LECTURE SERIES:
Interfaces of Chemistry, Life Sciences And Physics

Friday, October 17, 2014
At 3:30 p.m.
Room 207, Buller Building

AQUATIC MATERIALS

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Abstract

Protecting the oceans and identifying cancer cells before they become a big problem: these challenges require salty solutions.

I report on our work on two sticky maritime problems: first, how to keep ship hulls free of fouling organisms, and thereby use dramatically less fossil fuel for transportation; second, how to keep aquaculture nets clean, to farm fish more safely and effectively. The current solutions to these problems have significant shortcomings, typically involving toxic metals. We are developing non-toxic methods involving copolymers and related materials, which safely inhibit undesired marine fouling. In parallel, we study the marine organisms that contact these surfaces, to better understand how they are affected by our materials. We make practical test samples that can be many square meters in area. These are designed to control the settlement of macrofoulers like alga, barnacles, mussels and hydroids, as well as the biofilms composed of mostly single cell organisms that are early colonizers.

I also report on novel cell surface technologies for biomedical diagnostics. We aim to improve the number of distinct cell surface markers (proteins) that can be simultaneously detected, thereby improving leukemia and lung cancer cell detection and patient prognosis. With biomemetic surface chemistry, we create detection platforms based on plasmonic nanoparticles as well as metamaterials as components of lab-on-chip devices that analyze blood and tissue samples, addressing challenges similar to those we encounter when assaying our marine coatings.

To design better materials, we seek to understand how their structure controls their function. We are developing novel characterization methods, especially focused on nanoscale surface mechanics and adhesion. To understand hydrophobic hydration, a dark shadow cast over much of aquatic materials chemistry, we have even gone so far as to study (bio) polymer molecules one at a time. This gives us useful insight into the states that proteins adopt at surfaces, and how that affects their function.

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