

Tensile Instability in a Thick Elastic Body

J. T. B. Overvelde, D. M. J. Dykstra, R. de Rooij, J. Weaver, K. Bertoldi

Harvard University - School of Engineering and Applied Sciences
Cambridge, Massachusetts 02138, USA

ABSTRACT

A range of instabilities can occur in soft bodies that undergo large deformation. While most of them arise under compressive forces, it has previously been shown analytically that a tensile instability can occur in an elastic block subjected to equitriaxial tension. Guided by this result, we conducted centimeter-scale experiments on thick elastomeric samples under generalized plane strain conditions and observed for the first time this elastic tensile instability. Interestingly, we found that equibiaxial stretching leads to the formation of a wavy pattern, as regions of the sample alternatively flatten and extend in the out-of-plane direction. Our work uncovers a new type of instability that can be triggered in elastic bodies, enlarging the design space for smart structures that harness instabilities to enhance their functionality.