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Synergistic Imaging of Battery Materials Using Laboratory and Synchrotron X-Ray Microscopy

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The past decade has seen the rapid development and proliferation of three-dimensional X-ray imaging tools applied to Li-ion batteries, providing a framework to improve the understanding of electrode morphology and its influence on transport processes, electrochemistry and mechanical behaviour. The non-destructive, and multi-scale characteristics of X-ray imaging tools provide benefits to quantify hierarchical complexity from the particle to the electrode and device level. These can be effectively applied using both laboratory and synchrotron sources, providing benefits of longitudinal access for long term studies and high speed acquisition respectively.

The increasingly sophisticated range of X-ray tools includes absorption and phase contract CT across multiple spatial and temporal domains, XRD-CT to reconcile chemical, crystallographic and morphological behaviour and Bragg Coherent Diffraction Imaging to access sub-particle behaviour. Moreover, complementary neutron, electron, ion-beam and X-ray imaging techniques can leverage the benefits of the alternative contrast modes to build correlative maps of materials and devices. This is further enhanced by advanced geometrical analysis and image based modelling approaches.

In concert, the portfolio of imaging and modelling tools provides a platform to explore the performance, degradation and failure of Li-ion batteries and post Li-ion chemistries, including LiS and solid state batteries, which will also be presented here.