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Drying-induced bending of hydrogel disks

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Hydrogel actuators are typically made of a bilayer gel that can promote water diffusion in one of the layers, subsequently inducing bending. Here, we show that similar bending behavior can be achieved by simply drying a hydrogel disk on a substrate. By varying the gel's aspect ratio and the substrate surface energy we are able to either observe (1) a deposit stuck to the substrate, (2) the bending of the hydrogel disk, or (3) planar drying until buckling of the disk occurs. This bending/buckling phenomenon is due to the coupled diffusion, deformation, and glass transition that freezes the deformation of the material elements in the hydrogel disk at different stressed states during evaporation. We further develop a finite element model to illustrate the role of the adhesion between the gel and the substrate in determining the different final shapes of the dried hydrogel disk. Together, our results provide both fundamental and application insights on, e.g., the drying-induced buckling of thin disks, an active field of research in the colloidal suspension community; and the design of new actuators, sensors, or even origami using differential drying.

Participation

In-Person

References

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