

Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Patterns formed by swelling-induced folding of films¹

SACHIN VELANKAR, VICTORIA LAI, University of Pittsburgh,
RICHARD VAIA, Wright Patterson Air Force Base —

The solvent swelling of a thin polymer film attached to a rigid substrate is known to induce a creasing pattern on the free surface of the film. Here we show that if the film is weakly attached to the substrate, the swelling-induced compressive stress nucleates buckle delamination of the film from the substrate. Surprisingly, the buckles do not have a sinusoidal profile, instead, the film near the delamination buckles slides towards the buckles causing growth of sharp folds of high aspect ratio. The folds persist even after the solvent evaporates. Such fold formation depends on the size of the region of the film exposed to solvent. A very small region of exposure (realized by placing a small drop of solvent on the film) does not induce delamination. Remarkably, with moderate sized drops, the delamination and folding occurs around the perimeter of the drop, thus culminating in a corral with tall walls. We quantify the parameters (drop volume, film thickness) which demarcate the transitions between no fold formation, corral formation, and multiple fold formation.

¹Funding support from AFOSR Grant number FA9550-10-1-0329 is acknowledged.

Sachin Velankar
University of Pittsburgh

Date submitted: 09 Nov 2011

Electronic form version 1.4