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Stretching Ultra-thin Polymer Films on Water YUJIE LIU, ALFRED J. CROSBY, University of Massachusetts-Amherst — The mechanical properties of many materials, including polymers, are known to change as materials become dimensionally confined; however, the extent and mechanism for these transitions are difficult to quantify due to experimental challenges. Some methods allow a single property, such as the elastic modulus, to be determined, however relatively few, if any, allow the full constitutive relationship, including linear and nonlinear regimes, to be measured for thin, inherently fragile materials. Here, we describe a new method that overcomes these limitations. Specifically, we quantify the uniaxial tension stress-strain relationship for polystyrene (PS, MW=130kg/mol) and crosslinked polydimethylsiloxane (PDMS) elastomer as a function of film thickness (29nm-400nm for PS; 2μm-200μm for PDMS). We perform these measurements by floating thin films on a water surface and attaching one end of the film to a fixed boundary, and the other to a cantilever that is attached to a translating actuator. We use a reflective laser tracking system to measure cantilever displacement, hence the force, as a function of applied displacement. In addition to the elastic modulus as a function of thickness, we present observations of non-linear transitions and cyclic hysteresis as a function of strain.

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