DEPARTMENT OF
Chemistry
UNIVERSITY OF WISCONSIN-MADISON

Ph.D. Dissertation Defense

Gray Jackson

Mahesh Mahanthappa Research Group

"Nanoconfined Water and Water-mediated Ion Transport in Model Membranes Formed by Lyotropic Liquid Crystals"

The ill-defined pore morphologies and connectivities of conventional membrane materials have hampered a clear understanding of the relationship between pore geometry, pore interfacial chemistry, and ultimate membrane performance. Derived from the self-assembly of ionic amphiphiles in concentrated aqueous media, lyotropic liquid crystals (LLCs) are a well-defined materials platform for uncovering these fundamental membrane structure-property relationships due to their monodisperse, sub-3 nm pores decorated with amphiphile headgroup chemical functionalities. Beyond fundamental studies, network (N) phase LLCs are coveted for membrane applications by virtue of their co-continuous aqueous and hydrocarbon domains, yet their non-constant mean curvature interfaces limit their thermodynamic stabilities.

My thesis research has focused on several aspects of this problem: (1) investigating the ability of gemini amphiphiles to stabilize network phase LLCs, (2) using sulfonic acid-based LLCs to uncover structure-property relationships in nanoporous proton conductors, and (3) using LLCs of deuterated amphiphiles as platforms to study the how pore interfacial chemistries and geometry alter nanoconfined water dynamics. In this presentation, I will first describe our efforts to understand how pore interfacial curvature (concave or convex) affects H^+ transport in sulfonated LLCs, which reveal that convex nanopores have significantly higher H^+ conductivities. Complementary studies of confined water dynamics in LLCs with convex nanopores indicate that water diffusion depends sensitively on the amphiphile headgroup, counterion identity, and pore interfacial curvature.

Tuesday, May 15, 2018 at 2:00 pm. in Room 9341