

# **Synthesis, Mechanics, and Modeling of Stimulus Responsive Polymers for Engineering Applications**

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This research program aims to develop nanoscale stimulus-responsive polymer brushes and hydrogels to functionalize surfaces and to study and model their physico-mechanical properties for engineering applications. These polymer structures display a large volume change by undergoing a reversible phase transition when exposed to an environmental stimulus, such as a change in temperature, pH, or ion concentration. Order increases through hydrophobic folding that results in the generation of potentially useful work.

Colloidal probe microscopy will be used to quantitatively explore the mechanical (e.g., viscoelastic) and physico-chemical (e.g., adhesion) properties of polymeric surfaces at the nano- and meso-scale. For this technique, a micrometer-sized silica sphere is attached to the cantilever of an atomic force microscope. The microsphere will increase the contact area significantly thereby reducing the pressure on soft polymer surfaces; facilitate analysis of the contact mechanics due to the defined probe geometry; and be useful for preparation of functionalized probes. A better understanding of mechanical, tribological, and adhesional properties of stimulus-responsive polymer brushes and hydrogels will provide predictive capabilities to tailor material properties for the design of hydrogel actuators and sensors.