Innovating Energy Conversion and Storage by Atomic-Level Materials Structure Engineering

Dr. Liliang Huang
Lawrence Berkeley National Laboratory

November 2, 2022, 11:00am, 2004 Black Eng.

Abstract:
Advances in sustainable energy conversion and storage rely on the discovery of new materials, whose properties are quite likely to be dependent upon their surface and lattice structures at the atomic level. From the perspective of application, understanding the influence of these structural features and developing new manufacturing strategies to achieve delicate control over them will be essential. In this seminar, I will first talk about our manufacturing efforts towards heterogeneous catalysts development. Specifically, we pioneered a strategy to stabilize nanocatalyst surface atoms in a highly low- coordinated environment, which significantly increases the catalytic activity of the surface. Unlike conventional methods, this scalable strategy gets rid of catalyst-poisoning ligands during the nanocatalyst manufacturing and can be utilized to recycle waste catalysts that are not in industrially useful forms. A new surface-regulation mechanism has been proposed, allowing for further extension of the synthetic capabilities of this strategy to include a library of multielemental nanocatalysts with low cost and high performance. The second part of my talk will focus on introducing a lattice vacancy-based design strategy for Li-excess cation-disordered rocksalt oxide materials, which have recently shown great promise for creating cathodes with better performance than commercial layered cathodes while using earth-abundant elements (e.g., Mn and Ti). Specifically, by using Mn-based disordered cathodes as a demonstration, we show that introducing lattice-vacancies during the manufacturing process can help optimize the cation distribution within the disordered cathodes for Li-ion transport and thus improve the rate performance of the battery while maintaining optimal cycling stability. Computational simulations have been employed to further rationalize the influence of these lattice vacancies, providing important insights for the future design of non-stoichiometric cathode materials.

Biography:
Liliang Huang is a postdoctoral research associate in the Materials Sciences Division at the Lawrence Berkeley National Laboratory with Professor Gerbrand Ceder, where he is working on developing high-performance cathode and solid-state electrolyte materials for rechargeable batteries. He earned his B.S. in Materials Science and Engineering from Zhejiang University, and Ph.D. in Materials Science and Engineering from Northwestern University under the mentorship of Professor Chad A. Mirkin. His Ph.D. research was focused on nanomaterials design, manufacturing, and application as electrocatalysts, for which he received, among other honors, an International Precious Metals Institute Student Award, Park AFM Scholarship, and Chinese government award for outstanding self-financed students abroad.

***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.**
me.iastate.edu