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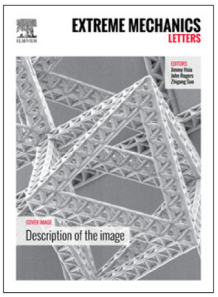

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Fatigue Fracture of Tough Hydrogels

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Abstract:

Tough hydrogels of many chemical compositions have been developed in recent years, but their fatigue fracture has not been studied. The lack of study hinders further development of hydrogels for applications that require long lifetimes under cyclic loads. Examples include tissue engineering, soft robots, and stretchable electronics. Here we study the fatigue fracture of a polyacrylamide-alginate tough hydrogel. We find that the stress-stretch curve changes cycle by cycle, and reaches a steady state after thousands of cycles. The threshold for fatigue fracture is about 53 J/m^2, much below the fracture energy (~10,000 J/m^2) measured under monotonic load. Nonetheless, the extension of crack per cycle in the polyacrylamide-alginate tough hydrogel is much smaller than that in a single-network polyacrylamide hydrogel.

Keywords: tough hydrogel, fatigue fracture, polyacrylamide, alginate, shakedown