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High Strain Deformation and Fracture of Self-Assembled Polymer Gels

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Triblock copolymers with poly(methyl methacrylate (PMMA) endblocks and a poly(n-butyl acrylate) (PnBA) midblock form thermoreversible gels in a variety of alcohols. The mechanical response of the gels is determined by the nature of the PMMA aggregates that are bridged by PnBA midblocks. The close proximity of the ordering temperature to the glass transition of the PMMA aggregates gives rise to a remarkably strong temperature dependence of the relaxation time for the polymer gels. At low temperatures, where the relaxation times are very large, the gels can be deformed to very large strains prior to solid-like fracture. At intermediate temperatures the materials flow, but strain localization leads to a melt fracture phenomenon, and at higher temperatures the materials behave as viscous polymer solutions. We have used these gels as a model material for studying rate effects in the high strain deformation and fracture of soft solids.