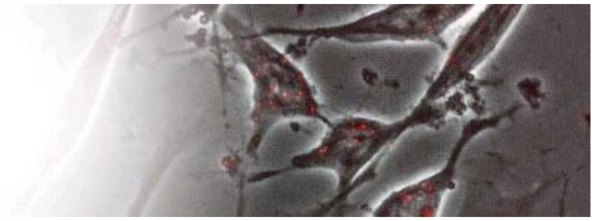
UCLA Engineering

Chemical and Biomolecular Engineering



SEMINARS IN CHEMICAL AND BIOMOLECULAR ENGINEERING

Friday, Jan. 18, 2019
10:00am - 11:00am
Boelter Hall 3400

Jonathan Bachman

Postdoctoral Researcher
Chemical Engineering
Stanford University

"Energy-Efficient Separations using Metal–Organic Framework Membranes and Adsorbents"

Large-scale purification of chemicals and fuels has historically been achieved using energy-intensive thermally-driven distillation and scrubbing processes. With the recent development of metal–organic frameworks, a class of microporous adsorbents with unique pore structures and functionalities, we now have an opportunity to revisit and reinvent chemical separations. The M_2(dobdc) (MOF-74; M = Mg, Mn, Fe, Co, Ni, Zn; dobdc^{4-} = 2,5-dioxido-1,4-benzenedicarboxylate) family of frameworks is particularly promising due to coordinatively unsaturated metal sites that display selective gas-metal interactions. I will first discuss membrane-based separations and show how M_2(dobdc) nanocrystals can be incorporated into polymer matrices to form mixed-matrix membranes with exceptional improvements in ethylene permeability, ethylene/ethane selectivity, chemical stability, and plasticization resistance originating from the presence of coordinatively unsaturated metal sites. I will then go on to show that a framework isomer, M_2(m-dobdc) (m-dobdc = 4,6-dioxido-1,3-benzenedicarboxylate), can dramatically improve ethylene- and propylene-separation through a detailed investigation of adsorption thermodynamics that elucidate useful trends metal-gas interaction energies. Together, these works highlight the power of combining materials design with gas transport and adsorption thermodynamics to produce new technologies for energy-efficient separations.

Dr. Jonathan Bachman is a Postdoctoral Researcher at Stanford University in Professor Yi Cui's laboratory. He earned his PhD in Chemical Engineering at the University of California, Berkeley, under advisement of Professor Jeffrey Long. Dr. Bachman's work focuses on engineering transport and adsorption thermodynamics in novel porous materials, including metal–organic frameworks, porous aromatic frameworks, and high free-volume polymers with applications in gas separation, gas adsorption, and ion transport. His research has contributed to the advancement of materials and devices for CO_2 capture, olefin/paraffin separation, ethylene production, natural gas purification, air separation, Li-metal batteries, and grid-scale energy storage.