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Nanoscale phase separation in ultra-tough hydrogels RYAN NIXON, Department of Mechanical and Aerospace Engineering, University of Florida, JAN BART TEN HOVE, Laboratory of Physical Chemistry and Colloid Science, Wageningen Universiteit en Researchcentrum, ADRIAN OROZCO, J. Crayton Pruitt Family Department of Biomedical Engineering, University of Florida, W. GREGORY SAWYER, THOMAS ANGELINI, Department of Mechanical and Aerospace Engineering, University of Florida — Soft, wettable, water permeable materials that resist protein adsorption are essential to countless biomaterials, adaptive optics and microfluidics technologies. Hydrogels would be ideal for these applications, but are notoriously brittle and weak. For example, hydrogel coatings of synovial joint prosthetics exhibit irrecoverable damage after a single cycle of wear. The development of elastomer-like hydrogels that are tough, soft, and mechanically resilient would improve their versatility and create opportunities for a wide range of new applications. Here we present studies of an ultra-tough hydrogel, synthesized by the co-polymerization of two monomer species that polymerize at different rates and have strongly differing degrees of solvation. The resulting blended hydrogel network forms with both covalent and labile adhesive bonds, greatly improving recoverable energy dissipation and reducing fatigue relative to networks made from either constituent alone. We have studied the structural origins of the strengthening behavior using small angle x-ray scattering (SAXS) and found that the constituent polymers phase separate into nanoscale domains, which may prevent crack nucleation and propagation.

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