Materials Science and Engineering Department

Spring Seminar Series

Progress in the Analytical Capability of X-rays to Locate Chemical Phenomena in Battery Materials

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3-4PM | Hill Seminar Room (LeBow 240)

The evolution of local chemistry determines the performance of electrodes and electrolytes used in batteries because limitations can be tracked to slow kinetics and transport, and irreversibilities in the storage reaction. Tools that provide insight into local chemistry are critical for identifying the underpinnings of electrochemical function. This information must be resolved within architectures, from individual particles to microscale domains, to pinpoint the relationship between local phenomena and their role in macroscopic metrics and degradation. Technical developments in X-ray microscopy and mapping have built a flexible suite of tools that combine the desired spatial resolution and 3D capabilities with a suite of possible contrasts mechanisms, such as diffraction and spectroscopy. In this talk, we will discuss our recent research that demonstrates the diversity of length scales at which important chemical heterogeneity can be induced in battery electrodes. For this purpose, the systems of study will be the leading cathodes for Li-ion batteries. We will highlight the new fundamental insight generated by the tools, but also motivate the need for the extension of the analytical capabilities of the tools into outcomes of high statistical significance. The insight generated by our approaches will be related to their impact on material and architecture properties. Along the way, we will also provide a glimpse into the future by showing how emerging synchrotron techniques can enhance the impact of X-ray microscopy in fundamental battery science. Particularly, we will discuss the prospects of probing time-resolved phenomena using operando measurements to avoid uncertainty due to relaxation under open circuit conditions.

Jordi Cabana is a Professor at the Department of Chemistry of the University of Illinois at Chicago (UIC) and, since October 2022, a Group Leader in the Materials Science Division at Argonne National Laboratory (ANL). Prior to his appointment at UIC, he was a Research Scientist at Lawrence Berkeley National Laboratory from 2008 to 2013. Professor Cabana completed his Ph.D. in Materials Science at the Institut de Ciència de Materials de Barcelona, Spain in 2004, followed by a postdoctoral appointment in the Department of Chemistry at Stony Brook University. He is generally interested in the physical and inorganic chemistry of materials for electrochemical applications, with emphasis on redox and transport properties. He was designated "Up-and-Coming" by Chemistry of Materials in 2017. He was a Scialog Fellow in Advanced Energy Storage from 2017 to 2020, and he received Scialog Awards in 2018 and 2020.

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