~~Special Polymer Physics Seminar ~~

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301 Steidle Bldg.

Instabilities in Polymer Networks

Upon the development of a critical stress, many materials and geometries experience a mechanical instability, which produces significant changes in geometry with small changes in stress. In nature, mechanical instabilities are ubiquitous with the definition of shape, morphology, and function. Examples range from fingerprints to the snapping of Venus Flytrap. Inspired by these examples, we use elastic instabilities to control the morphology of soft polymer surfaces and investigate the local mechanical properties in polymer networks. Two vignettes will be presented: 1) controlling wrinkle morphology in top-constrained elastomers; and 2) cavitation rheology for hydrogels and biological tissues. For wrinkling, we use methods with osmotic and adhesive driving forces to induce surface buckles, observing morphological transitions from dimples to wrinkles to organized folds. For cavitation rheology, we study the instantaneous expansion at the tip of a syringe needle induced at a critical pressure for a given polymer network. The critical pressure can be related to the elasticity or fracture properties of the polymer network, depending upon the needle radius. This method provides opportunities for studying mechanical properties in both synthetic polymer networks and biological tissues from molecular to macroscopic length scales at an arbitrary location.