Spring 2024 Joint Colloquium
Materials Department & Materials Research Laboratory

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Pasadena, CA

Friday, May 3, 2024
11:00 am | ESB 1001

One is the Loneliest Number: Multielectron Processes for Next-Generation Batteries

Rechargeable Li-ion batteries have revolutionized portable energy storage but the limitations imposed by intercalation chemistry, cost associated with precursors of active materials, and critical nature of crucial elements drive the need for new batteries. Our lab aims to develop energy dense chemistries that obviate the need for the critical and costly elements like Co and Ni in the cathode and Li as a working ion. The search for these so called "beyond Li-ion" technologies include systems based on alternative charge storage mechanisms that promise high theoretical capacity and energy density. This talk will focus on our efforts to go beyond Co- and Ni-containing cathodes. We will discuss how charge storage mechanisms beyond intercalation can be leveraged to yield Fe-based materials with high energy densities. Coupling anion redox to traditional transition metal-based redox enables high energy density, commensurate with state-of-the-art NMC cathodes. Importantly, we leverage sulfides to achieve anion redox due to their ability to form stable persulfide bonds in solids as a result of anion oxidation. We will discuss the impact anion redox has on both the physical and electronic structure of materials. We solidify our understanding of anion redox through systematic variation of the materials chemistry which leads to predictable effects on the anion redox processes. Using this information, we can design materials with features that promote anion oxidation.

Bio: Kim received her B.S. in Chemistry from the Colorado School of Mines in 2009 where she worked with Drs. John Turner and Todd Deutsch at the National Renewable Energy Laboratory on photoelectrochemical water splitting. Following a year at the University of Colorado working with Prof. Gordana Dukovic on zinc oxide nanoparticle synthesis and a year in industry at NuSil Technology working on high refractive index silicones, Kim came to UC Santa Barbara for her Ph.D, where she worked with Profs. Ram Seshadri and Galen Stucky on next-generation batteries and received her Ph.D. in 2014. Kim was awarded the St. Elmo Brady Future Faculty Postdoctoral Fellowship at the University of Illinois at Urbana-Champaign and worked with Prof. Andrew Gewirth in the Department of Chemistry until the fall of 2017, when she started as an Assistant Professor at Caltech.

Hosted by Ram Seshadri