MAR14-2013-020250

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Mechanics of composite cytoskeletal and extracellular networks

MOUMITA DAS, Rochester Institute of Technology

Living cells sense and respond to mechanical forces in their surroundings. This mechanical response is mainly due to the cell cytoskeleton, and its interaction with the extracellular matrix (ECM). The cell cytoskeleton is a composite polymeric scaffold made of many different types of protein filaments and crosslinking proteins. Two major filament systems in the cytoskeleton are actin filaments (F-actin) and microtubules (MTs). Actin filaments are semiflexible, while the much stiffer MTs behave as rigid rods. I shall discuss theories that help understand how the direct coupling to the surrounding F-actin matrix allows intracellular MTs to bear large compressive forces and controls the range of force transmission along the MTs, and how the MTs not only enhance the stiffness of the cell cytoskeleton, but can also dramatically endow an initially nearly incompressible F-actin matrix with enhanced compressibility relative to its shear compliance. A second source of compositeness in the cytoskeleton is the presences of different types of crosslinkers that can interact cooperatively leading to enhanced mechanical rigidity and tunable response. Like the cytoskeleton, the ECM is also a polymeric composite. It is primarily composed of a mesh of fibrous proteins, mainly stiff collagen filaments, and a comparatively flexible gel of proteoglycans and hyaluronan. I shall discuss a model that shows how the interplay between the collagen network and the background elastic gel leads to a mechanically robust ECM.