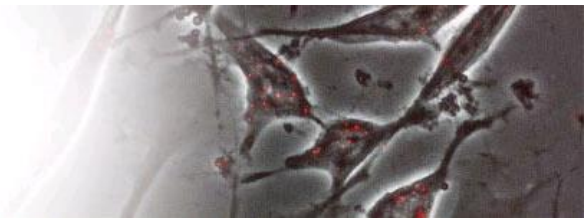
UCLA Engineering

Chemical and Biomolecular Engineering



SEMINARS IN CHEMICAL AND BIOMOLECULAR ENGINEERING

Friday, Jan. 25, 2019
10:00am - 11:00am
Boelter Hall 3400

Jovan Kamcev

Postdoctoral Scholar
Chemistry
UC Berkeley

"Advanced Polymeric Materials for Water and Energy Applications: Relating Molecular Structure to Macroscopic Properties"

Securing adequate, sustainable supplies of energy and water at affordable costs is an enormous challenge facing humanity. Due to the interconnected relationship between these two vital resources, often termed the Water-Energy Nexus, a shortcoming in one could negatively impact the availability of the other. Technologies based on polymeric materials (e.g., membranes and sorbents) will play a key role in addressing our water and energy needs due to their efficiency, simplicity, and small footprint. The success of such technologies hinges on developing new materials with improved functionality. However, despite a longstanding interest in this research area, significant fundamental and practical challenges remain. This presentation will focus on two such challenges: (1) the lack of fundamental understanding of the influence of polymer structure on ion/water transport in dense polymer membranes and (2) the need for materials with exceptional selectivity for neutral contaminants (e.g., boron) that are ubiquitous in natural waters and difficult to remove with conventional technologies. The first part of the presentation will introduce a theoretical, unifying framework for ion partitioning and diffusion in ion exchange membranes (IEMs), a class of materials that has attracted significant interest for various membrane-based technologies. The framework, based on counter-ion condensation theory for polyelectrolyte solutions, accurately predicted ion transport properties of IEMs from basic structural knowledge, in some cases with no adjustable parameters. The experimental and modeling results elucidate key membrane structural properties that influence ion transport in IEMs and provide guidance on how to rationally design high performance materials. The second part of the presentation will describe the synthesis of novel porous aromatic frameworks (PAFs) with specific functionality for removing boron from aqueous solutions. Due to their exceptionally high porosity and robust chemical structures, the PAFs exhibited high boron adsorption capacities, remarkably fast kinetics, and good reusability. Notably, the boron-selective PAFs removed trace amounts of boron from synthetic seawater solutions at unprecedented rates, demonstrating the promise of this relatively new class of microporous polymers for water treatment applications.

Jovan Kamcev, Ph.D., is a postdoctoral scholar working with Prof. Jeffrey Long in the Department of Chemistry at University of California, Berkeley. He earned his bachelor's degree in Chemical Engineering and Applied Math & Statistics from Stony Brook University and his master's and doctorate in Chemical Engineering from the University of Texas at Austin under the guidance of Profs. Benny Freeman and Donald Paul. His graduate research entailed fundamental studies of ion and water transport in ion-containing polymer membranes for water and energy applications. His current research focuses on developing novel porous organic frameworks for various applications, including selective ion removal from aqueous solutions and energy storage.