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Depletion potential between nanoparticles: From small molecule liquids to dense polymer melts DEBAPRIYA BANERJEE, KENNETH SCHWEIZER, University of Illinois at Urbana Champaign — An entropic depletion attraction generically exists between two hard spheres dissolved in a nonadsorbing fluid. PRISM integral equation theory is used to study this problem over an exceptionally wide range of polymer-particle size ratio and chain length (N) including the monomer limit. To mimic constant atmospheric pressure conditions, the dimensionless melt compressibility is fixed at realistic values and polymer density varied with N accordingly. At constant polymer size, the attractive contact minimum of the particle potential of mean force (PMF) scales roughly as particle radius. At fixed particle size, this contact minimum deepens logarithmically with N before generically saturating beyond a crossover N 150. The equilibrium aggregation behavior is dominated by this local feature. However, the PMF beyond contact has features (including repulsive barriers) of a spatial range and amplitude that vary non-monotonically with N which are most pronounced when the particle radius is of order the polymer radius of gyration, R_g. At fixed particle size, this implies a value of N exists that maximizes kinetic stabilization. A weak but long range (R_g-scale) component of the PMF is also found when the radius of gyration is smaller than, or comparable to, the particle radius.

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