

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Mechanics of Geometrically-Tuned pH-Responsive Polymers

LIFENG WANG, Massachusetts Institute of Technology, LIN HAN, KHEK-KHIANG CHIA, ROBERT COHEN, MICHAEL RUBNER, MARY BOYCE, CHRISTINE ORTIZ — Stimuli-responsive polymer materials have been extensively explored over the past two decades because of their promising applications. We consider the mechanics of mechanomutable polyelectrolyte multilayers (PEMs), which undergo reversible pH-responsive transition from a condensed, ionically crosslinked state (small pH) to a hydrated, ionized state (large pH). Instrumented indentation and micro-structurally-based finite element analysis are conducted on the PEM thin films and PEM tube forests to determine the effective elastic properties and further the mechanomutability as a result of the coupling between inherent responsive material properties and geometry. We demonstrate that geometry can be used to introduce and tailor different deformation mechanisms as a means to tune mechanomutability of stiffness and dissipation in addition to the constitutive material properties. The rate-dependent stimulus-responsive mechanomutability can be finely controlled within a wide range from $\sim 2 - 100$ times by tailoring the tube geometrical factors at different indentation rates. These studies provide fundamental understanding and mechanics of indentation of PEM thin films and tube forests and show the tremendous potential for dynamically tuning surface and bulk properties of novel complex structured materials.

Lifeng Wang
Massachusetts Institute of Technology

Date submitted: 19 Nov 2010

Electronic form version 1.4