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Buckling instabilities in patterned, poly(N-isopropylacrylamide) microgels RYAN TOOMEY, SAMUEL DUPONT, RYAN CATES, Department of Chemical Engineering, University of South Florida, Tampa, FL 33620 — Stimuli-sensitive hydrogels facilitate reconfigurable microstructures with response integrated at the material level. Response is engendered by a competing mechanism: the elasticity of the network counterbalances expansion by the solvent. If the strength of expansion can be controlled by an environmental cue, the hydrogel can be adjusted in situ. The equilibrium state occurs when the osmotic stress exerted by the solvent in the gel equals the osmotic pressure of the solvent outside the gel. For a free structure, the equilibrium state corresponds to homogenous swelling. If a free surface of the gel is mechanically constrained, however, the dimensions available for the relief of the osmotic stress are reduced, resulting in non-uniform or inhomogeneous swelling. In this study, we demonstrate how mechanical constraints impose differential gel swelling, leading to complex three-dimensional structures that arise from two-dimensional poly(N-isopropylacrylamide) microstructures. Depending on the initial geometry of the constrained gel, three general modes of swelling-induced deformation can be observed: lateral differential swelling, bulk sinusoidal buckling, and surface wrinkling. Through confocal microscopy and 3D image rendering, the mechanics of swelling has been evaluated and compared to linear elastic theory.

Ryan Toomey
University of South Florida

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