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Cavitation, Elasticity and Fracture in Strong Hydrogels[1] JUN CUI, AHMAD MADKOUR, GREGORY TEW, ALFRED CROSBY, University of Massachusetts Amherst — The interplay between the molecular network and material microstructure of a polymer-based hydrogel is critical for determining both the low strain elastic properties and fracture toughness. We present a novel complex hydrogel network developed by introducing polydimethylsiloxane (PDMS) into a polyethylene glycol (PEG)-based network. Using a combination of conventional characterization techniques, as well as the recently developed technique of cavitation rheology, we investigate the balance of elasticity and fracture in these complex networks. The polymer network maintains elasticity, with negligible hysteresis, at large strains over a wide range of swelling ratios. These properties are investigated across a continuum of length scales ranging from microns to centimeters by taking advantage of cavitation rheology, which uses the onset of an elastic instability to quantify local network mechanics. We compare our results with established scaling theories to describe both the elastic and fracture properties as a function of polymer volume fraction.

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