SIMS Analysis of a Commercial Lithium Ion Battery Using a Highly Focused Neon Ion Beam

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Gas field ion source (GFIS) based helium (He) and neon (Ne) ion beams of ZEISS ORION NanoFab is a powerful technology for many imaging and nanofabrication applications[1]. Most recently, a custom designed Secondary Ion Mass Spectrometer (SIMS) has been integrated onto this instrument[2,3] enabling an unparalleled nanoscale surface analytical technique. The spectrometer is capable of identifying all elements and isotopes and even some small compounds and clusters. The NanoFab SIMS uses a high brightness ion source to produce a ~ 2 nm focused neon beam to generate secondary ions. In contrast, conventional SIMS instruments rely on lower brightness ion sources with heavier ions, and this limits the probe size to > 50 nm, ultimately limiting the lateral resolution[3, 4]. It has been demonstrated that NanoFab SIMS is capable of producing elemental maps with lateral resolution down to <15 nm[3-6]. Alternate techniques such as X-ray mapping has limitations besides resolution when it comes to detecting lighter elements like Li. Therefore, NanoFab SIMS is an excellent technique to study the Li battery samples because of its better lateral resolution and can detect the lithium and all other battery elements. Moreover, NanoFab SIMS uniquely allows *in-situ* correlative imaging, combining high resolution SE images (<1 nm with He beam) with elemental information from SIMS[3,7].

In this report, NanoFab SIMS elemental analysis is performed on a commercial graphite/NMC($Li[Ni_{1/3}Mn_{1/3}Co_{1/3}]O_2$) pouch cells to observe degradation due to storage and the cycling processes[8]. Figure 1 (a) shows He induced secondary electron SE image and 1 (b) shows the elemental mapping of ^6Li on separator foils (anode side). It is obvious from the mapping that all the newly created features (precipitates) on top of the separator foil shows an enrichment in the lithium content. Results from other samples will also be presented.

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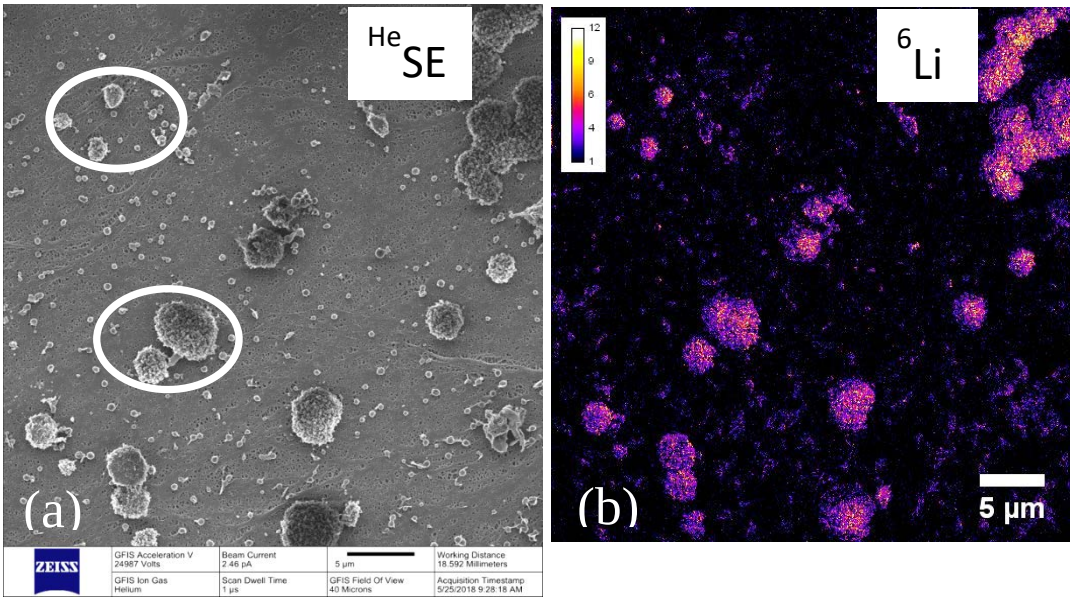

Figure 1: Investigations of a separator foil (anode side) from an aged battery cell with ORION NanoFab SIMS. (a) Helium secondary electron (SE) image of grown precipitations formed by degradation effects (examples of precipitates are in white circles) and (b) correlated ^{6}Li distribution image from NanoFab SIMS.

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