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Filament turnover kinetics determine the mechanical relaxation of entangled F-actin solutions PATRICK M. MCCALL, Department of Physics and the James Franck Institute, University of Chicago, DAVID R. KOVAR, Department of Molecular Genetics and Cell Biology & Department of Biochemistry and Molecular Biology, University of Chicago, MARGARET L. GARDEL, Department of Physics, the James Franck Institute, & the Institute for Biophysical Dynamics, University of Chicago — The actin cytoskeleton of eukaryotic cells displays rich mechanical behaviors, which enable cells to efficiently transmit forces required for shape maintenance and tissue stability while also facilitating large shape changes required for morphogenic processes at longer time scales. The molecular processes that control mechanical relaxations of the actin cytoskeleton are poorly understood. Actin filament assembly kinetics are controlled in vivo by an assortment of regulatory proteins, which lead to a complete dissolution and re-formation of filaments on the timescale of seconds. How such "turnover" of filaments influences the mechanical properties of the actin cytoskeleton is less clear. To address this, we developed a system using purified actin regulatory proteins, including the severing protein ADF/cofilin and the formin nucleation/elongation factor mDia1, to tune filament turnover kinetics and measured the frequency-dependent shear modulus of entangled actin solutions via particle-tracking microrheology. We observe a tunable reduction in the terminal relaxation time when filament turnover is enhanced through severing, despite a constant mean filament length.

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