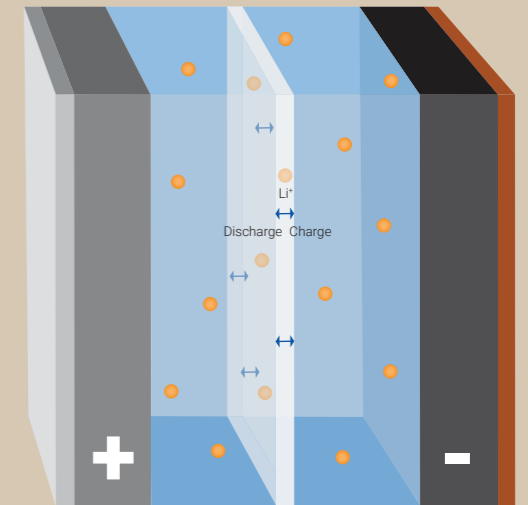


FAILURE ANALYSES IN BATTERY COMPONENTS

Investigate:

- ▶ Chemical Degradation
- ▶ Dendrite Formation
- ▶ Poor Mechanical Performance
- ▶ Thermal Runaway

Understand the mechanism of failure in each battery component and which analytical techniques could identify the root cause



Lithium Ion Battery System

Current Collector (Cathode)

Aluminum

Although generally corrosion resistant, during operation can corrode and deposit on the cathode or migrate to be deposited. Failure through this mechanism would be detected by increased Al^{3+} concentration on anode or cathode as well as decreased current collector thickness. Determination of Al can be carried out with ICP-OES or ICP-MS.

Application: [Analysis of Aluminum Alloys](#)

Cathode

LFP, NMC, LCO or other active material

Presence of impurities such as Fe, Cu, Cr, Zn or Pb can lead to performance issues further down the line. Impurities can reduce electrochemical performance while also encouraging the growth of dendrites which can eventually lead to an internal short-circuit. Impurities can be determined with ICP-MS or ICP-OES.

Application: [Determination of Elemental Impurities in Lithium Battery Cathode Materials](#)

Electrolyte

Carbonate Solvent, Conducting Salt, Additives

An incorrect conducting salt concentration can lead to poor performance. This can be determined rapidly by FT-IR spectroscopy. Additives and solvents can be measured using GC/MS. Elemental impurities can be monitored with ICP-OES. Evolved gas analysis can allow users to understand degradation products in a more in-situ manner.

Application: [Direct Analysis of Impurities in Lithium Hexafluorophosphate Battery Electrolyte](#)

Separator

Polyethylene, Polypropylene, Ceramic, other Polymers

A separator with the incorrect thermal or mechanical performance may ultimately lead to failure. TGA, DSC & DMA can be used to test thermal and mechanical properties.

Application: [Battery Analysis Guide](#)

Current Collector (Anode)

Copper

Although generally stable, some dissolution of the copper current collector can occur. Deposition of copper on the cathode is thought to contribute to dendrite growth which can cause eventual failure. This redeposition has also been known to occur on the anodic SEI (solid electrolyte interface) Copper can be determined using spectroscopic techniques such as ICP-OES or ICP-MS.

Application: [Determination of Bromine in Ultra-High-Purity Copper](#)

Anode

Graphite, Binder, Conductive Additives

Although generally corrosion resistant, Graphite decomposes at a much lower temperature than the active material in the cathode and so is more susceptible to degradation during thermal runaway. Degradation products and thermal properties can be understood with evolved gas analysis. Moisture found in the anode can also be understood using evolved gas analysis.

Application: [Characterization and Analysis of PVDF Used as a Lithium-Ion Battery Binder](#)