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Responsive Polymer Surfaces: Crumpling, Folding, and Snapping Films. DOUGLAS HOLMES, ALFRED CROSBY — This work focuses on understanding deformation mechanisms and responsiveness associated with folding, crumpling, and snapping of thin polymer films attached to patterned and nonpatterned substrates. By studying folding and crumpling in confined regimes, we gain insight into material properties, while developing new strategies for adhesive, optical, and patterning applications. Using a novel processing technique, microarrays of freestanding polydimethylsiloxane plates are placed in equibiaxial compression and transition through crumpled morphologies that are difficult to attain through traditional patterning techniques. The microstructures also change their curvature through a snap-through instability via environmental stimuli. When triggered via osmotic pressure the snap transition time scales as the square of the plate thickness and the inverse of the plate modulus. Recently, we have transferred this knowledge into the crumpling of ultrathin polymer films. We have fabricated sharply folded films directly on elastomeric and silicon substrates. The fold width scales directly with the film thickness and applied strain. We find that normally brittle, polystyrene films can accommodate excessive compressive strains without fracture by undergoing strain-localizing fold events.

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