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Swelling-Induced Dynamic Responses of Soft Materials: Bending, Buckling, and Twisting TARUN SINHA, DOUGLAS HOLMES, MATTHIEU ROCHE, Princeton University, ARNAUD SAINT-JALMES, EQUIPE Biophysique, Institut de Physique de Rennes, France, GEORGE MAURDEV, CSIRO Melbourne, AU, HOWARD STONE, Princeton University — Soft materials (e.g. tissue, gels) undergo volume changes and instabilities when subjected to external stimuli. We present the dynamic instabilities that occur by straining an elastomer anisotropically. We examine how thin elastic plates can undergo rapid bending and buckling instabilities after exposure of the crosslinked, elastic network to a favorable solvent that causes it to swell. The shape of the swollen material is determined by the minimization of the system's bending energy in conjunction with any external forces, or constraints on the geometry; here we focus on dynamics. An unconstrained beam bends along its length, while a circular disc bends and buckles with multiple curvatures that rotate azimuthally around the disc. Theoretical interpretations motivated by the complementary thermal expansion problem of transient shape changes triggered by time-dependent heating will be presented. Developing a quantitative understanding of this phenomena will not only further explain the dynamics of morphogenesis in growing soft tissues, but also will lead to the creation of advanced elastic materials that can adapt to stimuli to change shape, and possibly direct and control fluid flow.

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