**ZEISS eMobility Solutions** 

# **Battery Material Microstructure Analysis** by SEM & EDS





Seeing beyond

### **High quality imaging** Battery material R&D by SEM & EDS

Power battery is a crucial component of new energy vehicles (NEV), directly impacting the safety, performance, and production costs of the entire vehicle. Comprising primarily of cathode and anode materials, separators, electrolytes, the development direction of batteries primarily revolves around the exploration of cathode and anode materials that offer high specific capacity, superior safety, low cost, and environmental friendliness.

To develop new-generation battery materials, a series of characterizations and analyses must be conducted throughout the research and development (R&D) process. ZEISS provides scanning electron microscopes (SEM) and energy dispersive spectrometer (EDS) as research tools for battery microstructure analysis.



### **Ensuring quality of raw materials** Evaluation with SEM & EDS

The battery production process encompasses material R&D, the electrode manufacturing, cell assembly, and module packaging.

Among these steps, the quality of battery materials, including geometric morphology, particle size distribution, and composition and phase structure of microscopic regions, is directly linked to the overall vehicle performance and safety.

SEM are commonly used for observing material surface morphologies, and EDS can be paired with SEM to conduct qualitative or quantitative analysis of elements present in minute areas. These solutions provide crucial microscopic information for the design, optimization, and performance enhancement of battery materials.



#### **R&D** and production process evolution of NEV battery

**Step 1** New material demand **Step 2** Material synthetic methods **Step 3** Single material evaluation



### SEM & EDS

## Surface morphological characterization

- 1. High-resolution imaging
- 2. Low-kV imaging
- 3. Surface sensitive samples imaging
- 4. Magnetic samples imaging

It is necessary to develop new battery materials with enhanced electrochemical performance, higher safety, and cost-effectiveness to fulfill societal demands.



### **Application areas of SEM & EDS**



#### High-resolution imaging

- Observation of material micromorphology
- Material category and structure identification



#### Low-kV imaging

- Extreme surface details obtaining



#### Surface sensitive samples imaging

- Microscopic imaging of high molecular polymers
- Sub-Nanometer imaging of Thin Films



#### Magnetic samples imaging

Avoidance of material surface charging



#### Element detection and percentage analysis

- High resolution EDS analysis on non-conductive samples
- Low vacuum / low kV EDS analysis

• Observation of iron, cobalt, nickel and their metal oxides Observed directly without degaussing



#### Technical cleanliness analysis

- Particle classification on the basis of elemental composition
- Correlative Automated Particle Analysis (CAPA)

### Value proposition of ZEISS solution



#### **Excellent imaging results**

- Acquire great imaging results and accurate elemental chemistry information
- Deepen understanding of battery materials



#### Reliable and repeatable data

- Reliable user-independent and reproducible results
- Reach highest quality and fulfill industry standards like VDA 19.1



#### Friendly for both expert and novice users

- images, regardless of skill level



#### Cost saving

- Long service life and high durability

• For expert users: enable full control over the microscope with full access to all functions and parameters available • For novice users: empower users to generate excellent



#### **Increase efficiency**

- Flexible and convenient operation to save time
- Highly intelligent to improve efficiency

• Easy to use: drastically reduce training costs



#### Speed up workflow

- Achieve high throughput for simple automated imaging workflows
- Satisfy sub-nanometer imaging, analytics and sample flexibility

### **Recommended portfolio**

Best qualified SEM to support industrial quality

ZEISS EVO



Field	emission	SE
user	experienc	e
ZEISS	Sigma	



Resolution	3 nm @ 30 kV - SE 8 nm @ 3 kV - SE
Magnification	5x to 1,000,000x
Probe current	0.5 pA to 5 µA
Acceleration voltage	0.2 - 30 kV, step: 10V

#### **Benefits:**

- High cost performance
- High probe current stability
- High resolution storage: 32000 × 24000 pixels

 $\checkmark$ 

• Correlation microscope: SEM & LM

Magnification

#### Acceleration voltage

#### EM technology with an excellent

### Field emission SEM for the highest demands in imaging and analytics

ZEISS GeminiSEM



0.02 - 30 kV, step: 10V Acceleration voltage

\* The highest indicator in the series

#### $\checkmark$ **Benefits:** High probe current stability ■ High resolution storage: 32000 × 24000 pixels Excellent low-kV imaging

■ Correlation microscope: SEM & LM

#### ZEISS eMobility Solutions

Battery Material Microstructure Analysis by SEM & EDS

# ZEISS Industrial Quality Solutions Present in all regions

Sales & service

organizations

00060

Master the transition of the Automotive sector with ZEISS New Energy Vehicle Solutions. From Battery, E-Motor, Power Electronics, and Automotive Electronics, to Car-body, Transmission, and Thermal Management System, we help you get to grips with new technologies and processes for electrification and intelligence of the vehicle. Our dynamic solutions ensure your operations are fit for the future of mobility.



