404c Direct Measurement of Multi-Dimensional and Multi-Body Colloidal and Surface Interactions

Michael A. Bevan, Hung-Jen Wu, and William N. Everett

Recent work in our group has focused on developing a novel experimental technique called Diffusing Colloidal Probe Microscopy (DCPM) to simultaneously measure single and ensemble particle-surface interactions and multi-body particle-particle interactions in concentrated interfacial colloidal systems. By integrating total internal reflection, digital video, and confocal optical microscopy techniques, DCPM is capable of monitoring three-dimensional Brownian excursions of latex colloids, ceramic particles, metal nanoparticles, and quantum dots to construct equilibrium particle distribution functions and dynamic particle trajectories. Equilibrium particle-particle and particle-surface distribution functions are interpreted using inverse statistical mechanical theories and Monte Carlo simulations. Brownian particle trajectories are well described by theories for self diffusion and Stokesian dynamic simulations adapted to interfacial geometries.

In this talk, we present results for the application of DCPM to measuring and manipulating self assembly of attractive polymer coated colloids on physicochemically patterned surfaces. Our results demonstrate the utility of the DCPM method for measuring interfacial colloidal interactions, allowing new fundamental insights into the role of weak attractive forces in equilibrium and non-equilibrium interfacial structural transitions, and assisting the design of effective approaches to tune self assembly of attractive colloids on patterned substrate surfaces. Ultimately, achieving a consistent understanding of particle-wall and particle-particle interactions in interfacial colloidal systems via direct measurements is essential to numerous complex fluid and advanced material technologies.