

Using Neutron Scattering Techniques to Study Lithium-Ion Batteries

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Li-ion batteries provide portable power to devices such as mobile phones, media devices, and laptop computers, and are one of the most extensively studied energy storage devices in world today. Emerging applications for these batteries include electric vehicles and energy-storage systems for smart electricity grids based on renewable and intermittent power generation sources. These emerging applications promise to fundamentally change how we live. An in-depth understanding of the processes occurring in Li-ion batteries is crucial for further development of these technologies.

Neutron diffraction is useful in the study of components within Li-ion batteries due to the sensitivity of this technique towards Li positions and occupancies and the large penetration depth that enables bulk analysis of real-life Li-ion batteries. This talk will highlight recent results from *in-situ* [1] and *ex-situ* neutron diffraction studies of electrode materials in Li-ion batteries. In particular the development of specialised batteries for *in-situ* experimentation, crystal-structure investigations that reveal Li-insertion, and the elucidation of structure-property relationships of electrodes in Li-ion batteries, that include the real-time and simultaneous measurement of both the graphite anode and LiCoO₂ cathode in commercial Li-ion batteries.

This work is aimed at providing a real-time understanding of critical structural processes occurring at the electrodes and highlights the insights obtainable by marrying together neutron-diffraction with electrochemistry.

- [1] N. Sharma, V. K. Peterson, M. M. Elcombe, M. Avdeev, A. J. Studer, N. Blagojevic, R. Yusoff and N. Kamarulzaman, *J. Power Sources* **195**, 8258 (2010).