UC San Diego
JACOBS SCHOOL OF ENGINEERING
NanoEngineering

UCSD NANOENGINEERING/CHEMICAL ENGINEERING

Hybrid SEMINAR SERIES

Wednesday, November 9th, 2022
Seminar Presentation: 11:00am – 12:00pm PDT
SME room 248

"Micron-scale Device Fabrication using Reactive Inks"

Dr. Owen Hildreth, PhD

Associate Professor
Colorado School of Mines

Abstract: Manufacturing is hard – but it doesn't need to stay that way. Our ability to design and manufacture complex devices on a massive scale is unparalleled in human history. Unfortunately, the ecological and social costs of modern manufacturing are unsustainable. Modern microfabrication plants cost billions of dollars, require hundreds of thousands of local workers for just a single product line, and generate billions of tons of waste and CO2 every year.

Nano/sub-micron scale printing is one route towards lowering the cost and environmental footprint of "smart" devices. However, traditional printing materials suffer from a mix of high cost, limited material selection, and poor material performance. Printable reactive inks are one potential route to addressing these issues. These low-cost inks can print high-quality metals, oxides, and polymers at near room temperatures with material properties almost matching bulk properties. For example, using new reactive silver ink formulations and optimized printing methods, our group has reduced the amount of silver required to metallize a photovoltaic cell by 97% while increasing overall energy yields by 4%-10% (depending on installation latitude). This talk will summarize the key concepts behind reactive inks, demonstrates the importance of balancing heat transfer, mass transport, and reaction kinetics to tune the printed morphology, and demonstrates some applications of reactive inks, including photovoltaic metallization and microfluidic device manufacturing along with new reactive ink chemistries to print oxides and magnetic materials.

Biosketch: Dr. Owen Hildreth is an Associate Professor at Colorado School of Mines. Before joining Mines, he was an Assistant Professor at the School for Engineering of Matter, Transport, and Energy at Arizona State University. He received his B.S. in Mechanical Engineering from the University of California, San Diego in 2002 and worked for five years as a mechanical engineer designing consumer products. In 2012 received his Ph.D. in Materials Science and Engineering from the Georgia Institute of Technology under the supervision of Prof. C. P. Wong. His Ph.D. research identified the mechanism for catalyst motion in metal assisted chemical etching for applications in 3D nanofabrication.

His current research areas focus on additive manufacturing (nm to cm scales); mass transport, reaction kinetics, and interface design in reactive inks for stretchable electronics, photovoltaics, and microfluidic devices; sensitization kinetics, microstructure evolution, dilution, and corrosion of metals fabricated using Powder Bed Fusion (PBF) and Directed Energy Deposition (DED) technologies.