



SHELL SEMINAR SERIES

CHEMICAL & BIOLOGICAL ENGINEERING

Complex Colloidal Particles near Boundaries

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ABSTRACT Our lab is focused on developing experimental, computational, and theoretical techniques for the measurement and interpretation of the dynamics of complex or ‘anisotropic’ colloidal particles in confined geometries. This talk will summarize two vignettes from that work, namely (1) the development of Brownian dynamics simulations (BDS) to predict the probability density of states for anisotropic particles and (2) developing Scattering Morphology Resolved Total Internal Reflection Microscopy (SMR – TIRM) to directly measure such dynamics. First, we used BDS to predict the dynamics of a Janus particle very near a boundary. Data from these simulations were used to evaluate the influence of cap thickness and surface charge mismatch on the rotational dynamics of a single Janus particle very near a boundary. We found the presence of 5 nm - 20 nm thick gold caps had a profound effect on the rotational dynamics of particles with experimentally relevant sizes. Although Janus particles with a diameter less than 1 μm behaved as if they were isotropic, Janus particles with diameters larger than 1 μm experienced strong rotational quenching. This simulation tool was also utilized to develop methodology for computing the potential energy landscape from observations of position and orientation. In the second part of my talk, I will describe evanescent wave scattering mapping experiments conducted for the development of SMR - TIRM. Data from these mapping experiments on ellipsoidal particles show a strong dependence of the scattering morphology on both the particle orientation and shape. When combined with light scattering simulations from the T-matrix method, this morphology map will provide comprehensive information about the position and orientation of anisotropic particles near a boundary. Such information can be used to formulate the potential energy landscape of the particle, as shown by results from our BDS tool.

BIO Dr. Chris Wirth is an Assistant Professor in the Department of Chemical and Biomedical Engineering at Cleveland State University (CSU). Following completion of his Ph.D. in Chemical Engineering at Carnegie Mellon University (CMU), he was a research associate at PPG Industries, in conjunction with the Center for Complex Fluids Engineering at CMU. He then joined the Department of Chemical Engineering at KU Leuven, Belgium, as a postdoctoral scholar in the Soft Matter, Rheology and Technology Laboratory. Currently, his lab is interested in the measurement and control of the forces acting between nanoparticles that are nearby or adsorbed to a solid/fluid or fluid/fluid interface. He is a recipient of the Doctoral New Investigator Award from the American Chemical Society Petroleum Research Fund and the CAREER award from the National Science Foundation. More information about his group’s work can be found at: <https://wirthlab.org/>

