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Transient Binding and Viscous Dissipation in Semi-flexible Polymer Networks OLIVER LIELEG, TU Muenchen, Germany, MIREILLE CLAESSENS, Universiteit Twente, The Netherlands, ANDREAS BAUSCH, TU Muenchen, Germany — Nature specifically chooses from a myriad of actin binding proteins (ABPs) to tailor the cytoskeletal microstructure. Herein, cells rely on the dynamics of the cytoskeleton as its structural and mechanical adaptability is crucial to allow for dynamic processes. A molecular understanding of such biological complexity calls for an in vitro system with well-defined structural rearrangements and cross-linker dynamics to elucidate the physical origin of the unique viscoelastic properties of cells. As we present here, the frequency-dependent viscoelastic response of cross-linked in vitro actin networks is determined by the binding kinetics of cross-linking molecules. Independent from the particular network structure, the viscous dissipation (loss modulus) exhibits a pronounced minimum in an intermediate frequency which is dominated by elasticity. We show that in this frequency regime the molecular origin of the viscoelastic response is given by the non-static nature of actin/ABP bonds as they are subjugated to chemical on/off kinetics. The time scale of the resulting stress release is set by the lifetime distribution of the cross-linking molecule and therefore can be tuned independently from other relaxation mechanisms. We speculate that unbinding of distinct cross-links might be the molecular mechanism employed by cells for mechanosensing.

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