In-operando microbeam X-ray diffraction of individual grains in LIB batteries

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To better understand the (de)lithiation behavior in LIB materials several characterization methods[1] are available. Most methods have at least one of the following disadvantages: probing a real life battery is not possible due to physical limitiations imposed by the technique such as material thickness and pressure, limited temporal resolution, limited spatial resolution, material degradation induced by beam exposure.
X-ray diffraction does not have these disadvantages, apart from beam induced material degradation. Using a microbeam, of a few micron in size, it is possible to achieve nanoscale spatial resolution in a X-ray diffraction experimental setup (see **Figure 1**). This means we can individually follow a few hundred grains with a time resolution of a few seconds. In [2] a first attempt was made to look at the phase evolution in cathode material $LiFePO_4$ (LFP) during cycling using the setup shown in **Figure 1**. Now we present results for different LFP geometries but also for solid solution cathode material $LiNi_{0.33}Co_{0.33}Mn_{0.33}O_2$ (NCM). We improved the pouch cell assembly (see **Figure 1**) by introducing aluminum and copper windows thereby eliminating X-ray diffraction from the pouch cell polymer layers. With this improved pouch cell it is now possible to see different types of grain transition behavior in LFP grains.

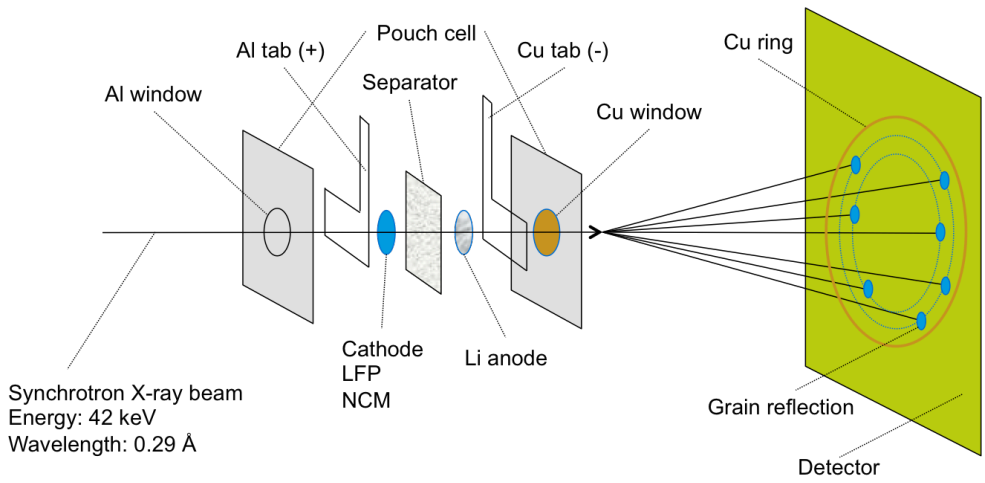

Figure 1 X-ray microbeam diffraction experimental setup

References:
[1] Yingchun Lyu, Yali Liu, Tao Cheng, Bingkun Guo, J. Materiomics 3 (2017) 221-229.
[2] X. Zhang, M. van Hulzen, D. P. Singh, A. Brownrigg, J. P. Wright, N. H. van Dijk, M. Wagemaker, Nature Communications (2015) 6, 8333.