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Abstract for an Invited Paper
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The phase stability and properties of polymer – nanoparticle blends¹

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In our studies of nanoparticles blended with linear polymer melts two unusual phenomena were noted; the viscosity was reduced upon nanoparticle addition and the nanoparticles remained dispersed despite the interparticle gap being smaller than the polymer radius of gyration. The viscosity decrease is not easily explained and it appears as if it is related to introduction of free volume created by the vast surface area generated by the nanoparticles and elimination of entanglements via constraint release generated by the fast diffusing nanoparticles. Further study is required to fully understand this phenomenon. This leads to the key point, unless nanoparticles are well dispersed in polymer melts then one would not expect any unusual phenomena to exist. Furthermore, one would expect the equivalent of depletion flocculation to occur at moderate volume fraction since the interparticle gap becomes so small in nano-systems and this simply does not occur. We suggest the dispersion driving force is due to an enthalpy gain the nanoparticles experience. Consider the pure nanoparticle phase, the van der Waals forces effectively propagate over a distance of order δ , however, the interstices between the nanoparticles could be larger than this resulting in a reduced cohesive energy. Thus, when a nanoparticle is dispersed in a polymer melt it gains molecular contacts or enthalpy. This is a true nanoscale phenomenon since if the nanoparticles are too small then the interstices are quite small and the driving force for dispersion is reduced while if they are too large then there are not enough of them per unit volume to cause a significant enthalpy gain for a given volume fraction. An optimum exists at a radius of approximately 3-5 nm. This phenomenon and others will be discussed in the seminar.

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