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Dynamic non-linear response of cross-linked actin networks: an energy dissipation approach[1] SAYANTAN MAJUMDAR, MARGARET L. GARDEL, MRSEC and The James Franck Institute, University of Chicago, IL 60637 — Cross-linked bio-polymer networks that primarily maintain the shape and rigidity in eukaryotic cells show striking non-linear mechanical properties. Here, we study the steady-state energy dissipation (E_{diss}) over a complete sinusoidal shear strain cycle for a macroscopic assembly of reconstituted network of actin filaments cross-linked with Filamin A, over wide range of strain amplitude and frequency values. For small values of the applied strain amplitudes (linear regime) E_{diss} increases monotonously with the increasing frequency over the entire frequency range studied but in the non-linear regime (larger applied strain amplitudes), a clear saturation in E_{diss} is observed at higher frequencies. Also, the normalized dissipated energy distribution binned over the fixed strain intervals along the shear cycle show frequency dependence in the nonlinear regime but remains frequency independent in the linear regime. Remarkably, the monotonously increasing behavior of E_{diss} with frequency is also observed in the non-linear regime when a more rigid cross-linker A-Actinin is used, suggesting the importance of flexibility of cross-linkers in controlling the non-linear mechanical response in this class of materials.

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