Crack growth in mechanical metamaterials: random architectures, toughness and roughness

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Abstract

Linear elastic fracture mechanics provides a predictive theoretical framework for addressing fracture problems in a wide range of brittle materials such as glasses, polymers, ceramics, etc (1). On the other hand, its application to mechanical metamaterials made up of microbeams or microtubes arranged periodically to confer lightness and mechanical resistance to the structure remains more questionable. In particular, these discrete architectures lead to specific system-size dependencies that are a priori incompatible with standard LEFM (2, 3).

In this context, we have carried out a series of simulations and tensile fracture experiments on mechanical metamaterials with random architectures. In the presentation, we will see and discuss to what extent crack growth in these metamaterials differs from that observed in standard brittle materials in terms of crack roughness, fracture toughness, and the damage mechanisms involved.

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(2) Shaikeea, A.J.D., Cui, H., O'Masta, M. et al. The toughness of mechanical metamaterials. Nat. Mater. ***21****, 297–304 (2022).*

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