

Nanoscale Organisation and Dynamics Group

University of Western Sydney



Probing electrochemistry and crystal structure simultaneously

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Abstract

Electrochemical energy storage devices in the form of batteries are ubiquitous in society, used in everything from children's toys to mobile electronic devices, providing portable power solutions. There is a continuous drive for the improvement of batteries. A large proportion of the function of batteries arises from the electrodes, and these are in turn mediated by the atomic-scale perturbations or changes in the crystal structure during an electrochemical process (e.g. battery use). Therefore, a method to both understand battery function and improve their performance is to probe the crystal structure evolution *in situ* while an electrochemical process is occurring inside a battery.

Our work has utilized the benefits of *in situ* neutron diffraction (e.g. sensitivity towards lithium) to literally track the time-resolved evolution of lithium in cathode materials used in rechargeable lithium-ion batteries. With this knowledge we have been able to directly relate electrochemical properties such as capacity and differences in charge/discharge to the content and distribution of lithium in the cathode crystal structure. In addition, the ability to test smaller samples (e.g. in coin cells) with *in situ* X-ray diffraction has allowed us to probe other batteries types, such as primary lithium and ambient temperature rechargeable sodium-ion batteries. This talk will showcase some of our recent results on electrode structural evolution with respect to electrochemistry in fully functioning batteries.

Profile

Neeraj completed his Ph.D. at The University of Sydney then moved to the Bragg Institute at ANSTO for a post-doc. He is now a lecturer in chemistry at UNSW and holds an AINSE Research Fellowship. Neeraj has been the RACI Nyholm Youth Lecturer (2013/2014) and won the NSW Young Tall Poppy Award in 2014. Neeraj has over 55 publications and extensively collaborates with researchers all over the world. Neeraj enjoys science communication and he is actively promoting the International Year of Crystallography 2014 by designing and displaying large-scale crystal structure models all over Australia. The relatively new Sharma research group consists of a part-time PhD student, 3 science Honours students and 2 electrical engineering Honours students. His research is broadly solid state chemistry and the relationship between physical properties and crystal structure. His group investigates a range of materials with a current emphasis on battery materials.

Staff and students at all levels are welcome to attend.

Venue and Time:

This talk will be held on 9th October at 2.00 pm at the Campbelltown Campus in Building 21, Lecture Theatre LT06 (CA-21.G.18).

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