MS40 Operando and in situ crystallographic studies

MS40-02
Lithiation heterogeneities in full cells by combined neutron and synchrotron scattering techniques
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Abstract
Operando characterization techniques are key to understand the electrochemical processes that dictate battery performance and the concomitant materials transformations during cycling. In particular, synchrotron and neutron techniques are increasingly employed as they provide unique insights into the chemical, morphological and structural properties inside electrodes and electrolytes across multiple length scales with, potentially, high time/spatial resolutions. Horse techniques such as XRD/NPD, as well as advanced methods such as coherent bragg imaging or ptychography, are constantly developed to better characterize the structure of crystalline battery materials e.g. phase transitions, strain, defects, etc… - extending the experimental limits towards high fidelity and high resolution data. However, the usual rules at Large Scale Facilities is to perform stand-alone experiments providing one type of information at one scale, therefore leading to a fragmented knowledge. Bridging scales and heterogeneous datasets is a challenge that require correlative data acquisition and analysis integrated in multimodal multi-techniques workflows, an approach that is still in its infancy [1]. In this talk, we will present combined and/or coupled operando experiments performed on full batteries of different types, using both neutrons & X-rays, and/or both atomic scale and nanoscale techniques, including scattering computed tomography. We will focus on lithiation heterogeneities at the scale of electrodes, in the depth and/or in 3D, revealed in different types of materials as hierarchical composite anodes based on silicon nanodomains [2] or silicon nanowires [3], and layered intercalation compounds such as LNO [4].

References
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