MAR14-2013-020221

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

Semiflexible networks with labile crosslinkers: Bundling, rheology, ripping, and healing

ALEX LEVINE, UCLA, Department of Physics and Chemistry

Networks of semiflexible filaments may be cross-linked by molecules that unbind and then rebind in different places throughout the network. The structure of such networks in equilibrium is dynamic. That structure will also evolve in time either in the relaxation towards equilibrium, or in response to external perturbations such as applied stress. Cross linker mobility leads to new rheological features that depend on e.g., the degree of filament bundling, and allows for new dissipative mechanisms related to cross linker unbinding and rebinding in the networks under applied mechanical load. In this talk, I present the results of analytic calculations and numerical simulations exploring the effect of labile cross linkers on the rheology and structural evolution of semiflexible networks. Specifically, I discuss the fluctuation-induced or Casimir interactions between cross linkers in a semiflexible filament network. I also report on the linear response of such network to applied shear, particularly for the case where the cross linkers induce filament bundling. In that case, there is a universal high-frequency bundle rheology distinct from that of semiflexible filament networks. Cross linker unbinding leads to new dissipative mechanisms, and there is a new low frequency, non-Newtonian rheological regime associated with bundle dissolution. Finally, I comment on the nonlinear response of these networks to applied stress, examining the role of cross linker unbinding (and rebinding) on the energy dissipation in, and the plastic deformation of the network under a time-independent applied load.