We propose an X-ray imaging technique based on synchrotron X-ray Compton scattering and demonstrate its application to batteries under in-situ and operando conditions. The demonstrations include the measurements of a coin cell (CR2032) and large cells for plug-in hybrid electric vehicles, and show that dynamic imaging of working batteries, including lithium ion migration and internal structure change, is feasible with the technique.

The technique proposed here uses high-energy, monochromatic X-rays as the probe, and detects Compton scattered X-rays from a certain volume element inside a battery cell. Both X-rays are higher than 100 keV with high penetration power into the battery cell. X-ray Compton scattering is sensitive to the constituent elements, which enables the electrochemical and structural analyses of the inside of the cell. The drawbacks of the previous experiments with conventional X-ray or gamma-ray sources were the relatively low counting rate and large probing volume element, but these have been overcome by the use of synchrotron X-rays and related focusing X-ray optics.

This presentation also includes the new apparatus equipped with a compound refractive lens and a pin-hole for X-ray Compton scattering imaging, and the results obtained by the new analysis method of Compton scattered X-rays.

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