Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Mechanics and crack formation in the extracellular matrix with articular cartilage as a model system[1] SARAH KEARNS, Rochester Institute of Technology, JESSE SILVERBERG, Harvard University, LAWRENCE BONASSAR, ITAI COHEN, Cornell University, MOUMITA DAS, Rochester Institute of Technology — We investigate the mechanical structure-function relations in the extracellular matrix (ECM) with focus on crack formation and failure. As a model system, our study focuses on the ECM in articular cartilage (AC), the tissue that covers the ends of bones, and distributes load in joints including in the knees, shoulders, and hips. The strength, toughness, and crack resistance of native articular cartilage is unparalleled in materials made by humankind. This mechanical response is mainly due to its ECM. The ECM in AC has two major mechanobiological components: a network of the biopolymer collagen and a flexible aggrecan gel. We model this system as a biopolymer network embedded in a swelling gel, and investigate the conditions for the formation and propagation of cracks using a combination of rigidity percolation theory and energy minimization approaches. Our results may provide useful insights into the design principles of the ECM as well as of biomimetic hydrogels that are mechanically robust and can, at the same time, easily adapt to cues in their surroundings.

[1]This work was partially supported by a Cottrell College Science Award

Moumita Das
Rochester Institute of Technology

Date submitted: 05 Nov 2015 Electronic form version 1.4