



Contribution ID: 258

Type: Oral Presentation

Pattern Formation in Crumpled Hydrogel upon Rapid Dehydration with Acetone

Wednesday, 24 May 2023 15:15 (15 minutes)

It has been previously observed that when polymer gels (e.g. hydrogels) undergo rapid extensive swelling, a transient crumpling instability can form on the surface of the gel. This instability consists of many line segments of cusps patterning the gel's surface into an array of bumps that arise from shear bending of a homogeneously swollen gel surface

Here, we present experiments showing that when a hydrogel sheet whose upper surface exhibits such an instability is rapidly dehydrated (e.g. through rapid immersion in acetone), the instability is locked in place, becoming much visible as the bumps undergo a phase transition and change colour from transparent to white (see the attached figure showing this pattern for a range of initial water drop volumes). We explore the different facets of this rich behaviour, comparing the acetone induced pattern with the initial crumpling instability. In particular, we demonstrate that the pattern that emerges is independent of the total size of the blister, rather it is just a function of the time before immersion in acetone. Furthermore, by controlling the time before immersion we can control reliably the wavelength of the instability. We close by discussing potential next steps to be taken in investigating this fascinating phenomena.

Participation

In-Person

References

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Session Classification: MS04

Track Classification: (MS04) Swelling and shrinking porous media