Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Tension-induced tunable corrugation in bio-inspired two-phase soft composite materials: mechanisms and implications AHMED ELBANNA, QIANLI CHEN, University of Illinois Urbana Champaign — We numerically investigate the elastic deformation response of a two-phase bio-inspired soft composite material under externally applied concentric tension using the finite element method. We show that by carefully designing the inclusion pattern it is possible to induce corrugations normal to the direction of stretch. By stacking 1D composite fibers to form 2D membranes, these corrugations collectively lead to the formation of membrane channels with shapes and sizes that are tunable by the level of stretch. Furthermore, we show that by using specific inclusion patterns in laminated plates, it is possible to create pop-ups and troughs enabling the development of complex 3D geometries from planar construction. We have found that the corrugation amplitude increases with the stiffness of inclusion and its eccentricity from the tension axis. We discuss the mechanisms leading to the development of corrugations as well as its different implications. We discuss applications for this design in a variety of fields including tunable band gap formation, surface roughness controllability, auxetic materials and toughness enhancement via programmable evolving geometrical effects..

Ahmed Elbanna
University of Illinois Urbana Champaign

Date submitted: 01 Dec 2015 Electronic form version 1.4