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Biography: Robert (Rob) M. Rioux is the Friedrich G. Helfferich Associate Professor of Chemical Engineering at the Pennsylvania State University. Prior to joining the Pennsylvania State University in 2008, he was a National Institutes of Health Postdoctoral Fellow at Harvard University in the Department of Chemistry and Chemical Biology working with Professor George Whitesides. He received his Ph.D. in physical chemistry from the University of California, Berkeley in 2006 working for Professor Gabor Somorjai. He holds a B.S. and M.S. degree in chemical engineering from Worcester Polytechnic Institute and the Pennsylvania State University, respectively. Since joining the Penn. State faculty, he has received a number of awards, including a DARPA Young Faculty Award, an Air Force Office of Scientific Research Young Investigator Program Award, a NSF CAREER Award and a 3M Non-Tenured Faculty Award. Research in his laboratory is currently sponsored by NSF, DOE-BES, DARPA, AFOSR, AFRL, ACS-PRF and industry. His group’s current research focus is on the development of spatially- and temporally-resolved spectroscopic techniques for imaging catalytic chemistry, single molecule methods to understand single molecule/particle catalytic kinetics and dynamics, elucidating reaction mechanisms in nanoscale systems, including catalyst synthesis, development of solution calorimetric techniques to understand catalytic processes at the solid-liquid interface and the development of base-metal catalysts for chemoselective chemical transformations, including biomass to chemicals conversion.


Abstract: The low volatility of biomass-derived compounds and the omnipresence of water in biomass feed streams typically requires that their conversion/upgrading by catalytic routes be conducted at “buried” solid-liquid interfaces. Under these circumstances, the role of solvent becomes critical since it constitutes the majority species in solution and most likely on the catalyst surface. The interactions between solute and solvent in solution (i.e., excess solution thermodynamic properties) and at a solvated interface are complicated but must be accounted for when measuring chemical kinetics (i.e., activities versus concentration) or determining reaction mechanisms. In this tutorial talk, we will review the ability of calorimetry to characterize solid-liquid interfaces. Following an introduction to solution-phase calorimetry, including theory and practical experimental considerations, I will provide examples from our own research using calorimetry to quantitatively assess water tolerance (or conversely water inhibition) in heterogeneous organocatalysts using a simple esterification reaction. From our participation in collaborative research, I will demonstrate how solvent effects can be accounted for quantitatively for catalytic reactions involving reactions of sugars in zeolites.