[CHBE] MULTIPHASE MICROREACTION ENGINEERING WITH ONLINE ANALYTICS FOR DISCOVERY IN CHEMICALS, ENERGY, AND MATERIALS

Date:  
Friday, April 6, 2018 - 10:30am  
Location: L2D2

Engineering novel tools for the discovery of science and translation of the new knowledge from the laboratory to application are societal challenges. Our laboratory helps address these challenges through the field of catalysis and reaction engineering. The design of novel experimental methodologies for direct measurements in flow have the potential to reduce the amount of chemical waste generated, minimize the building space and energy requirements, expedite information, and yield more accurate predictive mathematical models during discovery, development, and manufacture. This so called “process intensification” has merit to revolutionize our understanding of chemicals and materials that have global impacts. Microfluidics with online characterization techniques can be considered as the appropriate experimental tools, and the systems are often heterogeneous.

This three-part seminar will commence with a brief introduction followed by our discoveries on i) green chemical reaction engineering, ii) multiphase microfluidics with in situ Raman spectroscopy, iii) and microsystems design for chemicals and materials in the energy and environmental sciences. In Part I, concepts drawn from catalysis in organometallic C-C cross-couplings, water as an unconventional reaction solvent, and process intensification will be examined. Reaction interfaces confined in micro-scale flows sometimes behave differently than unconfined ones. In response, Part II will present our recent work on the design of microfluidics with in situ Raman spectroscopy to understand confined non-polar solvent/water and methane/water interfaces.

Microsystems with online spectroscopic methods also have tremendous potential for understanding chemicals and materials in the energy and environmental sciences. In Part III, we will examine flash crystallizations of methane hydrates with high-pressure sub-cooled microsystems that reveal the contribution of mass transport on the crystal growth kinetics. Packed-bed microfluidics with online analytics for the discovery of methane activation catalysis and asphaltenes nanosheet size distributions will also be discussed. The seminar will conclude with a discussion of emerging trends in catalysis and reaction engineering.