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Fabrication of Converging and Diverging Polymeric Microlens Arrays By Spatiotemporal Control of Thermocapillary Forces[1] SOON WEI DANIEL LIM, KEVIN FIEDLER, CHENGZHE ZHOU, SANDRA TROIAN, California Institute of Technology, 1200 E. California Blvd., MC 128-95, Pasadena, CA 91125 — Spatiotemporal control of the surface tension of liquid films allows methods for patterning films into myriad 3D shapes. We demonstrate how thermocapillary forces arising from local control of surface temperature deform a flat nanofilm into a microlens array then solidified in situ. An array of chilled, prefabricated slender pins placed in close proximity to the film provide thermal control via thermal conduction. By varying the pin width, pin pitch and evolution time, we have fabricated plano-convex, plano-concave, caldera-like and hierarchical microlens arrays with ultrasmooth surfaces. For demonstration, the diverging arrays were used in a Shack-Hartmann geometry for imaging wavefronts disturbed by bursts of cooled spray. Characterization of the arrays by scanning white light interferometry shows that the resulting microlenses resemble aspheric paraboloids. The aspherical nature is likely caused by unintended lateral thermal flow due to non-parallelism of the heated and cooled substrates. We discuss results of finite element simulations showing how an initial flat film evolves in time through various shapes which can be affixed by controlling the processing time.

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