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P1: Synthesis Optimization and Characterization of Polymeric Microgels

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Abstract

Microgels are spherical particles suspended in solution, comprised of crosslinked polymer chains. Due to the amphiphilic property of the parent polymer, microgels display a temperature dependent de-swelling property, and therefore have the potential to be used for drug delivery. In this case, microgels were synthesized using hydroxypropyl cellulose (HPC) polymer and divinyl sulfone (DVS) cross-linker, as well as dodecyltrimethylammonium bromide (DTAB) surfactant to decrease particle size and promote microgel monodispersity. Synthesized particles were then characterized using dynamic light scattering (DLS) for both temperature and angle dependence to determine hydrodynamic radius, Rh, at a range of temperatures showing a transition from the swollen to de-swollen states. Previous studies suggest that increasing the concentrations of either the chemical cross-linker or the surfactant reduce Rh. Primary experiments focused on the variation of DVS and DTAB concentrations. Increasing the DVS:HPC ratio from 1 to 30 results in microgels that decrease in swollen size from 190 to 150nm and deswollen size from 95 to 65nm. However, at higher DVS:HPC ratio synthesized particles grow rather than shrink with increasing temperature. Surprisingly, increasing the surfactant concentration resulted in an increase in Rh; this might be related to DTAB effect on polymer transition temperature. Additionally, DLS experiemnts revealed a dependence of Rh on microgel concentration in samples. Rh at infinite dilution was extrapolated from the concentration dependence. Continued work with the synthesis procedure also revealed the importance of a meticulous synthesis procedure; most notably in regards to polymer stock preparation, pH and temperature control, and consistent stirring.