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The Effects of Chemical Crosslinker on Polymeric Microgels

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Abstract

Microgels are nanoparticles suspended in solution and comprised of crosslinked polymer chains. Due to the amphiphilic property of the parent polymer, microgels exhibit a reversible volume phase transition. The standard behavior of these microgels is to deswell from a large to small size with an increase in temperature. Microgels in this study were synthesized by crosslinking hydroxypropylcellulose (HPC) in a surfactant solution. The amount of crosslinker used for synthesis was varied by a factor of a hundred. Using dynamic light scattering, microgels were characterized at various temperatures and scattering angles to determine the particles' hydrodynamic radius (R_h) and dynamics both in the swollen and deswollen states. It was recently shown that for low crosslinker concentrations, microgels exhibit standard behavior, with a decrease in radii as crosslinker concentration increases. Above a certain concentration, the behavior switches from standard behavior to microgel growth with temperature increase. Using a new polymer stock, both behaviors were reproduced using the same synthesis procedure; however, the point at which microgel deswelling switches to growth appeared to shift towards a lower crosslinker concentration. Also observed was that some particles exhibiting standard microgel behavior increase in size at very high temperatures, possibly due to nonuniform crosslinker distribution. Lastly, it was found that microgels synthesized at intermediate crosslinker concentrations exhibit a spike in size at the transition temperature. These newly observed phenomena led to further light scattering studies and investigation into the synthesis procedure: including tests on pH dependence, mixing time, heating rate, and comparisons between the polymer stocks themselves.