Datasheet

Phenom ParticleX Battery Desktop SEM

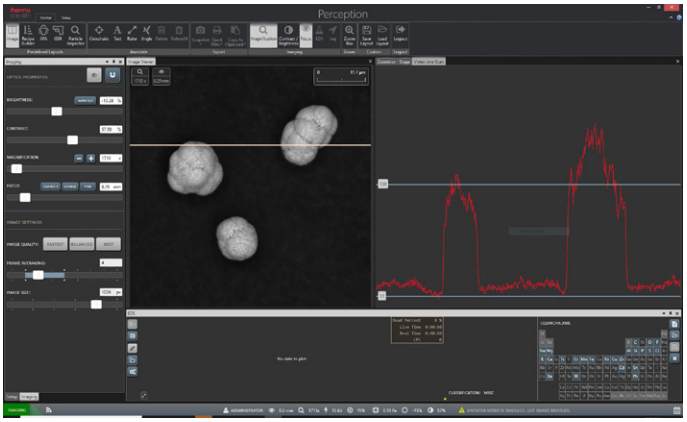
Automated structural and chemical analysis of battery materials using SEM and EDS.

thermo scientific

A growing number of manufacturing companies are establishing scanning electron microscopy (SEM) systems in-house. This trend, from outsourcing to in-house analysis, is growing, and the benefits, such as the ability to perform a broad range of automated desktop analyses, chemical classification, and verification according to specific norms, are clear. Timely and accurate quality control is a prerequisite for today's manufacturing.

Introduction

The Thermo Scientific™ Phenom™ ParticleX™ Battery Desktop SEM is a versatile desktop SEM solution for high-quality, in-house analysis. It gives you the ability to carry out speedy analysis, verification, and classification of materials, supporting your production with fast, accurate, and trusted data. The system is automated and offers analysis of multiple samples, making testing and classification up to 10 times faster. Outsourcing typically takes up to 10 working days, whereas the Phenom ParticleX Battery Desktop SEM gives you certainty within one day. The instrument is simple to operate and fast to learn, opening up the use of particle and material analysis to a wider group of users in-house. In addition to eliminating the need to outsource, the Phenom ParticleX Battery Desktop SEM's ease-of-use and automation allow you to offload sample analysis from other SEMs in your laboratory.

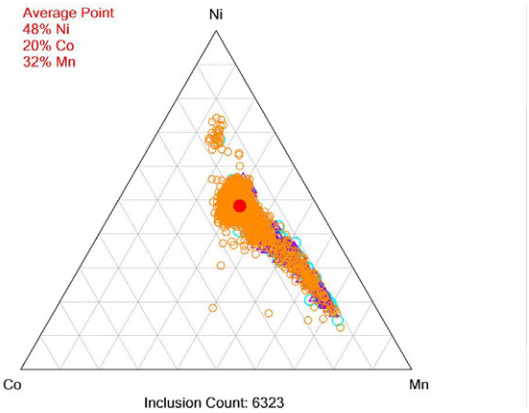


ParticleX User interface with line scan threshold.

The NCM powder (nickel, cobalt, manganese or Ni-Co-Mn) is a very important ingredient for batteries. The most common ratio is 8:1:1 (8 parts Ni, 1 part Co, and 1 part Mn). The particle size and exact chemistry of the powder influence the final battery performance, but even more important are the contaminations in the powder, as a single metal particle can have disastrous results in the battery. Finding these contaminations and classifying them is like trying to find a needle in a haystack.

Automated SEM EDS analysis helps with this challenge. When the thresholds are set high, it will quickly find only the contaminant and report the chemistry and size of the particles. But if the makeup of the general powder is of interest, it can also be done by analyzing many NCM particles automatically.

Thanks to the recipes used in the Phenom ParticleX Battery Desktop SEM's software, the analysis can be completely standardized, with the highest repeatability in the market. This standardization and repeatability are important, but just as important is that the software allows for customization. Not all batteries are the same, not all ingredients are the same, and not all manufacturers use the same process, so the software can be adapted individually to fit each case.



Ni-Co-Mn ternary diagram with the particle population showing a large spread in Mn-Ni ratio.

Features

Conductance classifications: Each particle class can be labeled with a conductance of the particles, allowing for appropriate sorting. This also allows you to asses the impact of contamination much more accurately since a small organic contamination is not as severe as a metallic conductive contamination.

Ternary diagram: To view the overall chemistry of the particle population, a ternary diagram can be generated where all particles are represented. With Ni, Co, and Mn on each axis, the outyears and general trends can be seen instantly.

General usage

The Phenom ParticleX Battery Desktop SEM features a chamber that includes an accurate and fast motorized stage that allows analysis of samples of up to 100x100 mm. In spite of this larger sample size, a proprietary loading shuttle keeps the vent/load cycle to an industry-leading sample loading time of 40 seconds or less. In practice, this improves the throughput factors more so than other SEM systems.

The user interface is based on the proven ease-of-use technology applied in the successful line of Phenom desktop SEMs. The interface enables both existing and new users to quickly become familiar with the system with a minimum of training.

The standard detector in the Phenom ParticleX Battery Desktop SEM is a four-segment backscattered electron detector (BSD) that yields sharp images and provides chemical contrast information. It works together with a fully integrated energy dispersive X-ray (EDX) system that allows you to obtain detailed chemical composition of your samples from a micro volume via spot analysis. Elemental distribution can be visualized with the elemental mapping option. A secondary electron detector (SED) for surface-sensitive imaging is optional.

Elemental Mapping and Line Scan

It is simply one click and go to work with the Elemental Mapping and Line Scan functionality of the Phenom ParticleX Battery Desktop SEM. The Elemental Mapping functionality visualizes the distribution of elements throughout the sample. The selected elements can be mapped at a user-specified pixel resolution and acquisition time. The real-time mapping algorithm shows live buildup of the selected elements. The Line Scan functionality shows the quantified element distribution in a line plot. This is especially useful for coatings, paints, and other applications with multiple layers for analyzing edges, coatings, cross sections, and others. Results of both the Elemental Mapping and Line Scan functionality can be easily exported by using an automated report template.

Secondary electron detector

A secondary electron detector (SED) is optionally available on the Phenom ParticleX Battery Desktop SEM. The SED collects low-energy electrons from the top surface layer of the sample. It is therefore the perfect choice to reveal detailed sample surface information. The SED can be of great use for applications where topography and morphology are important, which is often the case when studying microstructures, fibers, or particles.

Imaging Specifications	
Imaging modes	
Light optical	Magnification range: 3–16x
Electron optical	• Magnification range: 80–100.000x • Digital zoom max. 12x
Illumination	
Light optical	Bright field / dark field modes
Electron optical	• Long lifetime thermionic source (CeB^6) • Multiple beam currents
Acceleration voltages - Phenom UI	• Default: 5 kV, 10 kV and 15 kV • Advanced mode: adjustable range between 4.8 kV and 20.5 kV imaging and analysis mode
Vacuum levels	Low - medium - high
Resolution	<14 nm
Acceleration voltages Technical cleanliness EDX analysis	15 kV
Detector	
Standard	• Backscattered electron detector • Energy Dispersive Spectroscopy detector
Optional	Secondary electron detector
Digital image detection	
Light optical	Proprietary high resolution color navigation camera, single shot
Electron optical	High sensitivity backscattered electron detector (compositional and topographical modes)
Image formats	
JPEG, TIFF, BMP	
Image resolution options	
456 x 456, 684 x 684, 1024 x 1024 and 2048 x 2048 pixels	
Data storage	
USB flash drive, Network, Workstation	
Sample stage	
Computer-controlled motorized X and Y	
Sample size	
• Max. 100 mm x 100 mm (up to 36 x 12 mm pin stubs) • Max. 65 mm (h)	
Scan area	
• 50 mm x 50 mm • 100 mm x 100 mm (optional)	
Sample loading time	
light optical	<5 s
Electron optical	<40 s

EDX Specification

Hardware

Detector type	• Silicon Drift Detector (SDD) • Thermoelectrically cooled (LN_2 free)
Detector active area	• 25 mm^2
X-ray window	Ultra thin Silicon Nitride (Si 3 N4) window allowing detection of elements B to Am
Energy resolution	• Mn Kα ≤132 eV
Processing capabilities	Multi-channel analyzer with 2048 channels at 10 eV/ch
Max, input count rate	300,000 cps
Hardware integration	Fully embedded

Software

- Integrated column and stage control
- Auto-peak ID
- Iterative strip peak deconvolution
- Confidence of analysis indicator
- Export functions: CSV, JPG, TIFF, ELID, EMSA

Report

Docx format

Elemental Mapping & Line Scan Specifications

Elemental Mapping

Element selection	10 individual user specified maps, plus backscatter image and mix-image

Backscatter image and mix-range

Selected area	Any size, rectangular
Mapping resolution range	16 x 16–1024 x 1024 pixels
Pixel dwell time range	1–250 ms

Line scan

Line scan resolution range	16-512 pixels
Points dwell time range	50–250 ms
Total number of lines	12

Report

Docx format

SED Specifications

Detector type

Everhart Thornley

System specifications

Dimensions & weight

Imaging module	316(w) x 587(d) x 625(h) mm, 75 kg
Diaphragm vacuum pump	145(w) x 220(d) x 213(h) mm, 4.5 kg
Power supply	156(w) x 300(d) x 74(h) mm, 3 kg
Monitor	531.5(w) x 515.4(h) x 250(d) mm, 6.7 kg
Workstation	169(w) x 456(d) x 432(h) mm, 15 kg

Requirements

Ambient conditions

Temperature	15°C ~ 30°C (59°F ~ 86°F)
Humidity	<80% RH
Power	Single phase AC 110 - 240 Volt, 50/60 Hz, 300 W (max.)

Recommended table size

150 x 75 cm, load rating of 150 kg

Workstation Specifications

- HP-PC Tower PC
- CPU Intel Xeon E5-1620
- RAM 16 GB
- SSD 2 x 1TB
- USB Keyboard; USB Mouse
- Microsoft Windows ® 10 Enterprise Edition (64-bit)
- ParticleX Software pre-installed, full license code included
- ProSuite Framework pre-installed, full license code included- Automated Image Mapping- Remote UI

Learn more at **thermofisher.com/phenom-particle-x-tc**