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Void Collapse as a Platform for Observing the Effects of Strain Stiffening on Creasing MATTHEW MILNER, SHELBY HUTCHENS, University of Illinois Urbana-Champaign — Creasing in soft materials occurs when initially flat surfaces are subjected to a critical field of strain, whereupon self-contact occurs. In Neo-Hookean solids this has been predicted and observed to occur at a biaxial compressive stretch of 0.75, independent of modulus. More recently, theory predicts that constitutive response, specifically strain stiffening, plays a role in delaying crease onset to larger values of stretch [Jin Suo, JMPS 2015]. We validate this prediction experimentally using a unique void collapse geometry in which water droplets embedded in PDMS are evaporated, placing the inner surface under biaxial compression. We analyze images of the collapsing droplet during evaporation to determine: void size reduction, crease onset, and crease evolution. The observed crease onset as a function of crosslinking ranges from a compressive stretch of 0.758 ± 0.007 to $0.0.728 \pm 0.016$. Furthermore, we measure that the increased crosslinking over this range decreases the onset of limiting stretch, J_{lim} from infinity (Neo-Hookean) to $J_{lim} = 6.3 \pm 1.3$ (Gent model). Accounting for these experimentally determined limiting stretch values results in excellent agreement between theory and our experimentally observed crease onset, requiring no fitting parameters.

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