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**Exploring elasticity and energy dissipation in mussel-inspired hydrogel transient networks** SCOTT GRINDY, ROBERT LEARSCH, NIELS HOLTEN-ANDERSEN, Massachusetts Inst of Tech-MIT — Dynamic, reversible crosslinks have been shown to specifically control the mechanical properties of a wide variety of mechanically tough and resilient biomaterials. We have shown that reversible histidine-metal ion interactions, known to contribute to the strong mechanical properties and self-healing nature of mussel byssal threads, can be used to control and engineer the temporally-hierarchical mechanical properties of model hydrogels orthogonally from the spatial structure of the material. Here, we explore the scaling relationships in our model networks to further inform our abilities to control the relative elasticity and energy dissipation on hierarchical timescales. Scaling arguments suggest that the elasticity is dominated by long-range entanglements, while the dissipation is controlled by the exchange kinetics of the transient crosslinks. Further, we show that by using UV light, we can further control the viscoelastic properties of our mussel-inspired hydrogels *in situ*. This process opens the door for creating biocompatible hydrogel materials with arbitrary spatial control over their viscoelastic mechanical properties. Overall, we show that by understanding the interplay between bio-inspired dynamic crosslinks and soft matter physics allows us to rationally design high-strength hydrogels for specific states of dynamic loading.

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