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Deuterium NMR and Rheology of Microgel Colloids at Ambient and High Pressure

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Microgel colloids exhibit a polymer collapse transition resulting in a large reduction in colloid size at high temperatures or pressures. They have potential for drug delivery and chemical separation applications that involve uptake and release of small or biological molecules. Our goal is to obtain a microscopic understanding of the structure and dynamics of the microgels by examining the temperature and pressure dependence of collapse transition in order to investigate the energetic and entropic contributions to polymer collapse. The nature of this collapse transition can be controlled by crosslink density (Cd) thus we plan a systematic study as a function of Cd. We have used deuterium NMR (2H-NMR) to probe the microscopic dynamics of cross-linked poly-N-isopropylacrylamide (p-nipam) chains, in microgel colloids, as a function of temperature and pressure. Dynamic light scattering (DLS) and rheology were employed to characterize the microgels and probe their macroscopic properties. The observed changes in particle size and viscosity by DLS and rheology measurements with temperature were related to changes in the internal structure of the microgel particle investigated by 2H-NMR. Microgels colloids were synthesized with deuteron labels on the nipam side chains (d7-nipam) or on the backbone (d3-nipam). 2H-NMR spectra of both suspensions indicated freely moving chains in the microgel particle at low temperature, and a nearly immobilized fraction of the d3-nipam suspension above 35℃, consistent with DLS observations of transition from swollen to collapsed colloids. We continue to investigate the role of crosslink density in microstructure and macroscopic response by 2H-NMR, rheology and DLS.

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