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Rheology of blends of dense star-like polystyrene soft nanospheres

AJAY KULKARNI, R.M. KANNAN, Wayne State University — Highly branched polymeric materials exhibit significantly different rheological behavior compared to linear polymers, suggesting that controlled branch density can have technological benefits. We have synthesized a dense star polystyrene molecule, (PS_{nano}) with 50 arms, $M_a = 5,000$ g/mol. Using rheo-optics and triple-detection GPC, we have shown that these materials act as soft nanospheres, with a size of ~ 8 nm. We are studying the effect of the nanospheres on the blending behavior of miscible polystyrene/ poly (vinyl methyl ether) (PS/PVME) blends with the help of dynamic stress-optical measurements. In PS_{nano} /PVME blends, at higher PS_{nano} wt. fractions, the interparticle distance between PS_{nano} is smaller than radius of gyration of PVME. Therefore we expect to see the conformational changes in PVME chains induced by PS_{nano} and compare it with linear PS (L-PS)/PVME blends. However the rheo-optics data suggests that the relaxation dynamics of PVME is not significantly altered by PS_{nano} whereas for L-PS/PVME blends the relaxation dynamics of PVME is slowed down by L-PS. DSC results show a single transition suggesting miscibility. Our results suggest that, the segments of PS near the periphery of PS_{nano} may be miscible, but the segments at the core would be immiscible, resulting in a molecularly dispersed blend, rather than a segmentally miscible L-PS/PVME blend.

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