MONTANA STATE UNIVERSITY | College of LETTERS & SCIENCE

Physics Colloquium

Friday, April 20, 2018
4:10 – 5:00 PM
Barnard Hall (EPS) 103

Looking at Molecules in Hard to See Places: Optical Studies of Membrane Partitioning and High Temp Energy Conversion Chemistry

Professor Robert Walker
MSU Department of Chemistry and Biochemistry
Leader of Montana Collaborative Ph.D. Program in Materials Science
http://www.chemistry.montana.edu/people/walker-rob.html
http://www.chemistry.montana.edu/rawalker/index.html
http://www.chemistry.montana.edu/rawalker/people/rwalker.html
http://www.mtmatsci.org/

Abstract:

Mechanisms describing chemical reactivity at complex, heterogeneous interfaces are challenging to formulate and even more difficult to validate. The quantitative information required to test a model's predictive power requires that experimental methods be capable of differentiating the response of small numbers of affected molecules from signals arising from much larger bulk concentrations. Research in our group uses a combination of nonlinear and linear optical spectroscopies together with complementary thermodynamic methods and computational approaches to understand how interfacial anisotropy changes molecular structure, organization and reactivity from bulk limits.

This seminar will focus on two examples from our current research activities. The first part of the seminar will describe how time resolved fluorescence together with differential scanning calorimetry was used to examine solute partitioning into biological membranes. Data show that in the vicinity of a membrane's gel-liquid crystalline transition temperature, solute solubility into a lipid bilayer increases dramatically, although raising the system temperature even further leads to solute exsolvation back into bulk solution.

The second part of the seminar will describe how we have adapted a vibrational Raman microscope to study electrochemical oxidation and materials degradation in solid oxide fuel cells (SOFCs). These fuel-flexible devices convert fuels such as natural gas, biogas and other feedstocks into products and electricity with conversion efficiencies of up to 85%. However, SOFCs require operating temperatures as high as 800˚C that accelerate degradation and device failure. Combined operando Raman spectroscopy and electrochemical measurements enable us to directly correlate SOFC performance with changes in electrode structure and fuel composition.

Host: Rufus Cone

**** Refreshments served in the Barnard (EPS) second floor atrium at 3:45 ****

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Professor Rob Walker

Professor Walker is a Professor in MSU's Chemistry and Biochemistry Department. He also leads the statewide collaborative Ph.D. program in Materials Science. Professor Walker earned a B.A. in Chemistry from Dartmouth College and a Ph.D. in chemistry from the University of Wisconsin–Madison. After postdoctoral work at the University of Oregon, he joined the Chemistry and Biochemistry faculty at the University of Maryland, College Park in 1998. He moved to Montana State in 2009 where his research program uses optical spectroscopy to study chemical structure and reactivity at intefaces. Professor Walker has published over 100 papers and has mentored more than 25 Ph.D. students. He has received several awards including the National Science Foundation's CAREER award, a Sloan Fellowship, a Research Innovation Award from the Research Corporation and is a Fellow in the American Association for the Advancement of Science (AAAS). In 2007, Professor Walker was a visiting Fellow at the Insitute of Advance Study at Durham University (UK) and in 2017, he worked with colleagues at the Danish Technical University as an Otto Mønsted Visiting Fellow.