Polymer analysis remains a challenging endeavor as new needs arise from the synthesis community while existing questions have yet to be fully resolved. Tackling these problems require a coordinated effort among various organizations and research groups. This talk will focus mainly on field-flow fractionation (FFF), particularly thermal FFF, and our efforts to make this into a cornerstone technology for polymer analysis.

Thermal FFF (ThFFF) is characterized by a separation mechanism that takes place in an open channel with no packing material, the application of a temperature gradient perpendicular to the separation axis, and the positioning of different polymer analytes in different velocity streamlines of the parabolic flow observed in the FFF channel. The temperature gradient causes thermal diffusion at a magnitude that is dependent on a number of factors such as polymer composition and separation solvent. This leads to intriguing separations on the basis of polymer composition and microstructure (in addition to molecular weight). The deterrent to using ThFFF has been the trial and error measurements approach to developing an analytical method for a new polymer. The ideal scenario is to develop an understanding of thermal diffusion such that a reasonable starting point can be selected on the basis of polymer and solvent properties.

Studies of thermal diffusion trends have been limited because of the unavailability of systematically varied and well characterized polymer standards. To resolve this, we have collaborated with National Starch whose scientists have synthesized and characterized polyacrylates ‘standards’ for our studies. These polymers are used as pressure sensitive adhesives and in paints and diapers and are a key business for the company. The theory effort involves a collaboration with physical chemistry colleagues. Finally, the funding for these studies comes from the federal government (via enlightened grant proposal reviewers) who support the need for developing new analytical technologies with potentially high impact on the industrial sector.

This talk will address our progress towards making ThFFF a more widely used technology. Specific studies that will be discussed include the measurement of thermal diffusion coefficients and evaluation of existing theories; assessment of flow through photon correlation spectroscopy and standard FFF practices; and compositional analysis for polyacrylate homopolymers and copolymers.