The goal of our laboratory is to conduct fundamental research in the field of soft materials. These are neither simple liquids, nor crystalline solids and many of the fascinating and useful properties of these materials result from thermal fluctuations in the local nanoenvironment. We develop novel spectroscopy techniques, which can offer structural and dynamical information about these systems with unprecedented spatial and temporal resolution, down to the atomic and molecular scale. This allows us to understand the issue of heterogeneities in soft matter systems. We are interested in a broad agenda of research problems including (i) micro- and nanofluidics with complex fluids (ii) single-molecule diffusion in confined fluids (iii) polymer dynamics in bulk and at surfaces, and (iv) Casimir force in critical systems. The laboratory has a unique experimental platform, which integrates force-based studies of confined fluids with single-molecule sensitive fluorescence spectroscopy techniques. The experimental platform allows time-resolved measurements of diffusion (translation and rotation) within an atomic force microscope. The goal is to understand the molecular origin of lubricated friction.

Our research is supported by National Science Foundation and Petroleum Research Fund.