2018

Towards Understanding Microgel Volume Phase Transitions

Jacob Adamczyk
Cleveland State University

Samantha Tietjen
Cleveland State University

Towards Understanding Microgel Volume Phase Transitions

College of Sciences and Health Professions

Student Researchers: Jacob Adamczyk and Samantha Tietjen

Faculty Advisor: Kiril A. Streletzky

Abstract

Microgels are polymer-based particles which are able to change size and shape during volume phase transition in response to external stimuli. We have investigated microgels which respond to changes in temperature for eventual use in drug-delivery systems on the nano to micro scale. Light scattering data on Hydroxypropylcellulose (HPC) microgels has been analyzed to determine microgel parameters such as radii, molecular weight, and polydispersity at various temperatures. The classic Flory-Huggins (FH) approach to mixing polymer-solvent solution is used to model a temperature-size dependence for the microgels. Existing theory on the microgel size dependence on the amount of crosslinker is examined. A new term is added to account for a minimum microgel size at large crosslink densities. We find that many microgels behave with the expected Lower Critical Solution Temperature (LCST) and are generally matched with FH theory despite not accounting for the crosslinker in the model. Several sample runs have exhibited other interesting temperature dependent functions which are likely due to non-homogeneous crosslinking occurring during synthesis. We discuss such inhomogeneities and the relevant models at length. New attempts at reconciling the Flory-Huggins theory with a crosslinker-dependent model as well as ways to model unusual swelling behaviors are being considered.