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Distinct Tensile Response of Model Semi-flexible Elastomer Networks[1] BERNARDO M. AGUILERA-MERCADO, CLAUDE COHEN, FERNANDO A. ESCOBEDO, School of Chemical & Biomolecular Engineering, Cornell University — Through coarse-grained molecular modeling, we study how the elastic response strongly depends upon nanostructural heterogeneities in model networks made of semi-flexible chains exhibiting both regular and realistic connectivity. Idealized regular polymer networks have been shown to display a peculiar elastic response similar to that of super-tough natural materials (e.g., organic adhesives inside abalone shells). We investigate the impact of chain stiffness, and the effect of including tri-block copolymer chains, on the network's topology and elastic response. We find in some systems a dual tensile response: a liquid-like behavior at small deformations, and a distinct saw-tooth shaped stress-strain curve at moderate to large deformations. Additionally, stiffer regular networks exhibit a marked hysteresis over loading-unloading cycles that can be deleted by heating-cooling cycles or by performing deformations along different axes. Furthermore, small variations of chain stiffness may entirely change the nature of the network's tensile response from an entropic to an enthalpic elastic regime, and micro-phase separation of different blocks within elastomer networks may significantly enhance their mechanical strength.

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