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Materials for soft robotic applications

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ABSTRACT

Soft robotics has been recently gaining interest and momentum, as soft, functional systems offer levels of flexibility, robustness, wearability, and safety that their rigid counterparts cannot match. To date, most soft robots are made from polymers that exhibit nonlinear behaviors and viscoelastic creep. However, the most common polymers employed in soft robotic applications have not been critically evaluated in high-strain environments over many cycles. We have performed tension experiments on representative material samples, including stress/strain relations up to rupture and cyclic loading. We also demonstrate a unique relaxation effect in polymer systems, where material properties change significantly from the first stress cycle to the subsequent cycles. Our experimental results are useful for creating material models for soft robot designers. We demonstrate that the unique properties of soft materials cannot be captured with linear models and that failing to account for these complex effects can significantly affect the design performance.