Poster

X-ray diffraction for battery analysis: Modern challenges and modern solutions

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With the ever-increasing demand for new and improved battery materials, efficient characterization methods to obtain precise insights into both raw materials and fully assembled batteries are more important than ever. Since most modern battery materials are crystalline, and the crystallinity and crystal structure can have a significant influence on a material's performance, X-ray diffraction (XRD) is one of the go-to methods both for operando structural characterization of assembled batteries (Fig. 1), and for ex situ investigation of battery raw materials or recycling products.

The large variety in battery materials, and the many different shapes and sizes of commercial cells pose certain challenges for XRD instrumentation. As many active materials only show slight structural differences from one another, such as the substitution of cobalt in LCO with similarly sized nickel and manganese to obtain NMC, high quality diffraction data that allows the precise determination of lattice parameters is essential.

Additionally, high energy X-rays are required to penetrate the airtight metal housings surrounding assembled batteries. For this reason, the availability of high energy X-ray sources (e.g. molybdenum or silver), and suitable optical components and detectors, is crucial.

Finally, dedicated battery sample holders that allow precise positioning and reliable electrical connection of batteries for operando measurements round off the requirements for modern, high-quality powder X-ray diffractometers for battery analysis.

In this presentation, a variety of challenges and solutions for XRD measurements on batteries will be discussed, covering both operando measurements on fully assembled batteries and ex situ analysis of raw materials. An overview of the state-of-the art in XRD on batteries, from cell assembly to sample holders and measurement setup will also be presented.

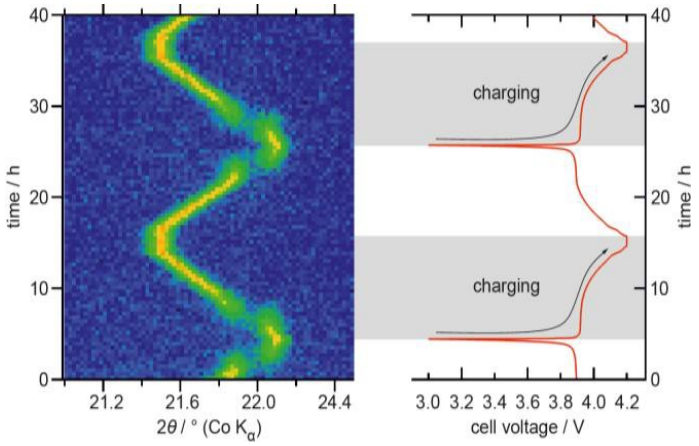

Figure 1. Example of operando XRD analysis of a LCO coin cell.