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Network Confinement and Heterogeneity Slows Nanoparticle Diffusion in Polymer Gels[1] EMMABETH PARRISH, MATTHEW CAPORIZZO, RUSSELL COMPOSTO, Univ of Pennsylvania — Nanoparticle (NP) diffusion was measured in polyacrylamide gels (PAG) with a mesh size comparable to NP size, 20nm. The confinement ratio (CR), NP diameter/mesh, increased from 0.4 to 3.8 by increasing crosslinker density and 0.4 to 2 by adding acetone, which collapsed PAG. In all gels, NPs either became localized (<200nm) or diffused microns, as measured by single particle tracking. Mean squared displacements (MSD) of mobile NPs decreased as CR increased. In collapsed gels, the localized NP population increased and MSD of mobile NPs decreased compared to crosslinked PAG. For all CRs, van Hove distributions exhibited non-Gaussian displacements consistent with intermittent localization of NPs. The non-Gaussian parameter increased from a maximum of 1.5 for crosslinked PAG to 5 for collapsed PAG, consistent with greater network heterogeneity. Diffusion coefficients, D, decreased exponentially as CR increased for crosslinked gels, but in collapsed gels D decreased more strongly, suggesting CR alone was insufficient to capture diffusion. Collapsing the gel resulted in an increasingly tortuous pathway for NPs, slowing diffusion at a given CR. Understanding how gel structure affects NP mobility will allow the design of gels with improved ability to separate and release molecules.

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