

Center for Soft Matter and Biological Physics

Discussion Meeting

Prof. William Ducker

(Chemical Engineering, Virginia Tech)

“Adsorption at Confined Interfaces”

Friday, November 9, 2018

4:00 pm—5:00 pm

304 Robeson Hall

Thin liquid films have different properties than bulk solutions because of the effects of the fields extending from the boundaries. These altered properties are important in determining the stability of colloid and nanoparticle suspensions, wetting films, adsorption in confined spaces, and in the fabrication and application of nanoscale devices. Our interest is in adsorption, which affects many of these applications: there is a multitude of applications where surfactants, polymers, ions, etc. are adsorbed to effect changes in thin films, for example, to alter the stability of colloidal particles.

We describe measurements of adsorption between two flat plates when the plates are separated by 0 – 65 nm and several results for several examples: depletion of a simple ion in dilute solution and adsorption in very concentrated salt solutions. These measurements have been made possible by our development of new technique. Measurement of all separations is achieved simultaneously by measuring visible-light interference in a wedge-shaped crack created between an oxidized-silicon wafer and a glass wafer. The adsorbed amount is measured from the fluorescence emission of a dye, after accounting for the optical interference.

The specific measurement is of the depletion of a divalent anion, fluorescein, in aqueous solution between two anionic solids. For dilute solutions at large separations between the flat plates, the dye is depleted relative to the bulk concentration. At smaller separations, the depletion of the dye decreases. The range of the depletion and the magnitude of depletion decrease with shorter Debye-length. Both of these effects are consistent with a simple calculation using the Poisson-Boltzmann equation. For concentrated solutions, results do not agree with Poisson-Boltzmann theory. That theory predicts that the surface potential decays exponentially with a decay length (Debye-length) that decreases with increasing concentration. Results are consistent with an increase in decay length with increasing concentration. We make comparisons to results in ionic liquids and drawn conclusions for crystal growth through particle attachment.