BATTERY QUALITY AND FAILURE ANALYSIS

ELECTRICAL SCREENING AND PERFORMANCE CHARACTERIZATION

Battery cyclers
- 2 × 8 channels 10 µA – 100 mA (BCS-810, Biologic)
- 6 × 8 channels 100 µm – 1 A (BCS-805, Biologic)
- 3 × 8 channels 10 mA (Neware)

Potentiostats
- 8 × channels 10 µA – 1 A, EIS 1 MHz – 10 µHz (VMP-3e, Biologic)
  - 1 × AUTOLAB PGSTAT128N (10 nA – 1 A) with FRA32M module (Metrohm)
- 1 × Vertex (10 nA – 1 A) (Ivium)

Thermal control
- Environmental chambers (-70…+120 °C, RH 10-90%)

Battery test station

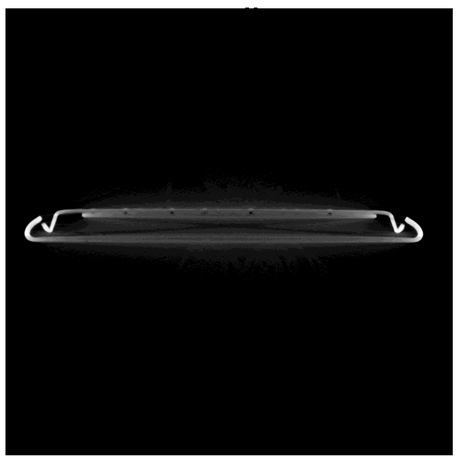
Environmental chamber

IMAGING AND CHEMICAL FAILURE ANALYSIS

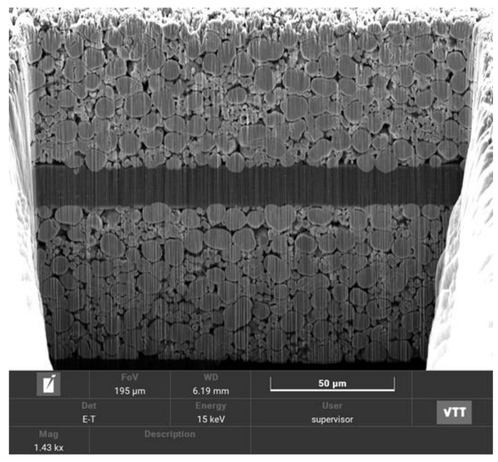
X-ray MicroCT scanning of the battery internal components or interconnections

Chemical failure analysis
- Battery teardown inside argon-filled glove box (visual analysis of the internal components, e.g. lithium deposition, delamination)
- SEM of battery components (electrodes, separator)
- Elemental analysis of the battery components with EDX
- XRD electrode material characterization

X-ray CT scan of a coin



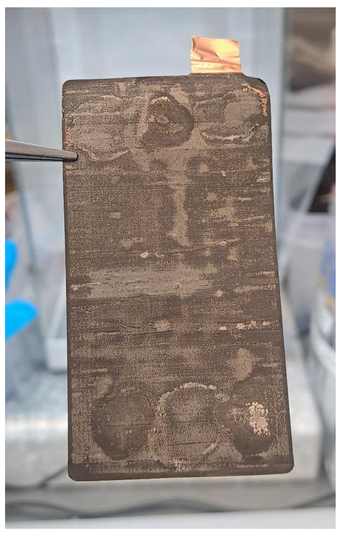
Electrode cross-section



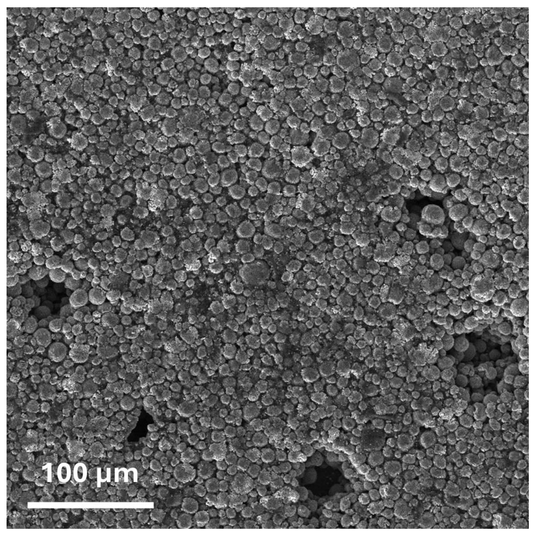
SAFETY TESTING

- Accelerating rate calorimetry (ARC, THT EV+ & Standard)

Lithium plating on graphite electrode



Pinholes on electrode



OTHER CHARACTERIZATION METHODS

- Optical microscopy
- Profilometry
- FTIR spectroscopy
- Raman spectroscopy
- + wide variety of other tools available at VTT (please ask if you need special characterization methods)

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beyond the obvious