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Creasing instability of solvent-swelled polymer films

RYAN HAYWARD, University of Massachusetts, Amherst

A thin layer of polymer bound to a rigid substrate develops compressive stresses when it is swelled by solvent, due to the constraint against lateral expansion imposed by the substrate. For sufficiently large stresses, the surface becomes unstable to a buckling mode in which tightly-folded "creases" form on the surface to relieve compressive stress. While this instability has been known in practice for more than a century, it remains poorly characterized and incompletely understood. I will describe experiments on model systems of surface-attached hydrogels to characterize the onset and growth mechanisms of creases, as well as methods that allow control of crease formation in both space and time. In addition to the implications that this instability has for any type of polymeric coating undergoing swelling, it also provides an opportunity to create surfaces with switchable topography and chemistry.