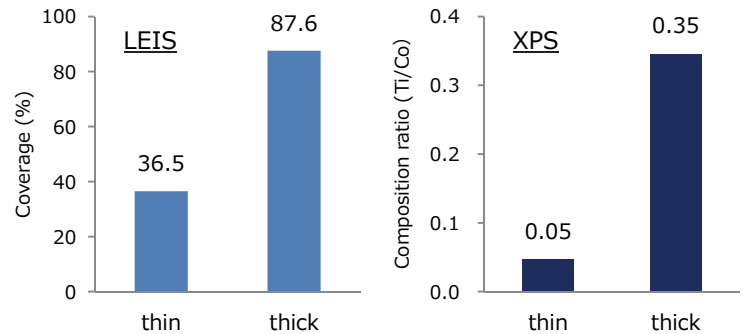
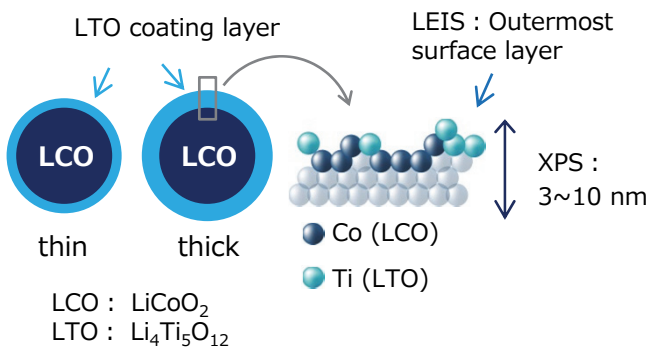


Evaluation of surface coating layer on active materials

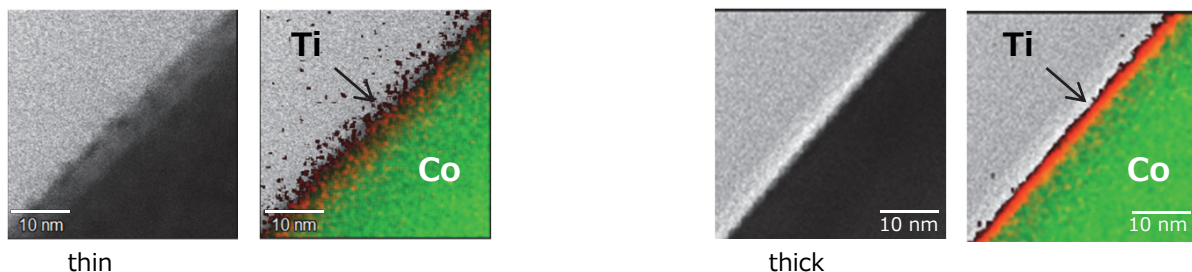
Surface coating on active materials can improve battery performance, and thin coating with high coverage is required. LEIS, XPS, TEM-EDX, and TOF-SIMS can acquire coverage, thickness, and surface distribution of coating.

Evaluation of coverage by LEIS, XPS



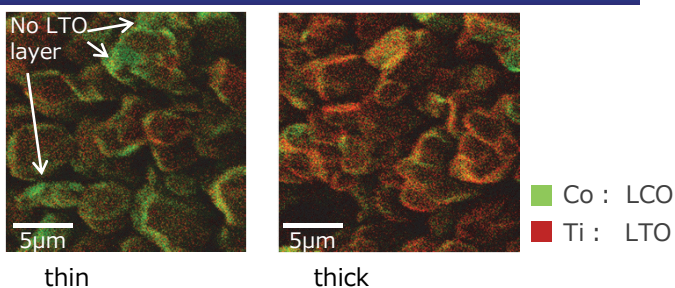
- LEIS : Information about the outermost layer is available. Coating coverage can be evaluated quantitatively.
- XPS : Sampling and transfer to instruments can be performed under inert atmosphere. Composition ratio within a depth range of 3 ~ 10 nm from the surface can be available.

Evaluation of thickness by cross sectional STEM-EDX



- LTO was detected on some LCO particles, and not detected on the other particles. The coating is inhomogeneous.
- Thickness of LTO layer: unknown (Edge-on condition will be suitable for the thickness estimation.)
- Direct evaluation of layer thickness and homogeneity can be achieved.
- Homogeneous LTO layer was observed on the LCO surface.
- Thickness of LTO layer : 1.2~1.4 nm

Evaluation of distribution by TOF-SIMS



- In "thin" sample, some LCO particles are not coated with LTO.
- In "thick" sample, almost all LCO particles are coated with LTO.
- Surface distribution of coating can be evaluated with high sensitivity and lateral resolution of 0.3μm (the information depth is 1 ~ 2 nm).

High-accuracy analysis of coverage, thickness, and distribution of coating on active materials should provide useful parameters for developing electrode mixture with high ionic conductivity and low resistance.