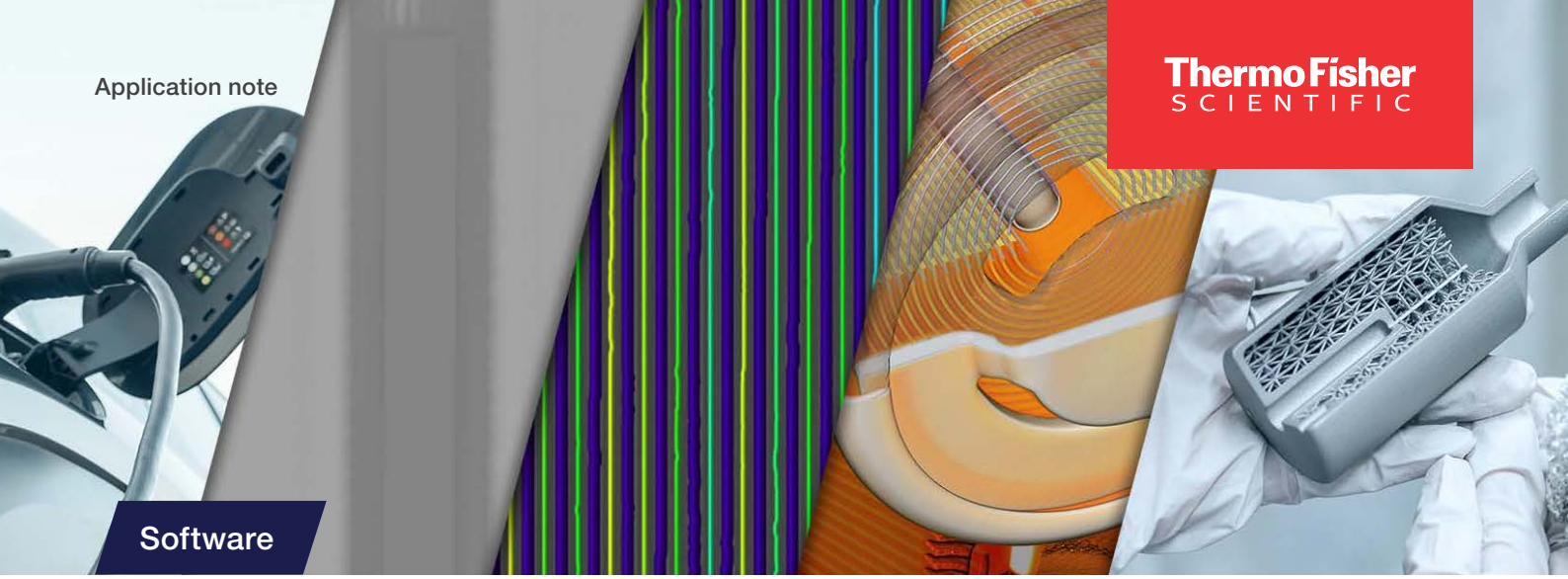
Application note



Software

Understand degradation mechanisms in lithium-ion batteries at different scales

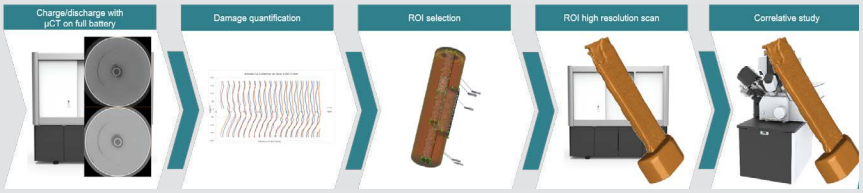
Correlative workflow - Raman Spectroscopy, CT, µCT, Dual-Beam SEM

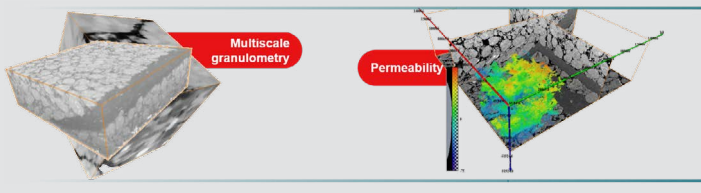
For users to fully understand degradation mechanisms, characterization requires that they look at a sample at different scales. In a degraded sample, locating the exact region of interest from micro-CT and driving the dual beam acquisition is very challenging, and no correlative solutions exist.

A correlative solution can be controlled easily through one particular software solution.

In this case, a module is built in Thermo Scientific™ Avizo™ Software to drive acquisitions at different scales, through the hard coding of the important regions of interest, which may even be used in conjunction with a sample holder so that actual manipulation of the sample is easier.

Degradation characterization at different scales may now be semi-automated thanks to the software solution and even reach an unprecedented level of automation through the combination of hardware and software.





In this workflow, we looked at the technological challenges for multi-scale and multi-modal correlation.

Different properties and defects affect the final performance of batteries:

- Chemical composition of cathode, anode, electrolyte
- Cathode's grain connectivity
- Cathode's grain morphology and spatial distribution
- Porous media permeability and percolation for electrolyte's conductive performance
- Tortuosity at macroscale, permeability at macro-microscale, effective transport at nanoscale
- Local variation of electric conductivity / formation factor
- Defects morphology and spatial distribution
- Delamination

These properties or defects may be simulated or spotted, providing enough resolution is used. But it may be difficult to run a full workflow going from identifying the right region of interest at the macro scale and performing additional acquisitions at the micro scale on the exact same location.

Avizo Software provides tools for the definition of ROI with georeferencing information, allowing the extraction of a lamella from the CT sample which can then be used with the FIB-SEM at a higher resolution.

Learn more at **thermofisher.com/avizobatteries**

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