Conn Center for Renewable Energy Research is pleased to announce organization of a seminar on March 8th (Friday), 2024 at Ernst Hall, Room 212, 11 am-12.15

"Electrode Behavior during Fast Charging of Lithium-Ion Cells"

Dr. Daniel Abraham, Argonne National Lab, Chicago, IL.

Abstract

Rapid cycling of lithium-ion batteries (LIBs), being developed for electric vehicles, is highly desirable. Rapid charge is needed to meet customer demands of time-parity with today's gasoline-powered cars; rapid discharge is needed to deliver the high performance expected of electric vehicles. The U.S. DOE has set a target charging time of 15 minutes (4C rate) as a near-term goal, further indicating that a 5-minute charge (12C rate) could be a long-term goal.

At higher cycling rates, however, the capacity, cycle life, and thermal stability of these LIBs is known to degrade. The mechanisms responsible for this performance decline are being examined at Argonne National Laboratory as part of projects funded by the U.S. DOE. These mechanisms are believed to include the following: heterogeneous Li intercalation/extraction reactions in the active particles, non-uniform reactions across the porous electrode cross-sections, fracture of anode and cathode particles, and lithium metal plating on the anode. A fundamental understanding of these processes is being gained by the application of various diagnostic techniques, including electrochemistry, diffraction, microscopy, spectroscopy and tomography.

During the presentation, results from the study of cells, containing layered oxide cathodes and graphite anodes, subjected to rapid cycling will be highlighted. In particular, the use of a microprobe reference electrode to monitor the onset of Li plating conditions will be examined and methodologies to investigate the lithium concentration gradients that develop in the electrodes during rapid cycling will be discussed.

Brief Biosketch

Dr. Daniel P. Abraham, Argonne National Laboratory, has authored 185+ articles in peer-reviewed journals that span the various frontier areas of lithium battery research. These areas include fast charging, crystal structure transformations in electrode materials, silicon electrode development, solid electrolyte interphase (SEI) formation/dissolution mechanisms, electrode stress evolution, electrode and particle coatings, electrolyte additives, and electrochemical modeling. His work enables the development of materials and components that enhance battery performance, life, and safety. He has delivered 360+ technical presentations in popular, academic, and industrial settings, including 135+ invited, keynote, and plenary lectures.

More importantly, Dr. Abraham has been a research advisor and mentor to various undergraduate students, graduate students and postdoctoral associates. In February 2010, he was awarded an "Outstanding Mentor Award" by the U.S. DOE-Office of Science. In addition, he received the 2013 Outstanding Postdoctoral Supervisor Award from Argonne and the Pinnacle of Education Award (both in 2015 and 2023) from the University of Chicago for "exceptional work in developing the next generation of scientists and engineers."