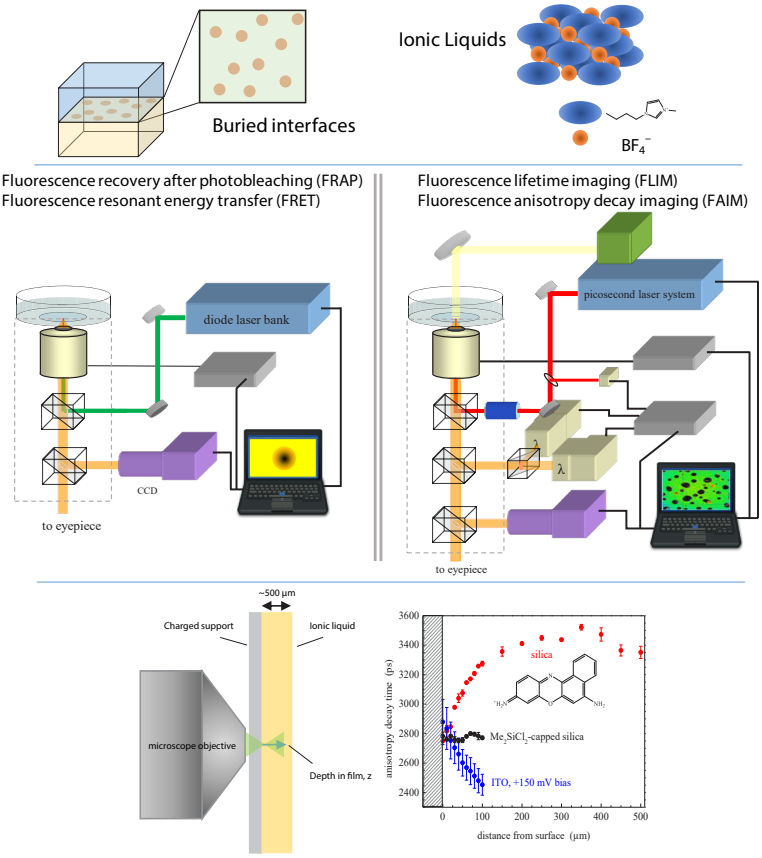
The ability to control the physical properties and chemical selectivity of an interface is an issue central to areas of science including cellular function, energy storage, heterogeneous catalysis and chemical sensing. The Blanchard group works on the design, synthesis and characterization of interfaces with an eye toward achieving this control. We are currently focusing our energies on catalytic and ordered systems because of their broad utility.

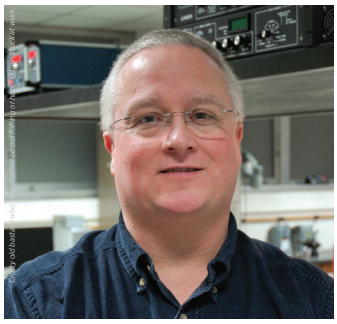
Long Range Order in Ionic Liquids. Ionic liquids are a class of materials that can be described as salts that are liquids at room temperature. These materials are typically viscous fluids and they have found use in areas ranging from organic synthesis to chemical sensing and energy storage. The organization that exists within ionic liquids is not well understood and has until recently been thought to be on the orders of nanometers in length. Our recent work has shown that when ionic liquids are placed in proximity to a charged surface, the charge induces order that persists on the sub-millimeter length-scale — five orders of magnitude greater than expected. These new findings not only provide insight into the structure of these systems, but also open the door to novel applications in energy storage and electronically-controlled optics.

Characterizing interfacial heterogeneity. We quantitate molecular motion on molecular length scales and over micron to millimeter length scales, using two complementary microscopy techniques. Using these techniques, we can evaluate the fluidity of a wide range of interfaces and, significantly, we can now characterize transient structural non-uniformities in mono- and bilayer films. This latter capability offers a new way to explore the presence of previously invisible spatial variations in chemical composition, with applications ranging from sensor interface design to in situ plasma membrane characterization.

Controlling interfacial fluidity. Covalently bound interfacial adlayers are not fluid, and fluid adlayers are not physically or chemically robust. These limiting cases have frustrated advances in fields such as molecular-scale lubrication, chemical separations and cellular adhesion. We are developing a novel family of interfaces that can be bound to an interface and at the same time retain the properties of a fluid. Both the thermodynamic driving force for complexation and the kinetics of surface diffusion can be controlled through metal ion complexation, system pH, the surface complexing moieties, and the amphiphile head groups.

Measuring fluidity in live cell plasma membranes. Diabetic retinopathy is a disease state that can compromise the vision of diabetic patients. It's origins are thought to be related to chronic exposure to high glucose conditions. Diabetic hyperglycemia leads to changes in the plasma membranes of circulating angiogenic cells which make them less rigid and thus less available to perform their repair functions in vivo. We work with Professor Julia Busik's group (physiology) to evaluate the fluidity of live cell plasma membranes using rotational and translational diffusion measurements of fluorescent molecules introduced to the cells. This work is providing new insight into the molecular-scale consequences of diabetic disease state on cells.





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Selected Publications

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