



Mechanical Engineering Seminar Series

In Situ Investigation of Chemo-Mechanical Phenomena in Batteries

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Abstract

It is critical to understand how electrochemical materials change, transform, and degrade within devices to enable the development of next-generation energy storage and conversion systems. In my research group, multi-scale *in situ* techniques are used to reveal reaction mechanisms and interfacial transformations in materials for batteries. Here, I will present our recent work on understanding and controlling transformations at interfaces between solid-state electrolytes and lithium electrodes within solid-state batteries, where we use interlinked *in situ* investigations (X-ray tomography and electron microscopy) to investigate how these interfacial transformations control chemo-mechanical degradation. Next, I will discuss our work on understanding phase transformation pathways in high-capacity battery electrode materials using *in situ* transmission electron microscopy. In particular, unexpected chemo-mechanical stability is found during reaction of conversion electrodes with alkali ions larger than Li^+ . Overall, this research demonstrates how fundamental understanding of dynamic processes can be used to guide the design and engineering of new energy materials with improved electro-chemo-mechanical stability in batteries.

Bio

Matthew McDowell is an assistant professor at Georgia Tech with appointments in the G. W. Woodruff School of Mechanical Engineering and the School of Materials Science and Engineering. He received his Ph.D. from Stanford University in 2013 and was a postdoc at Caltech from 2013 until 2015. McDowell has 70 publications, and he has received numerous awards, including the Presidential Early Career Award for Scientists and Engineers (PECASE), Sloan Fellowship, NSF CAREER Award, AFOSR Young Investigator Award, NASA Early Career Faculty Award, and Scialog Fellowship. For more information, see <http://mtmcdowell.gatech.edu>.

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