

Operando Observation of Reaction Distribution in a Composite Positive Electrode for Bulk-type All-Solid-State Lithium-Ion Batteries by Using CT-XAFS

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The 3-dimensional reaction distribution in a composite electrode for bulk-type all-solid-state lithium-ion batteries (ASSILBs) was observed by using *operando* computed tomography X-ray absorption fine structure (CT-XAFS) technique [1] to understand the mechanism of the reaction distribution formation. A bulk-type ASSLIB with the configuration of LiCoO₂(LCO)-Li_{2.2}Co_{0.8}B_{0.2}O₃(LCBO)|LCBO|PEO|Li was fabricated as a model battery [2]. The battery was charged to 4.35 V with 100 μA (0.2 C) at 100 °C. The *operando* CT-XAFS measurements were carried out in the energy range between 7725.5-7730 eV with an energy step of 0.1 eV under an exposure time of 30 ms per energy and projection angle from -70 to 70 deg with an angle step of 0.2 deg. The observation area was 810 x 660 x 50 μm. The spacial and time resolution were 4 μm and 25 min., respectively. Figure 1 shows 3D SOC mapping and in-plane views of the SOC mapping near the electrode/current collector interface, the central region of the electrode, and the electrode/solid electrolyte interface after charging. The colored and the white regions correspond to active materials and solid electrolyte/voids, respectively. In the colored region, the red and blue regions indicate more and less charged regions, respectively. As shown in these figures, unreacted areas were mainly observed inside the aggregated active materials. This suggests that the ion transport between the particles of the active material is comparatively slow and thus the battery capacity can be improved by more homogeneously dispersing the particles of the active material.

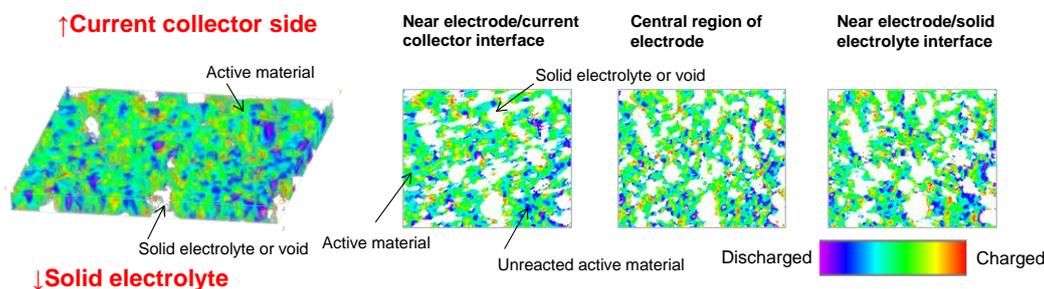


Fig. 1. 3D SOC mapping and in-plane views of the SOC mapping near the electrode/current collector interface, the central region of the electrode, and the electrode/solid electrolyte interface after charging.

References:

[1] H. Matsui *et al.*, *Angew. Chem.Int. Ed.*, **56** (2017) 9371-9375.

[2] T. Okumura *et al.*, *Solid State Ionics*, **288** (2016) 248-252.

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