



# IBS Center for Multidimensional Carbon Materials



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### Kinetics of Nanoscale Interactions at Self-Assembled Monolayers

16:00 FRI | Bldg. 101  
NOV 25 | Seminar room on the 1<sup>st</sup> floor

Self-assembled monolayers (SAM) have been the subject of great interest due to the high level of control they can afford over the physical properties of a surface 1 (i.e. hydrophobic vs. hydrophilic) as well as the affinity of the surface toward target analytes, i.e. electrode coatings for sensors 2. While many of the uses of SAMs occur at the surface-liquid interface, the dynamics and kinetics of the hydration process of the SAM components is still not clear. Langer and coworkers reported on low density dynamic SAMs based on voltage responsiveness, which allowed for tuning of the surface hydrophobicity based on applied potentials. 3 In turn, our group has recently developed a low density fluorescein dye-appended SAM to investigate salt-bridge formation adjacent to a hydrophobic surface. 4 We now have sought to take advantage of our low density dynamic SAM system to study two different phenomena: 1) investigation of the hydration dynamics of low density SAMs of aqueous and aqueous-organic solvent mixtures experimentally via fluorescence spectroscopy and 2) controlling the adhesion of polymers to SAM surfaces via multi-valent interactions, with aims toward controlled degradation of these polymers.

In Part 1 we report on SAMs on silicon electrodes containing hydrophobic or hydrophilic fluorescent headgroups dispersed on an alkane surface. In the initial dry state, the headgroups adhere to the surface (fluorescence off), but upon the addition of water, the linker and headgroups are hydrated, leading to an increase in fluorescence as the headgroups move further from the surface. Through fluorescence spectroscopy and ellipsometry we studied the dynamics of low density SAMs in aqueous environments to form a more complete model of this behavior. Based on these results, we believe that single molecule hydration studies at the surface may be useful models for the solvation of hydrophobic molecules, as well as for modeling the folding of polymers in solution. In Part 2 we report on low density SAMs on silicon electrodes containing carboxylic acid headgroups. Using a fluorescent caged dye polymer with complementary pendant guanidiniums for salt-bridge formation, we demonstrate control over the surface adhesion of this polymer through multi-valent interactions and applied potentials. Through tuning of the lability of the polymer backbone linkages, we hope to develop this toward a catalytic system for the degradation of polymers by taking advantage of pH changes generated at the electrode surface due to electric double layer formation in deionized water. This model system will open up a range of new options for performing controlled reactions at a surface through gentler and "greener" methods.

1. Bain, C. D., and Whitesides, G. M., Science 1988, 240, 62-63.

2. Gooding, J. J., et al., Electroanalysis 2003, 15, 81-96.

3. Lahann, J., et al., Science 2003, 299, 371-374.

**You are cordially invited to attend!**

Special Guest Speaker