

Cipher System

Model 475

Introducing Cipher® – The first and only system that quantitatively reveals the distribution of lithium in scanning electron microscopes and dual beam instruments. Using the groundbreaking lithium by composition by difference method (Li-CDM), Cipher determines the lithium content in metallic alloys, compounds, and complex metal oxides down to single-digit weight percentages accelerating the development of renewable energy materials and aerospace alloys.

Benefits

- Reveals the previously unobservable distribution of lithium at the microscale in a wide variety of materials
- Determines the charge state of oxide particles used as cathodes in lithium-ion batteries, such as lithium nickel manganese cobalt oxide (NMC) and lithium iron phosphate (LFP)
- Delivers quantitative analysis of lithium with a greater than ten-fold improvement in the minimum detection limit

Cipher provides unprecedented power to analyze all of the elements of the periodic table, including those low atomic number elements that were impossible to analyze previously.

Cipher uses the OnPoint™, the benchmark for backscattered electron (BSE) detection, enabling you to acquire higher-quality images that deliver unprecedented sensitivity, accuracy, and dynamic range to better understand complex materials.

With the highest BSE collection efficiency (50 – 80%) available, be confident in your ability to detect low-Z elements and discriminate the slightest variations in alloy or compound compositions.

Combined with the DigiScan™ 3 system, the OnPoint detector affords outstanding Z-number accuracy and resolution with the lowest dark noise and highest dynamic range (up to pm4-byte bit-depth), enabling variation in lithium content smaller than a couple of atomic percents to be determined.

Coupled with the EDAX Octane Elect Super or EDAX Octane Elite Super energy dispersive (x-ray) spectrometer (EDS) system, you can accelerate the delivery of outstanding EDS results for light and heavy elements to fast-track your microanalysis. Rapidly supplying accurate answers to your microanalysis challenges, the Octane Elect Super or Octane Elite Super EDS detectors allow Li-CDM measurements in minutes.

Connected by a single DigitalMicrograph® module, Cipher streamlines the Li-CDM workflow providing a turnkey solution for data collection, registration, and analysis of quantitative BSE and EDS data. Sharing the same analytical engine between

With DigitalMicrograph and EDAX APEX™ Advanced EDS, you are able to achieve outstanding microanalysis accuracy and reliability across the periodic table, enabling accurate and reliable lithium analysis in minutes rather than hours, days, or even weeks.

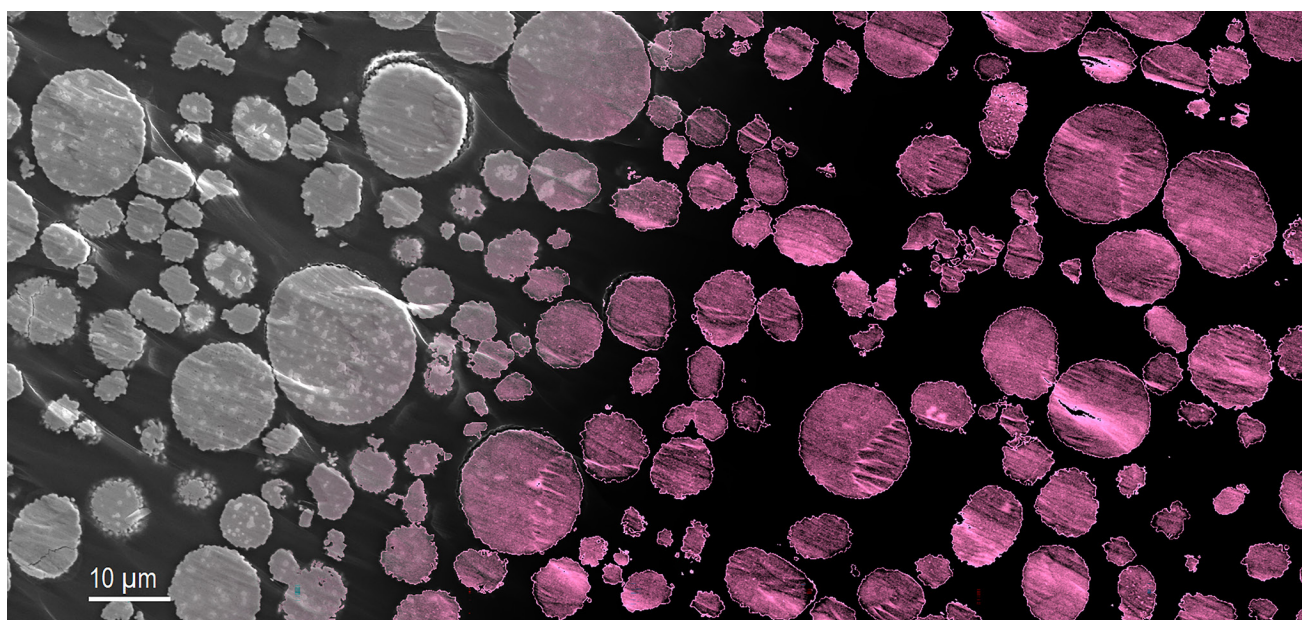


Figure 1. Cipher analysis of a lithium nickel manganese cobalt oxide (NMC) powder showing faded overlay of secondary electron image (gray scale, left) and lithium concentration (pink scale, right). Sample was embedded in epoxy and cross-sectioned using a PECS II system before analysis. Mean lithium content determined as 23.9 at. % (cf nominal value 25.0 at. %).

Specifications

OnPoint qBSE detector	
Operating range	<0.8 – 30 kV
Dark noise	<0.2%
Geometry	On-axis, concentric
Z reference block	Five materials in one block Z = 6 – 60
Images in calibrated Z	Included
Working distance	<3 – 30 mm
Insertion repeatability	50 µm

DigiScan 3 system	
Scan control	External scan input to SEM is required.
Image size	User-specified pixel density Max. 32k x 32k pixels (W x H)
Minimum pixel time	50 ns
Image options	Up to 20 configurable synchronous inputs

	EDAX Octane Elect Super	EDAX Octane Elite Super
Chip size	70 mm ²	
Energy resolution per ISO 15632:2012	127 eV	125 eV (123 eV optional)
Detection range	Al L (73 eV) – Am	
Throughput	>700 kcps	>850 kcps
Slide	Manual	Motorized
Shutter	Optional	
Data collection	DigitalMicrograph, spectrum imaging*	
Spectral analysis	Standardless eZAF corrected quantitative analysis with computed physical background	
Mapping	Region of interest and atomic or weight percent	

Cipher software module	
Composition by difference analysis	Supports Z = 1, 2, and 3
Data collection	Multipoint, linescan, or 2D array
Data registration	Yes

Specifications are subject to change without notice.

*APEX advanced EDS software also supplied

Research areas

- Material science
- Lithium-ion battery research and development
- Lightweight structural alloys

Ordering

Model	Description
475.127.70	Cipher System (EDAX Octane Elect Super)
475.125.70	Cipher System (EDAX Octane Elite Super)
475.123.70	Cipher System (EDAX Octane Elite Super HR)
475.UqBSE	Cipher Upgrade to Compatible EDS Detector
470.U1	High-speed EDS Kit, SEM. Suitable for selected EDAX detectors only
888S	DigiScan 3 System

Other products to consider

- PECS II Instrument (ProTransfer)
- EDAX Velocity™ Ultra

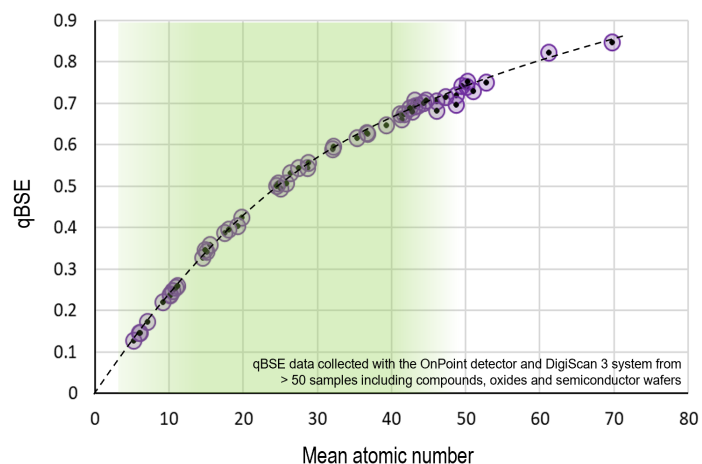


Figure 2. The Cipher system enables the analysis of the widest range of samples. By collecting qBSE data of the highest signal-to-noise ratio and widest dynamic range, Cipher provides reliable data from atomic numbers <5 – 40.

