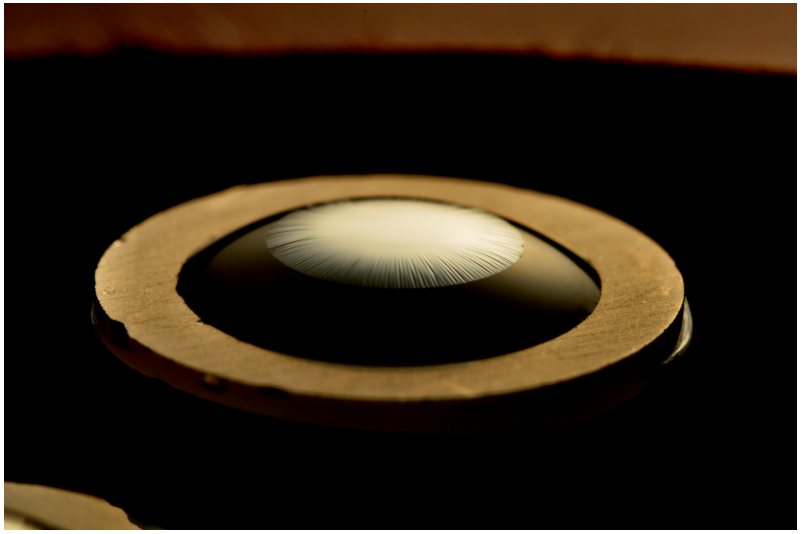
Wrinkle-to-crumple transition

Smooth wrinkles and sharply crumpled regions are familiar motifs in biological or synthetic sheets, such as rapidly growing plant leaves and crushed foils. Nevertheless, the generic route whereby a featureless sheet develops a complex shape remains elusive. A recent paper in PNAS reports on a ACS-PRF supported study in which an unusual sequence of transitions was found to underlie this morphological complexity. The research team used an ultra-thin circular sheet stretched over a liquid drop and imposed increasing levels of confinement on circles of latitude in the sheet by gradually decreasing the drop's radius. At first, the elastic sheet remained nearly flat, but as the drop's radius became small, the sheet developed fine wrinkles. Further decrease of the radius led to the second transition, from wrinkles to a crumpled shape.
This sequence of transitions was understood through a theory, called "far-from-threshold" approach, which was developed in PNAS in 2011, also supported by the ACS-PRF grant.

(H. King*, R.D. Schroll*, B. Davidovitch, N. Menon, PNAS 2012)

(B. Davidovitch, R.D. Schroll, D. Vella, M. Adda-Bedia, E. Cerda, PNAS 2011)



Ultarthin sheet (gray) at the top of a water miniscus (black)
(courtesy of H. King)