Thermophoresis of a thermally responsive polymer

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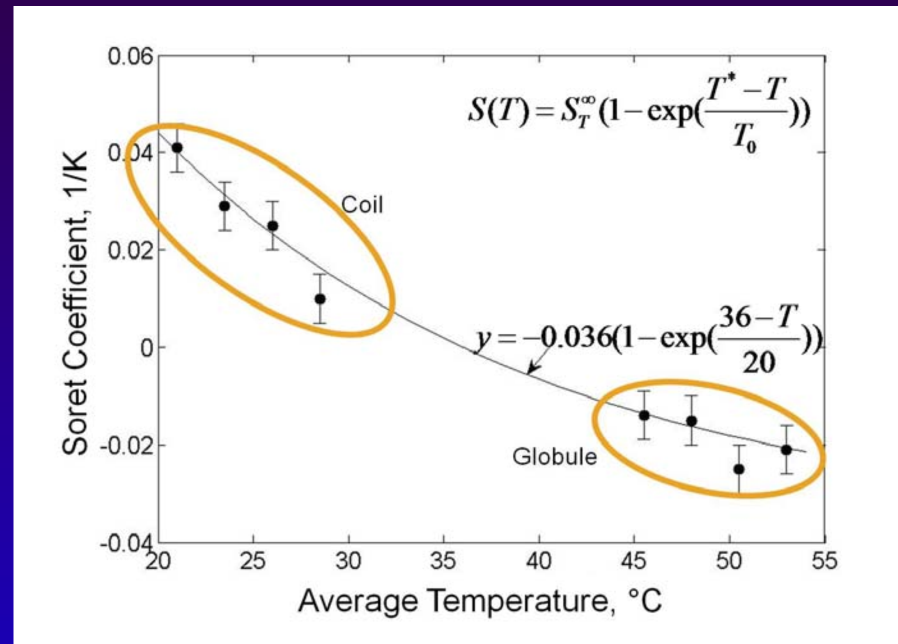
We aim to understand thermophoresis, or mass migration due to a temperature gradient. This effect has been used to separate molecules of different sizes and composition and has great promise to be used in microfluidic devices for chemical analysis. However, the underlying mechanism is elusive since many factors can affect thermophoresis.



We study how different conformations of a polymer (coil and globule) and the transition from one to another affect thermophoresis using both simulation and experiment. We synthesize a dye-labeled N-isopropylacrylamide (NIPAM) and N-acryloxysuccinimide (NASI) copolymer. If subjected to a certain temperature gradient, both forms of the polymer are present. We have observed experimentally that the globule conformation has a negative Soret coefficient (a measure of the temperature gradient induced concentration gradient) and migrates to the temperature maximum, while the coil form migrates to the temperature minimum. We have also found that both forms are fit with the same theoretical prediction for the temperature dependence of the Soret coefficient. In simulations, we have implemented a Lennard-Jones potential that varies with position to model the interactions of the polymer with itself and the surrounding fluid. We are currently investigating the mechanism of the sign change using this simulation. In experiment, we are also investigating how salt concentration and system size affects the migration of the polymer.