Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Wrinkling in Cellular Structured Composites NARGES KAYNIA, Massachusetts Institute of Technology, YANING LI, University of New Hampshire, MARY C. BOYCE, Massachusetts Institute of Technology — Many structured composites found in nature possess undulating and wrinkled interfacial layers that regulate mechanical, chemical, acoustic, adhesive, thermal, electrical and optical functions of the material. This research focused on the formation of wrinkling patterns in cellular structured composites and the effect of the wrinkling pattern on the overall structural response. The cellular composites consisted of stiffer interfacial layers constructing a network submerged in a soft matrix. Analytical and finite element models were developed to capture various aspects of the wrinkling mechanism. The characteristics of the undulation patterns and the instability modes were investigated as functions of model geometry and material composition. Mechanical experiments were designed to further explore the modeling results. The cellular composite samples were fabricated by using different types of elastomers and by varying the geometry and the material properties. The experimental and numerical results were consistent with the analytical predictions. The results in this research improve understanding of the mechanisms governing the undulation pattern formation in cellular composites and can be used to enable on-demand tunability of different functions to provide, among others, active control of wave propagation, mechanical stiffness and deformation, and material swelling and growth.

Narges Kaynia
Massachusetts Institute of Technology

Date submitted: 09 Nov 2012 Electronic form version 1.4