MAR13-2012-001857

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Canopy Dynamics in Nanoscale Ionic Materials Probed by NMR

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Nanoscale ionic materials (NIMs) are hybrids prepared from ionically functionalized nanoparticles (NP) neutralized by oligomeric polymer counter-ions. NIMs are designed to behave as liquids under ambient conditions in the absence of solvent and have no volatile organic content, making them useful for a number of applications. We have used NMR relaxation and pulse-field gradient NMR to probe local and collective canopy dynamics in NIMs based on silica nanoparticles (NP), fullerols and proteins in order to understand the relationship between the core and canopy structure and the bulk properties. The NMR studies show that the canopy dynamics depend on the degree of neutralization, the canopy radius of gyration and molecular crowding at the ionically modified NP surface. The viscosity in NIMs can be directly controlled with the addition of ions that enhance the exchange rate for polymers at the NP surface. These results show that NIMs for many applications can be prepared by controlling the dynamics of the NP interface.