Failure Analysis & Classic Case Studies

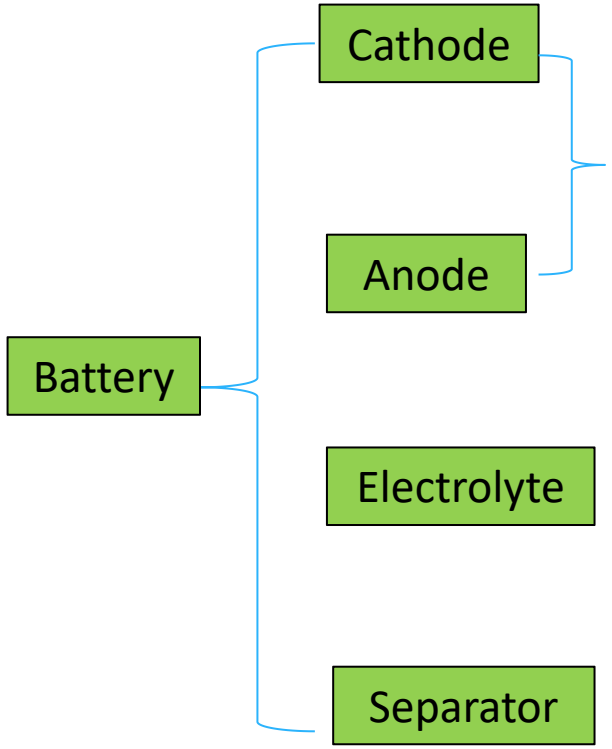
Canrd Technology Co., Ltd

2025/11

Catalog

Basic Principles and Components of Lithium-ion Batteries

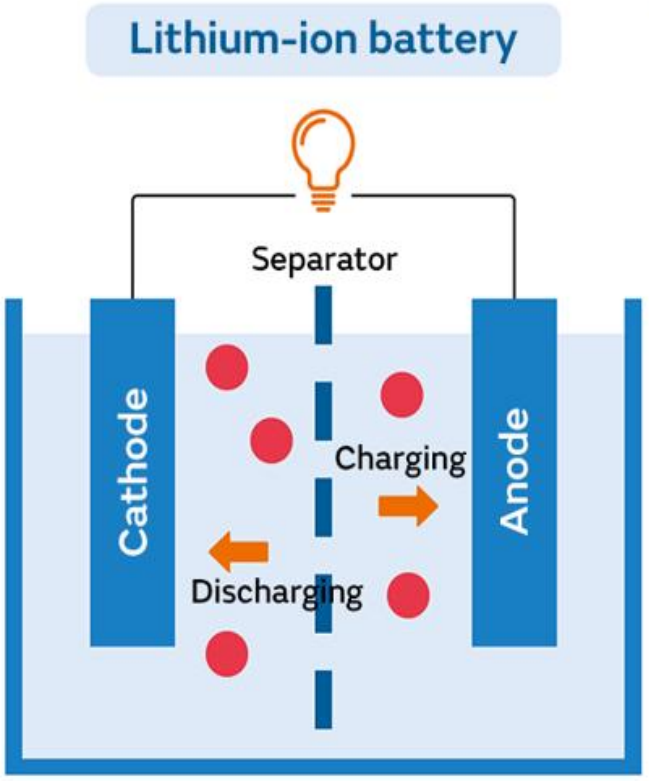
The selection of the raw material system determines battery performance and failure analysis



They determine the basic performance of the battery and serves as a key control point in the battery manufacturing process.

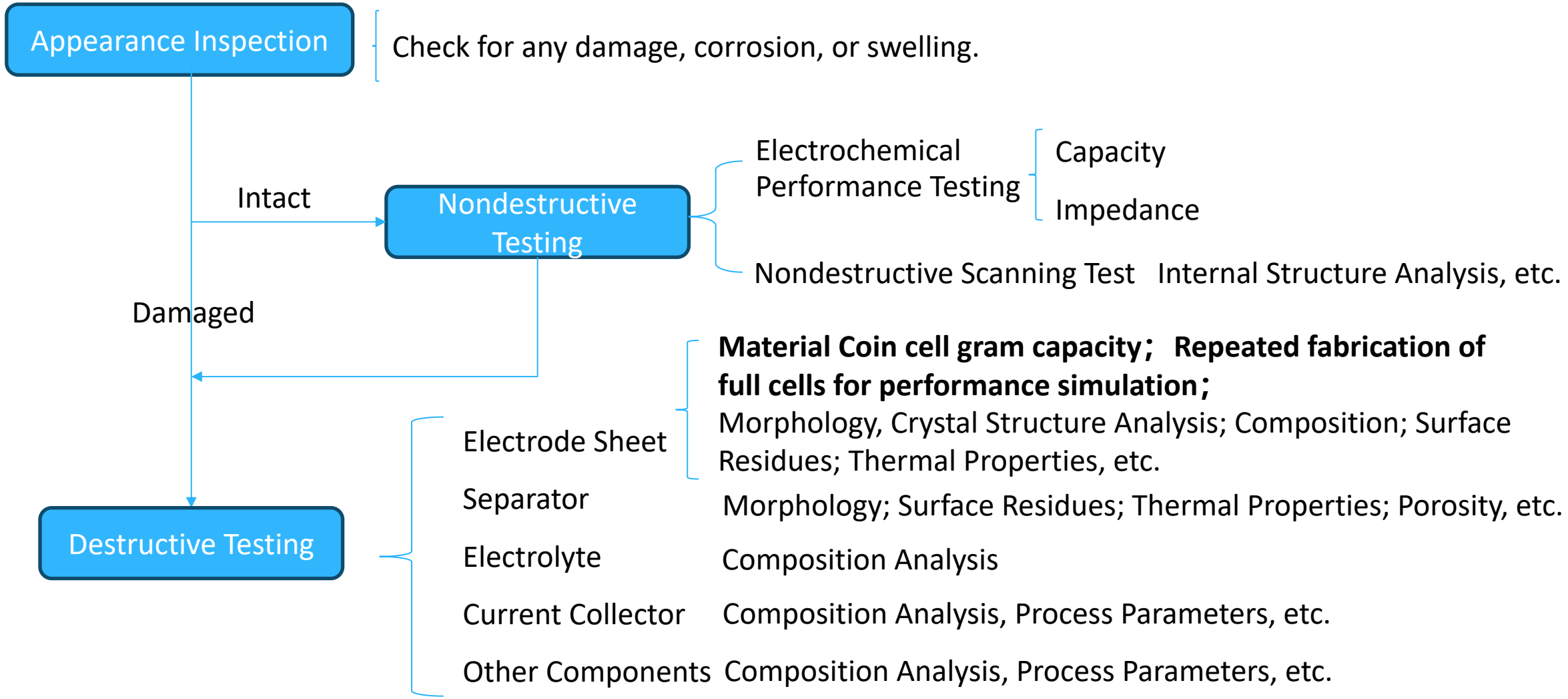
It facilitates conduction between the positive and negative electrodes of the battery, and its inherent properties as well as the interface formed with the electrodes significantly influence battery performance.

It facilitates ion conduction while blocking electrons, significantly impacting battery safety and cycle life.



Schematic Diagram of Lithium-ion Battery Operation

Main Approach to Failure Analysis



Main Methods for LIB Failure Analysis

Analysis Area	Main Analysis Methods
Non-destructive Internal Structure Analysis	X-ray CT
Positive/Negative Active Materials	**Material Morphology:** SEM, TEM, Cross-section SEM **Material Type & Element Distribution/Composition:** XRF, SEM-EDX, ICP-AES, EPMA **Composition Distribution:** TOF-SIMS **Crystal Structure, Lattice Constant:** XRD **Chemical State of Li Element:** 6Li, 7Li-NMR **Physical/Chemical Indicators:** Particle Size Analyzer, Specific Surface Area Analyzer, etc.
Electrolyte	**Solvent & Additives:** Qualitative Analysis: GC-MS, LC-MS, H-NMR; Quantitative Analysis: GC-FID **Electrolyte Salt:** Qualitative Analysis: F-NMR, P-NMR, LC-MS; Quantitative Analysis: ICP-AES, ISE, LC-MS **Diffusion Coefficient:** NMR **Impurity Content:** ICP-AES, GC-MS, IC

Main Methods for LIB Failure Analysis

Analysis Area	Main Analysis Methods
Separator	**Microscopic Morphology:** SEM； **Qualitative Analysis:** FT-IR **Pore Size Distribution & Porosity:** Porosimeter **Through-Pore Evaluation:** Porosity Meter **Qualitative Analysis of Inorganic Elements in Coating Layer:** XRF
Binder	**Qualitative Analysis:** FT-IR, GC-MS, NMR **Molecular Weight Distribution:** GCP **Additive Amount Analysis:** TG-DSC
Conductive Agent	**Additive Amount Analysis:** TG **Crystal Structure:** Raman Spectroscopy

Canrd's Capabilities Introduction

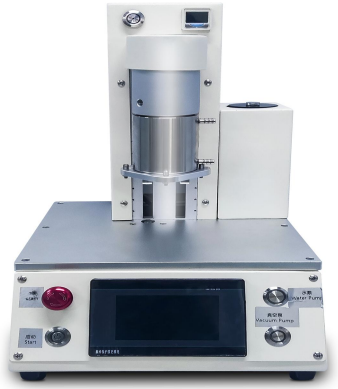
Hardware Resources

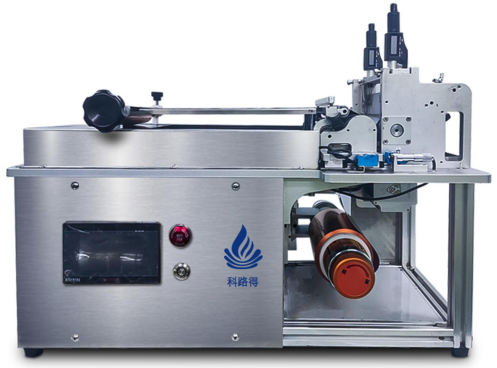
➢ Introduction to Canrd's Team

Team Scale: (1)Facility area: 10,000 m²;(2) Equipped with an independent pilot production line for battery manufacturing and a testing center;(3) Business scope covers customized cell production, material physical/chemical testing, cell electrochemical performance testing, safety testing, and other fields

Team Qualifications: (1)Successfully obtained ISO 9001 system certification;(2) Accredited with CNAS (China National Accreditation Service for Conformity Assessment) qualification

Hardware Resources- Coin Cell Production Line





- Features an independent pilot production line for coin cells, equipped with all relevant equipment including mixing, coating, calendering, slitting, coin cell assembly, and testing.

Hardware Resources - Full Cell Production Line






- Equipped with independent pilot production lines for pouch and cylindrical cells, capable of meeting different structural requirements such as winding and stacking.
- Equipped with mixing tanks in 5L, 10L, and 30L volumes to accommodate R&D, sampling, and failure/reverse analysis needs with varying batch sizes.

Hardware Resources - Drying Room (Disassembly & Assembly)

No.	Process Step	Dew Point Requirement
1	Mixing & Coating	-30℃
2	Calendering to Pre-baking	-40℃
3	Electrolyte Filling	-50℃
4	Lithium Metal Production	-50℃
5	Li/Na Metal Production (Glove Box)	<0.1PPM

- The drying room with full-process low dew point control can meet the R&D requirements of various customers and different battery systems (such as high-nickel, sodium-ion, and lithium metal batteries).
- The drying room implements cleanliness control (clean room environment) to ensure product quality meets requirements.

Hardware Resources - High-Precision Analytical Capabilities

BET

Synchronous Thermal Analyzer

GC-MS

XRD

In-situ FTIR

SEM

Established long-term and stable cooperative relationships with multiple testing laboratories, including ATL and the Tsinghua Shenzhen Testing Center.

Classic Case Studies

Basic information

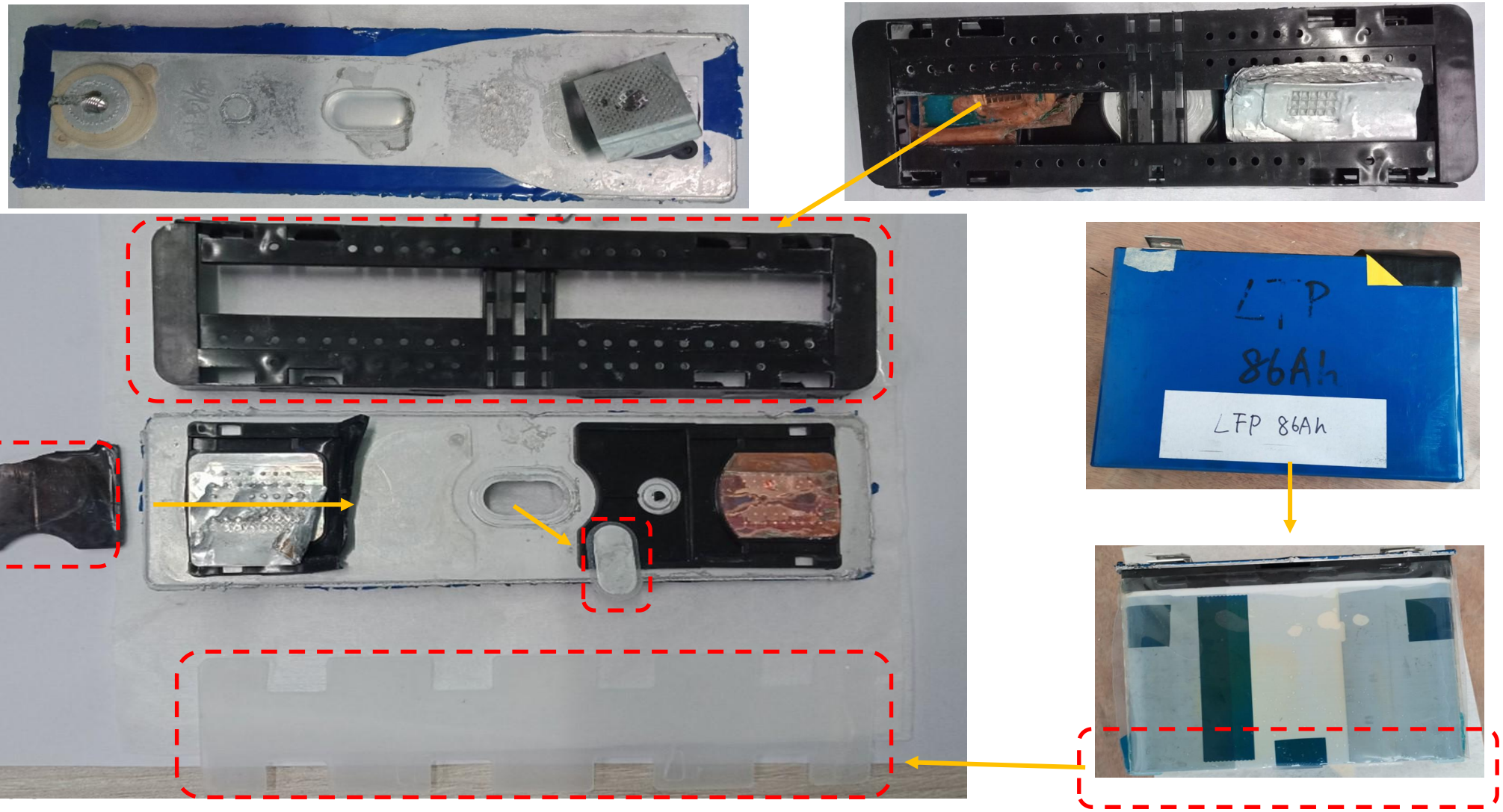
No.	Capacity (Ah)	Energy (Wh)	Voltage plateau (V)	Weight (kg)	E.D. (Wh/kg)	Length (mm)	Width (mm)	THK (mm)
LFP 86	89.1	285.6	3.21	2.130	134	48.26	173.57	127.68

No.	Capacity (Ah)	Test procedure	Voltage (V)	Cathode electrode width(mm)	Anode electrode width(mm)	Separator width(mm)
LFP 86	89.1	2.0~3.65V,0.2 /0.2C	2.567	99.0	104.0	110.0

◆ **Square aluminum cell**

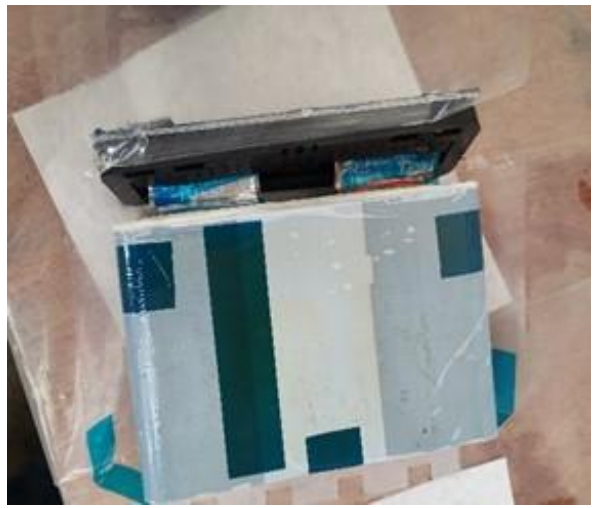
Classic Case Studies

Cell shell disassemble



Bottom retainer

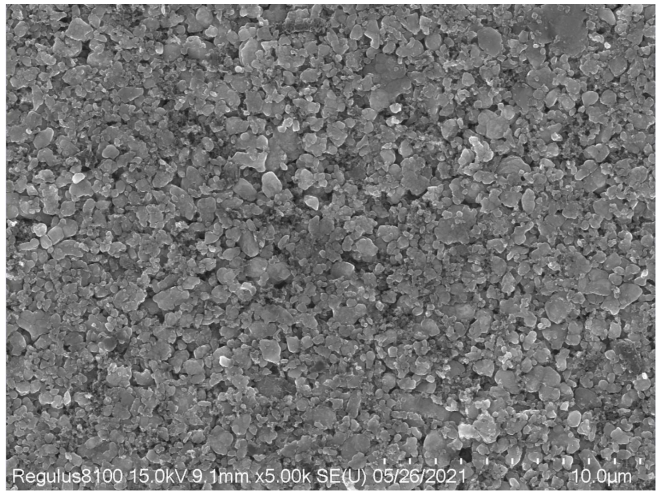
Classic Case Studies

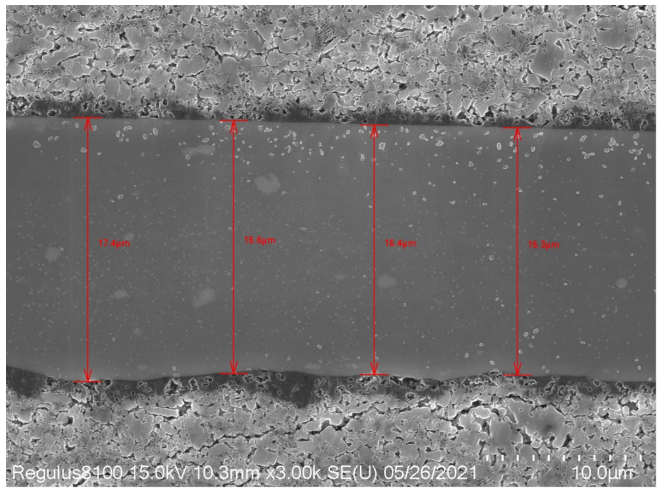



Ceramic coating which is good for insulation and less burrs during slitting

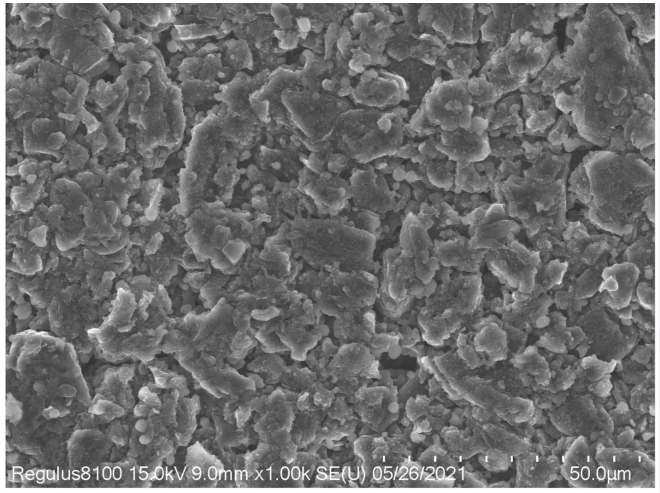
Classic Case Studies

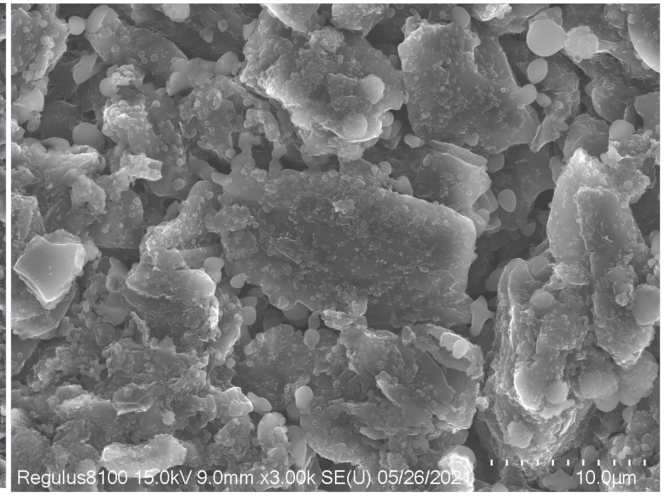
SEM-Cathode&Anode

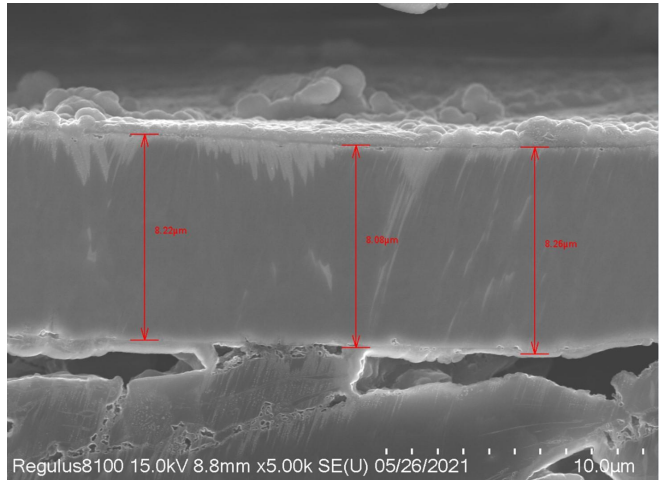




- The THK of Al foil is ~16um
- LFP is nano scale powder



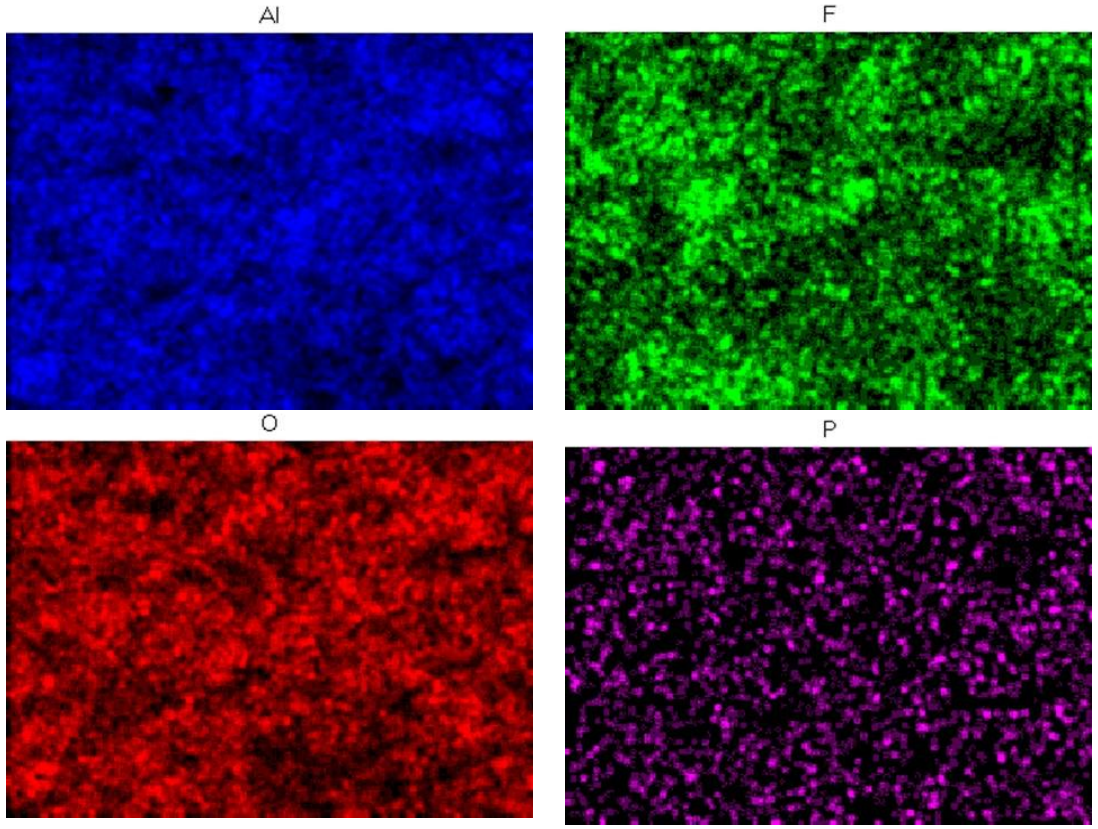




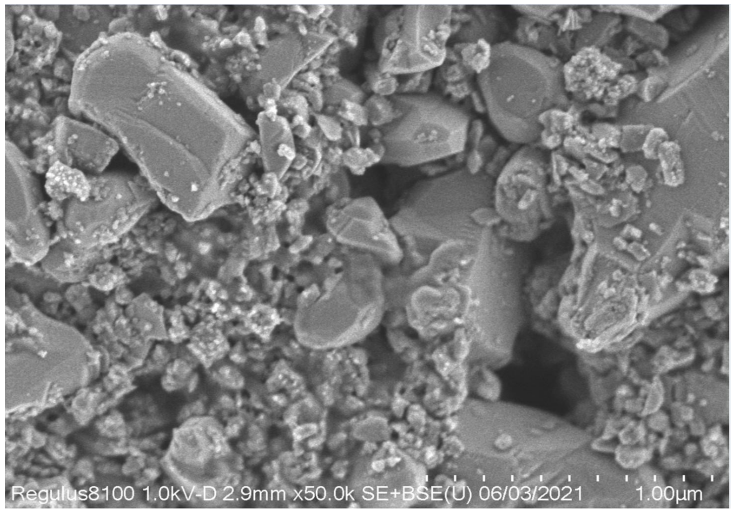
- The THK of Cu foil is ~8um
- Anode material is artificial graphite

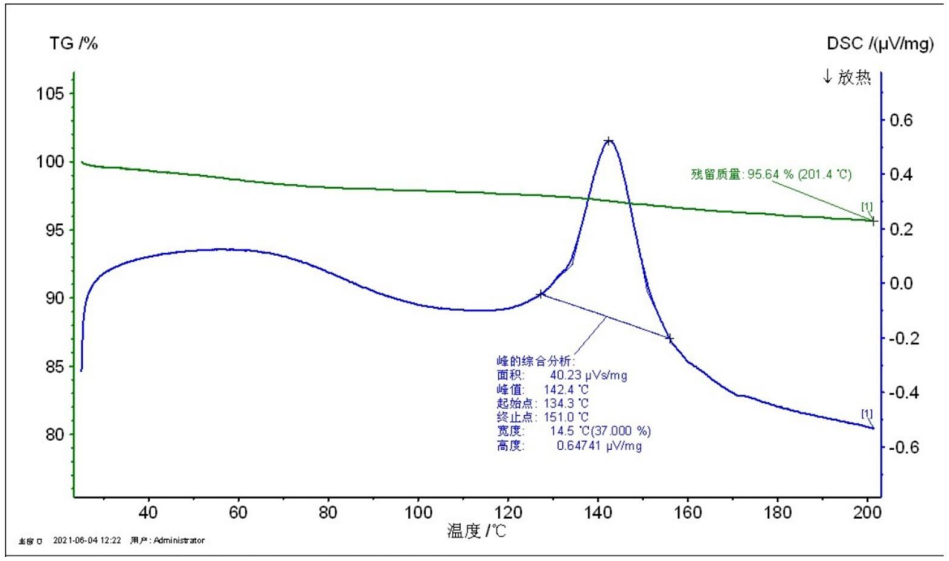
Classic Case Studies

Separator



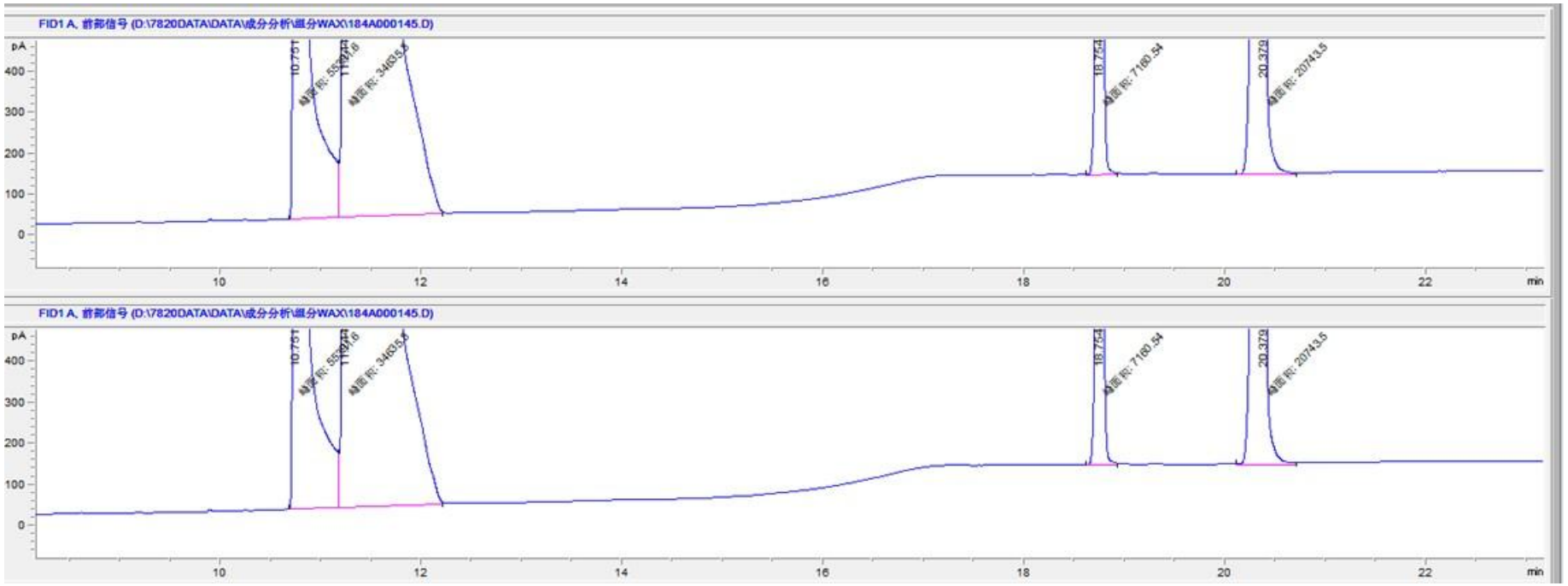
Elt.	Line	Intensity (c/s)	Conc.	Units	Error2-sig
O	Ka	53.17	29.306	wt.%	1.181
F	Ka	41.92	30.585	wt.%	1.386
Al	Ka	125.51	39.129	wt.%	1.003
P	Ka	2.39	0.980	wt.%	0.268
			100.000	Wt.%	





Classic Case Studies

Electrolyte



Reverse analysis result		Ratio
EMC	38.4%±10.0%	4.5
DEC	19.5%±10.0%	2
PC	4.4%±10.0%	0.5
EC	24.8%±10.0%	3
LiPF6	12.9%±1.0%	12.8%

Item	RA sample	Sample(new preparation)
Density(g/cm3)	1.1898	1.1919
Conductivity(mS/cm)	8.54	8.22

Thank you