrays. By adjusting the growth time, width of the chilled pins, and pin pitch, we created simple convex, simple concave, caldera-like and even hierarchical microarray components. The latter two tend to form when the pitch and pin width are comparable in size. The diverging arrays were incorporated into a Shack-Hartmann wavefront sensor for imaging spatial fluctuations in refractive index caused by bursts of cooled spray. The caldera-like arrays were used to collimate an incident beam into annuli. These demonstrations illustrate how spatiotemporal control over thermocapillary distributions can be used to fabricate a multiplicity of micro-optical components in a single, non-contact step.

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