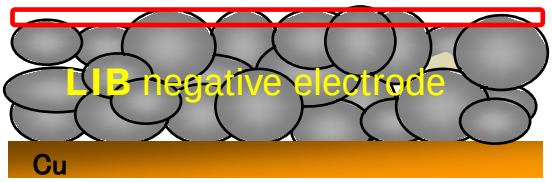
Surface analysis of SEI film on the LIB negative electrode

This article shows surface analyses of SEI (solid electrolyte interface) on the negative electrodes before (Fresh) and after charge-discharge cycles (After cycles).

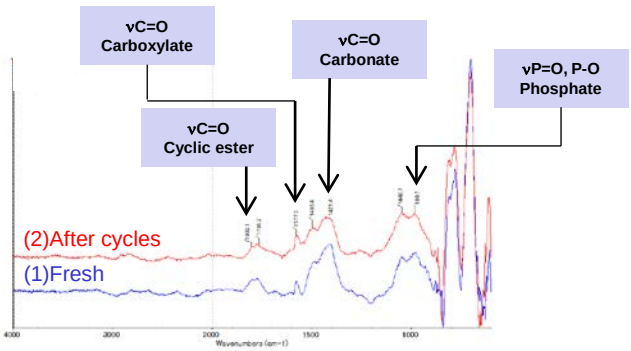


← Surface analyses (1)Fresh (2)After cycles

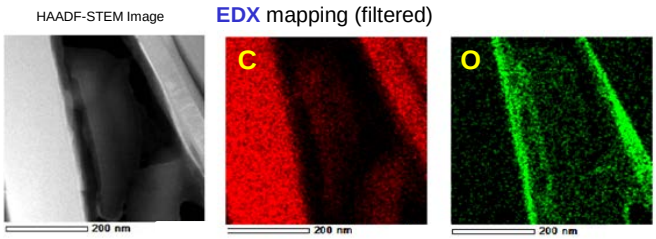
FT-IR, STEM-EDX, XPS, TOF-SIMS

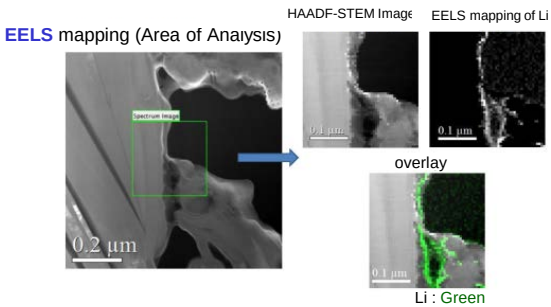
FT-IR Functional groups and the chemical structure of SEI (~1μm depth) were analyzed by FT-IR

There is no difference in the composition between (1)Fresh and (2)After cycles.

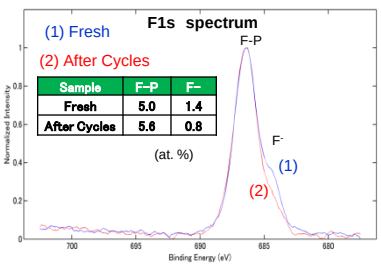


STEM-EDX Thin layer of SEI was observed by STEM-EDX and EELS

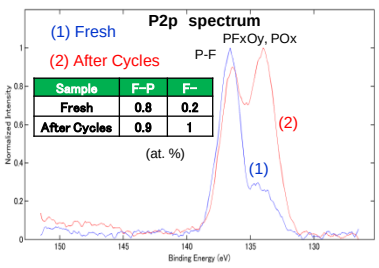




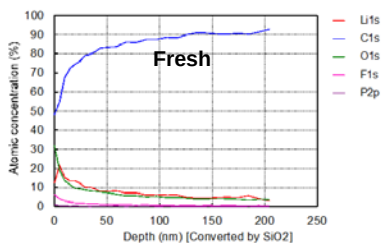
XPS Elemental composition, chemical state (~10 nm) and SEI thickness (~200 nm) were analyzed by XPS.



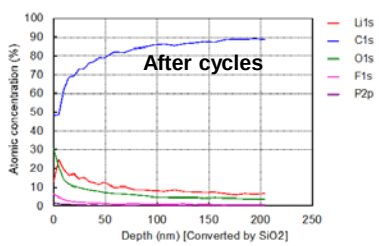
Sample	F-P	F-
Fresh	5.0	1.4
After Cycles	5.6	0.8



Sample	F-P	F-
Fresh	0.8	0.2
After Cycles	0.9	1



Fresh negative electrode depth profile



After cycle negative electrode depth profile

TOF-SIMS Chemical structure of SEI was analyzed by TOF-SIMS.

Sample	Characteristic components
Fresh	✓ Li_2CO_3 ✓ LiF ✓ Carboxylic acid or ester ⇒ **early stage of SEI**
After Cycles	✓ PO_2 ✓ PF_xO_y ✓ Ethylene glycol structure ✓ Al ⇒ **Decomposition product of the electrolyte, elution from positive electrode collector**

From surface analyses, chemical composition of SEI was determined.
SEI includes Li, C, O, F and small amount of P.