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Tuning mechanical relaxation through the regulation of non-equilibrium actin assembly PATRICK M. MCCALL, Dept. of Physics, University of Chicago, DAVID R. KOVAR, Depts. of MGCB and BMB, University of Chicago, MARGARET L. GARDEL, Dept. of Physics, University of Chicago
— Two of the most fundamental differences between the biopolymer filamentous actin (F-actin) and more conventional synthetic polymers are its semiflexibility and intrinsically non-equilibrium (active) nature. While the consequences of semiflexiblity on the mechanics of F-actin-based materials have received much study, less is known about the role of non-equilibrium dynamics. A major roadblock to experimental progress in this regard is that the assembly dynamics of purified actin at steady-state are too slow for appreciable effects to be observed. Taking a cue from living cells, we address this problem by polymerizing actin in the presence of the actin regulatory proteins formin, profilin, and cofilin, which promote filament elongation, nucleotide exchange on monomers, and filament disassembly through severing, respectively, to increase the rates of these processes. The mechanics of the resulting entangled F-actin solution is then monitored at steady-state with passive particle tracking microrheology. At fixed formin and profilin concentrations, the self-diffusion time of 1-micron tracer particles drops by more than two orders of magnitude as the cofilin concentration is increased above a molar ratio threshold of 10%. In addition, the elastic plateau gives way to anomalous scaling with a crossover time that shifts with cofilin concentration. Interestingly, these effects are not observed in the absence of formin, indicating filament treadmilling as the likely mechanism of the enhanced relaxation.

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