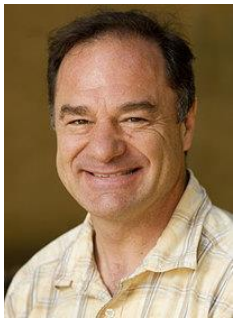
Faculty of Engineering and Applied Science

Chemical Engineering Seminar Series

Queen's University

The Fluid Dynamics of Ultra-low Surface Tension Liquids



Dr. Gerald G. Fuller/Stanford University

Thursday, October 13, 2016, 2:30pm

Dupuis Hall, Room 215

ABSTRACT

Multiphase flows involving liquids pairs with ultra-low surface tensions are common in processing flows and in living systems. For example, simple mixing operations that bring miscible liquids together cause mobile interfaces with vanishingly small surface tensions to be strongly deformed due to the presence of strong Capillary and Bond numbers. Water-water emulsions comprised of phase separated domains of aqueous solutions of distinct polymers have acquired increased attention as routes to design chemical delivery systems in medical and personal product applications. In living systems, complex coacervates and mucus layers are characterized by very low surface tensions that control their stability, spreading, and wettability.

The work described here will focus on two classes of problems: sessile and pendant drops of liquids existing within miscible environments and water-water, phase separated drops undergoing buoyancy-driven flows. In both cases, simple visualization experiments demonstrate that these systems spread and disperse in ways that are qualitatively different from immiscible pairs. For example, sessile drops spread across substrates with much stronger power law responses in time and “skim” across the surfaces instead of advancing behind a moving contact line. These unanticipated and distinct behaviors are expected to profoundly influence momentum and mass transport in this commonly encountered class of liquid processing flows.