

Characterization of Energy Storage Materials with Energy-Dispersive X-ray Diffraction: Challenges and Insights

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Present and future energy-storage technologies rely on the complex arrangement of highly specialized and engineered materials. The discovery and development processes for such materials, requires scientists and engineers to probe at multiple length scales, in unaltered environments, and during operation. Energy-dispersive X-ray diffraction (EDXRD) is one of the few techniques that can probe the internal structure of a battery during operation. This is accomplished with high energy polychromatic synchrotron X-rays that are transmitted through the battery and collected at a fixed scattering angle using an energy-discriminating detector. The resulting spectra resolve the crystalline structures of the materials within a defined gauge volume with micrometer resolution and can be collected within seconds.

The applications of EDXRD with lithium-based batteries will be discussed and specific challenges with phosphate and layered oxide based high capacity cells will be highlighted. While the power of elucidating otherwise black box operation is evident, the limitations of this technique will also be discussed.