東京大学
微細構造解析
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東京大学微細構造解析プラットフォーム
公開講演会

“How advanced transmission electron microscopy can contribute to battery research?”

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The design and improvement of the cathode materials for Li-ion batteries requires detailed knowledge on the crystal structure at different charge/discharge states and comprehensive understanding of the processes occurring at the nanoscale or even atomic scale level, as many electrode materials demonstrate highly inhomogeneous non-equilibrium behavior. Advanced transmission electron microscopy (TEM) is by far the most suitable and direct tool to look at the materials down to atomic scale. Recent progress in the quantitative electron diffraction methods and aberration-corrected scanning TEM imaging will be illustrated here with the examples of atomic structure investigation of various cathode materials. Electron diffraction tomography provides quantitative diffraction data enabling reliable structure solution and refinement from extremely small crystallites, typically smaller than 1 μm^3. Electron diffraction data can be acquired at very low electron dose, enabling investigation of the materials sensitive to the electron beam irradiation damage, such as polyanion and mixed-anion Li-ion battery cathodes, particularly in their charged state. The capabilities of quantitative electron diffraction in locating Li atoms and refining the occupancy of the Li positions will be demonstrated. Aberration-corrected scanning transmission electron microscopy (STEM) techniques deliver the information on the local structure with sub-A resolution. High angle annular dark field STEM (HAADF-STEM) imaging provides clear visualization of the cation positions, whereas annular bright field STEM (ABF-STEM) shows the location of the “light” elements, such as O and Li.

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