

Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Free volume in a granular nanocomposite REGHAN J. HILL, AHMAD MOHADDESPOUR, McGill University — Free volume plays a determinative role in the unusual molecular sieving and rheological characteristics of nanocomposites. To help elucidate the nanoparticle influence on polymer-chain packing, we mixed acrylic spheres with aluminum ball-chains and ascertained from measurements of the bulk density the partial molar sphere volume at small but finite sphere volume fractions. This macroscopic mechanical model permits a systematic exploration of how the chain length, sphere size, and mixture composition influence free volume. We show that the nanoparticle radius to the chain loop size is the primary dimensionless parameter that bridges the solvent and continuum scaling regimes. In the intermediate regime, where the inclusion and polymer nanoscales are comparable, the primary sphere-chain interaction increases free volume—up to twice the intrinsic inclusion volume per particle—and the primary sphere-sphere interaction decreases free volume. Comparisons will be made with data gleaned from PALS and the bulk density of molecular nanocomposites reported in the literature.

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Date submitted: 09 Nov 2011

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