

Current Laboratory Activities

1) Synthesis of Polypeptides to be used as Drug Delivery Systems:

(Bushra Siddique, PhD; Mei Wang, PhD; Mike Fowler, MSc)

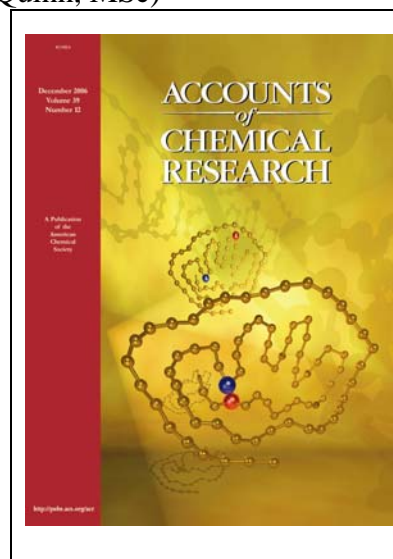
Polypeptides are synthesized with a well-defined repeating sequence. The sequence incorporates hydrophobic and hydrophilic amino acids in different ratios. The hydrophobic amino acids induce the self-association of the polypeptides into large polymeric aggregates which are stabilized in aqueous solution by the presence of the hydrophilic amino acids. The hydrophobic amino acids are expected to lead to the formation of hydrophobic pockets into which hydrophobic compounds can be loaded.

The molecular weights of the polypeptides are characterized by gel electrophoresis, light scattering, and end-labeling. The hydrodynamic diameter of the polymeric aggregates is measured by dynamic light scattering. Information about the nature of the core forming the polymeric aggregates is obtained by fluorescence. Preliminary release experiments of hydrophobic compounds into liposome membranes have been carried out with peptides.¹

2) Polymer Chain Dynamics:

(Mark Ingratta, PhD; Christine Keyes-Baig, PhD; Cristina Quinn, MSc)

The Duhamel laboratory has invented and developed the *blob* model to retrieve information on polymer chain dynamics.²⁻⁷ This model is based on the assumption that a fluorescent dye attached randomly onto a polymer will probe a finite volume of the polymer coil during its lifetime. This finite volume referred to as a blob is used to divide the polymer coil into compartments. The dyes distribute themselves randomly among the compartments according to a Poisson distribution and their encounters are monitored by fluorescence. Information about polymer chain dynamics is obtained from the rate of encounter and the size of the polymeric blob. These results are generalized by applying the *blob* model to polypeptides,⁷ with expected applications into the field of protein folding.



3) Associative Polymers:

(Howard Siu, PhD; Yu Shen, MSc)

Associative polymers are made of a backbone which is soluble in a given solvent onto which insoluble pendants have been attached. In the solvent, the insoluble groups can associate intermolecularly which triggers the formation of large polymeric aggregates. The large polymeric aggregates hinder the flow of the solution which increases the solution viscosity. These types of material have found numerous applications as viscosity modifiers or colloidal stabilizers in paints, inks, or oil additives. They are used either in aqueous solutions or apolar oils. In aqueous solutions, the polymeric backbone is water-soluble and the hydrophobes are apolar hydrocarbons. In

oils, the polymeric backbone is a polyolefin (ethylene-propylene copolymers, polyisobutylene) grafted with maleic anhydride which is later reacted with an amine containing compound.

By attaching the chromophore pyrene in place of the associating pendant, information about the level of association of the pendants can be retrieved either with water-^{5,8-12} or oil-soluble polymers.¹³⁻¹⁵ These measurements are made possible by handling the diffusive encounters between the pyrene pendants using the *blob* model. Since the level of association between the hydrophobes of associative polymers is an important parameter used by several theories to rationalize the rheology of the solutions of associative polymers, the determination of the level of association by fluorescence is expected to provide new insight into the rheological properties of these polymeric solutions. An effort is being made to correlate the trends obtained at the molecular level by fluorescence with the rheological properties of these polymeric solutions obtained at the macroscopic level.^{9,14,15}

4) Distribution of Functional Groups Along a Polymer Backbone:

(Mark Ingratta, Ph. D.)

The clustering of functional groups along a polymer can induce important changes in the physical properties of a polymeric material. For instance, an associative polymer containing clustered associative pendants will thicken a solution more efficiently than a polymer containing randomly distributed associative pendants. If the functional groups can be labeled with the dye pyrene, the *blob* model can be applied to fit the fluorescence decays of the pyrene labeled polymer. This analysis yields the fraction of pyrenes which are clustered or randomly distributed along the backbone.^{5,7,14} Since the dyes are attached onto the functional groups, these measurements provide information about the level of clustering of these groups.

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