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

**Biomimetic Interfaces.** The creation of interficial structures that can function biomimetically is a gateway to the design of biosensors. We have been actively involved in the creation of such structures where we deposit a lipid bilayer structure, with fluorescent and electrochemical probes imbedded at specific locations within the interface. Our efforts are aimed at probing local organization and fluidity in the bilayer, so that we will be able to incorporate transmembrane proteins into these interfaces for use as sensing elements.

**Lipid layer binding to surfaces.** We have recently devised a means of creating lipid mono- and bilayer structures that can be bound to surfaces and are stable in air. This work represents a novel effort aimed at creating robust bio-interfaces. We create these interfaces in a two-step process, modifying a gold surface with a hydroxyl-terminated molecule, then reacting the hydroxyl end group to create a phosphate. The surface phosphate group is complexed with a metal ion, which can then complex with phospholipid head groups to chemically bind the lipid molecule to the interface. The structural details and fluid behavior of this novel bio-interface depend on the metal ion and phospholipid structure, allowing us to “tune” the properties of the interface for specific applications.

**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 a surface 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.

**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.

**Selected Publications**

Defect Mediation in Inverse Opals Made with a Polymer-Sol-Gel Composite Material, Xiaoran Zhang and G. J. Blanchard, ACS Applied Materials and Interfaces 2015, 7, 6054-6061.


**The suite of microscopy instrumentation in the Blanchard labs allows the direct examination of molecular motion on length scales ranging from nanometers to millimeters. The ability to characterize molecular movement over such a wide range of distances allows us to characterize complex, and often hidden, structural features in biological samples and novel materials, in all cases with the ability to detect less than a single layer of molecules.**