Interactions between molecules and surfaces lead to complex and highly-varied interfacial behavior, where heterogeneity may arise from spatial variation of the surface/interface itself or from molecular configurations (i.e. conformation, orientation, aggregation state, etc.). These phenomena greatly impact technologies and applications including biomaterials, separations (chromatography and membrane filtration), heterogeneous catalysis, and biosensing, among others. The direct observation of adsorption, interfacial diffusion, and desorption of individual fluorescent molecules permits the characterization of heterogeneous interfacial behavior in ways that are inaccessible to traditional ensemble-averaged methods. Moreover, spectral information can be used to simultaneously track molecular configuration (aggregation or folding state). Single-molecule tracking experiments have traditionally been limited by small sample sizes, leading to poor statistical significance and a lack of sensitivity to rare populations. However, advances in high-throughput tracking methods now enable hundreds of thousands of molecules to be followed in a given experiment. This approach has recently been used to characterize heterogeneous molecule-surface interactions including: complex mechanisms of interfacial transport, spatially dependent interactions, surface-mediated intermolecular association, and others.

Host: Gufeng Wang