MAR16-2015-009363

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Biopolymer mechanics across the force regimes

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The elastic response of a single polymer can explain certain material properties, including the thickness of polymer brushes and the mechanics of gels; in turn, these material properties have a variety of biological applications, such as to the brush-like pericellular matrix surrounding certain cells. More fundamentally, the force-extension relation of a polymer can be predicted theoretically, making it possible to probe the structure of a polymer by measuring its elastic response. This works in a manner similar to scattering: just as scattering at a wave vector q gives information on structure at a length scale 1/q, the elastic response under applied tension f gives information on structure at a length scale of kT/f. Thus, in exact analogy to low-angle scattering, low-force elastic measurements are needed to probe the interesting long-range structure of polymers. I will discuss the basic physics of low-force elasticity, and present our experiments on various polymers, including nucleic acids and polysaccharides, that validate the power of low-force elastic measurements..