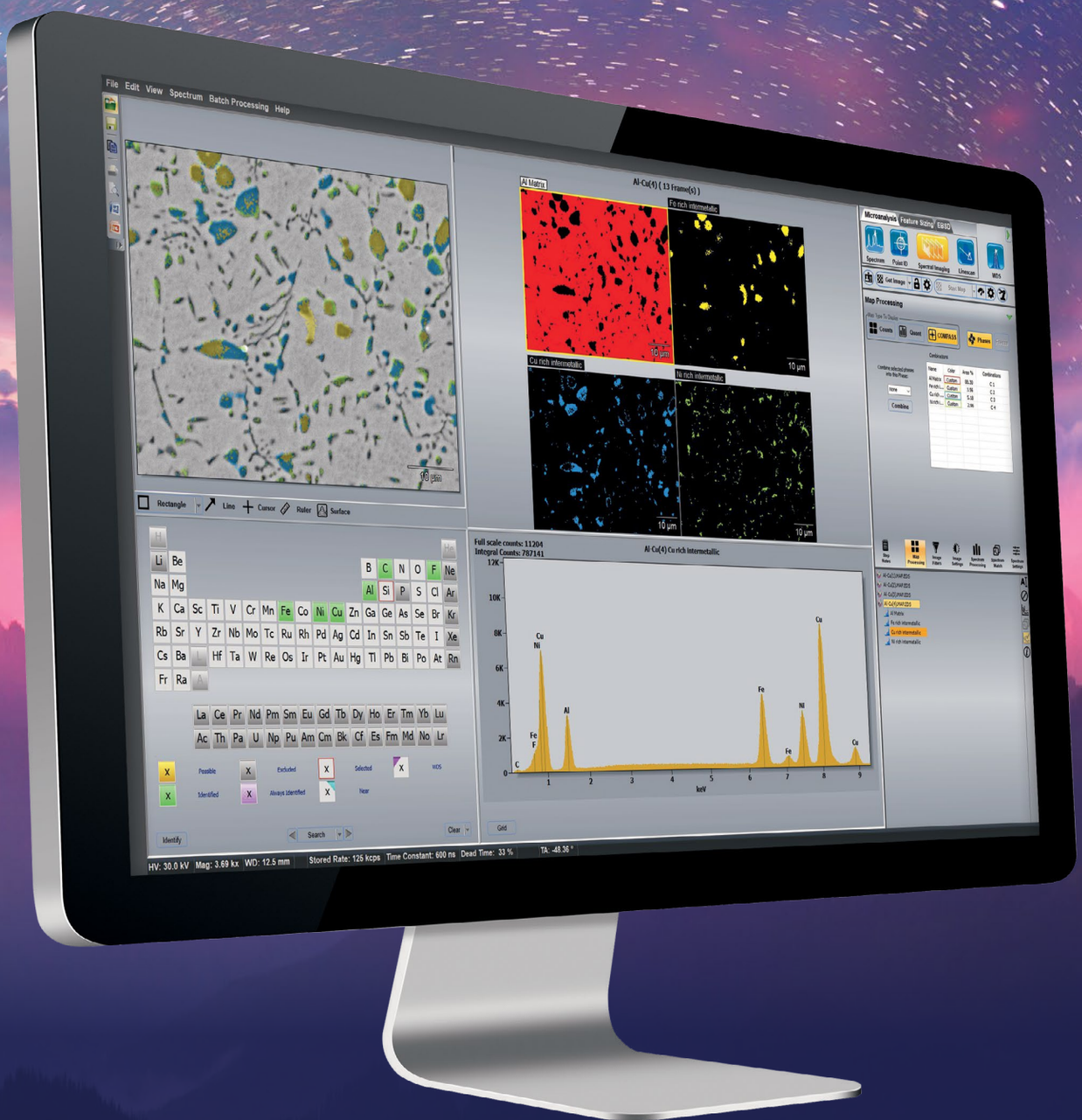
thermoscientific

X-ray Microanalysis Family

EDS | WDS | EBSD



ThermoFisher SCIENTIFIC

Pathfinder X-ray Microanalysis System

Built for speed, built for answers

Accelerate your electron microscope analysis with advanced microanalysis software that rapidly presents the elements and chemical phases within your sample. The Pathfinder microanalysis system presents a true 21st-century user interface. Routine setup tasks are automated to deliver accurate results for most samples, while still offering access to an additional level of fine control for expert users measuring challenging samples.

Pathfinder Software

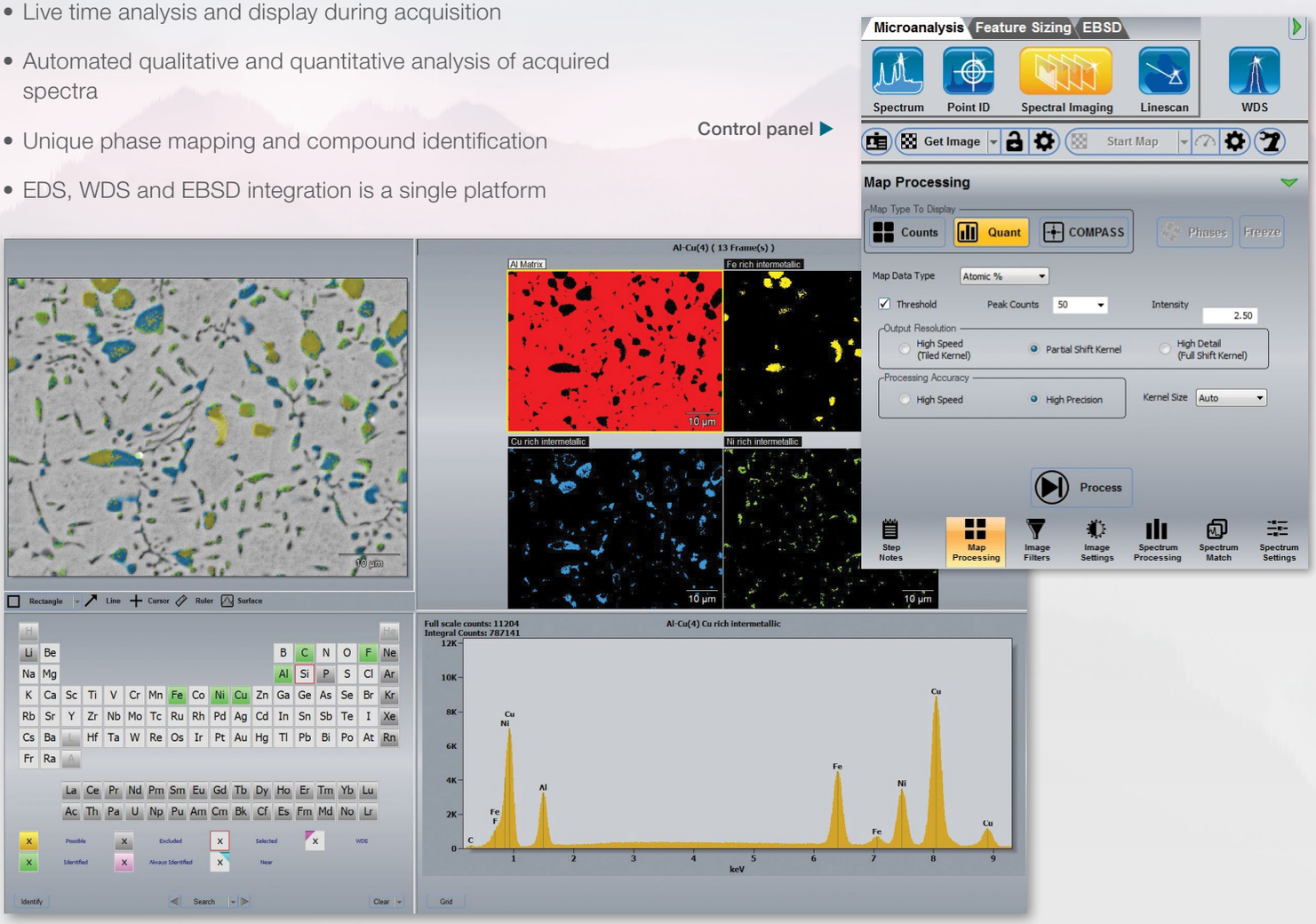
Work efficiently with a responsive Control Panel that presents only what you need to use at any given time. This easy-to-navigate panel lets you efficiently manage how data is processed and presented. As you change steps in the analysis, the interface changes with you—seamlessly.

- X-ray data collection modes: Spectrum-only, Point ID, Linescan and Spectral Imaging
- Live time analysis and display during acquisition
- Automated qualitative and quantitative analysis of acquired spectra
- Unique phase mapping and compound identification
- EDS, WDS and EBSD integration is a single platform

Pathfinder Analyzer

Your engine to X-ray microanalysis

- A real-time operating system controls pulse processors and digital imaging
- Live spectral images with quantitative deconvoluted x-ray maps
- Dedicated electronics architecture controlling up to two digital pulse processors, WDS and EBSD detectors
- Automatic selection of pulse processor settings based on the microscope and detector performance
- Spectral Imaging data at dwell times down to 10 microseconds, minimizing damage to beam sensitive samples
- Digital imaging scan dwell times down to 1 microsecond per pixel

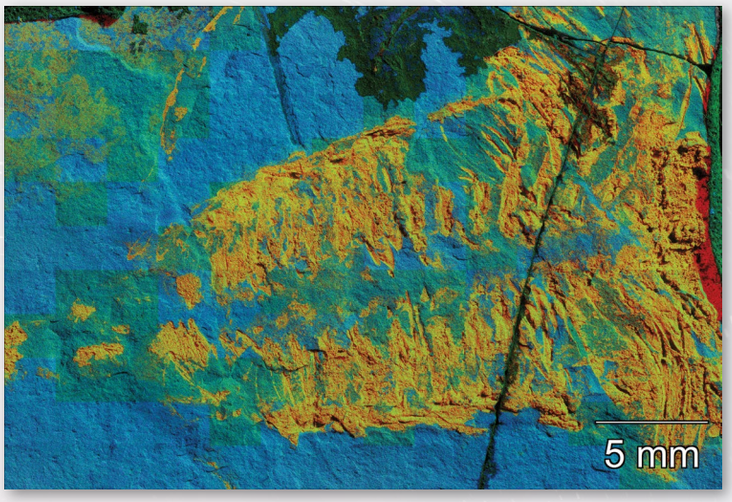


Direct-to-Phase analysis of multiple intermetallic regions within a heat treated aluminum-bronze alloy using the COMPASS multivariate statistical analysis algorithm, acquired in under 1 minute.

Take your data anywhere with an unlimited off-line site license

Revolutionary phase mapping

Pathfinder automatically sorts spectral data into statistically unique phases. Direct-to-Phase combines COMPASS multivariate statistical analysis and Phase Analysis with Spectral Match to classify phases based on known material compositions. This is the fastest, most comprehensive method of developing chemical images from your electron microscope. Unlike other EDS systems, Pathfinder requires zero user input, eliminating guesswork and assumptions about the material's chemistry.



A large area elemental distribution map montage of a notostacan fossil (sample courtesy of Western Illinois University). Three net counts X-ray maps are merged into a single image with an Fe map in the red channel, an O map in the green channel, and a Si map in the green channel. The maps indicate that the fossil material is rich in Fe and O relative to the matrix.

Engineered for fast, reliable answers

Pathfinder analysis uses advanced, real-time routines for precise and accurate elemental quantification. Automatic X-ray peak identification with either standardless or standards-based elemental quantification produces fast and reliable results. Intelligent background removal combined with robust peak deconvolution results in correct peak intensity calculations—even for the most challenging element overlap problems. Pathfinder offers a choice of PROZA Phi-Rho-Z, ZAF and Cliff Lorrimer matrix correction algorithms, providing accurate quantification results for all microscope types. Our exclusive SpectraCheck tool simulates synthetic spectral overlays based on the exact system configuration, providing the analyst with complete confidence that the data interpretation is correct.

Advanced features

- Analysis Automation controls the microscope stage for unattended points, areas and linescan acquisitions
- Montage analysis combines automation with phase mapping
- X-ray image filters give you the best visual representation of your sample without changing its underlying data
- Batch analysis of montage data including quantitative maps and COMPASS phase maps

Thermo Scientific™ Pathfinder X-ray Microanalysis System

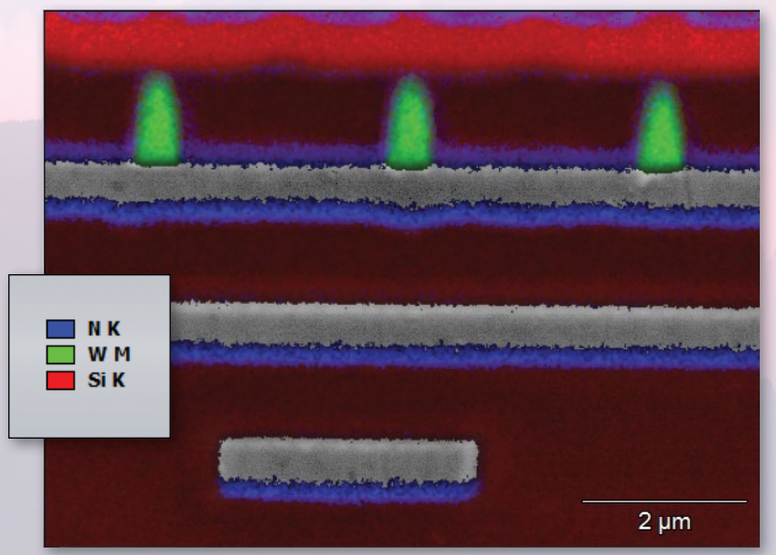
UltraDry EDS Detector

Unparalleled data collection

Team up with the Pathfinder X-ray microanalysis system for unparalleled X-ray collection and sensitivity. With a range of active areas and a small packaging envelope, the UltraDry silicon drift detector complements the Pathfinder system's ultra-fast live-time data analysis. Choose the right detector for your application and budget – 10 mm^2, 30 mm^2, 60 mm^2, 100 mm^2.

Built for speed and sensitivity

- An on-chip field-effect transistor (FET) and a proprietary preamplifier for extraordinary operating space
- Electronic noise virtually eliminated
- Handles pulse pile-up and sum peaks for minimal dead time and maximum resolution
- Designed for light-element sensitivity and low kV analysis
- Works hand-in-hand with Pathfinder processing algorithms for best possible results



Quantitative map of a semiconductor cross section showing Si, W and nitride layers.

Working hand-in-hand with the Pathfinder system

The UltraDry detector uses thin window or windowless technologies and eliminates the use of inert gas for superior low energy detection. For mapping applications, the UltraDry detector's fast electronics and low capacitance minimize the degradation in energy resolution that occurs at count rates of a few hundred thousand per second. High-resolution spectra alone are not enough to deliver accurate elemental identification and quantification. Pathfinder software combines decades of experience and empirical data on peak shapes with sophisticated peak deconvolution and quantitative algorithms to deliver accurate mapping and elemental analysis data.

UltraDry specifications

- FWHM measured (ISO 15632) at 5.89keV (Mn-Kα) with 10,000 counts per second stored in the spectra, measured on the electron microscope
- Input count rates >1,000,000 counts per second
- Light element sensitivity down to beryllium
- Vertically slotted collimator to enable maximum WD range essential for dual EDS/EBSD acquisition mode.
- ±5 eV resolution change (±3eV typical between 1% and 60% dead time) from minimum to maximum count rate at a given analyzer time constant
- ±5eV peak shift (±3eV typical between 1% and 60% deadtime) from minimum to maximum count rate at a given analyzer time constant

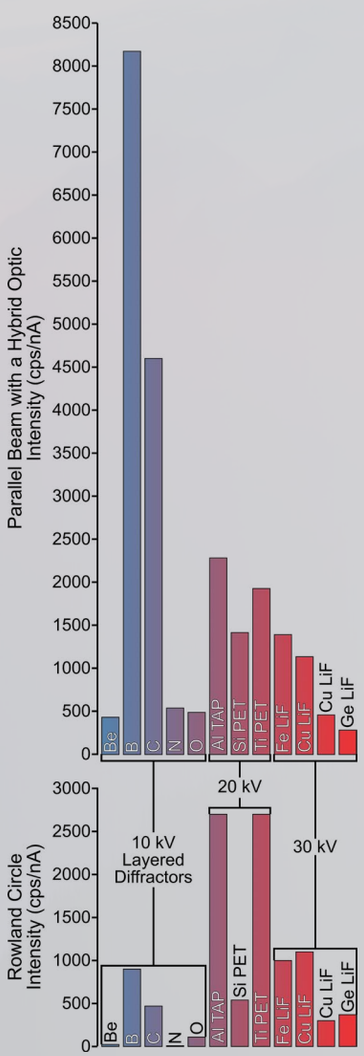
Thermo Scientific UltraDry EDS Detector

MagnaRay Parallel Beam Wavelength Dispersive Spectrometer

Complementing SEM/EDS analysis

When to use WDS

- Identification of elements unresolved by EDS
- Elimination of false positives in X-ray mapping
- Low voltage, low energy microscopy
- Finding trace elements
- K-line and M-line interference (e.g., S-Mo-Pb)
- L-line and K-line interference (e.g., Ba-Ti)
- Z+1 interference (e.g., Ti-V)



Expected intensities from a hybrid optic parallel beam WDS spectrometer (top) and a Rowland circle WDS spectrometer (bottom). Be, B, C, N, and O intensities were measured using layered diffractors with a 10 kV accelerating voltage.

Integrated with the Thermo Scientific™ Pathfinder X-ray Microanalysis System, the Thermo Scientific™ MagnaRay™ Parallel Beam Wavelength Dispersive Spectrometer determines the elements to analyze and performs all of the WDS operations. While the EDS detector collects all X-ray energies across a spectrum, WDS uses crystals to tune to specific collection energies by wavelength.

Thermo Scientific MagnaRay Parallel Beam Wavelength Dispersive Spectrometer

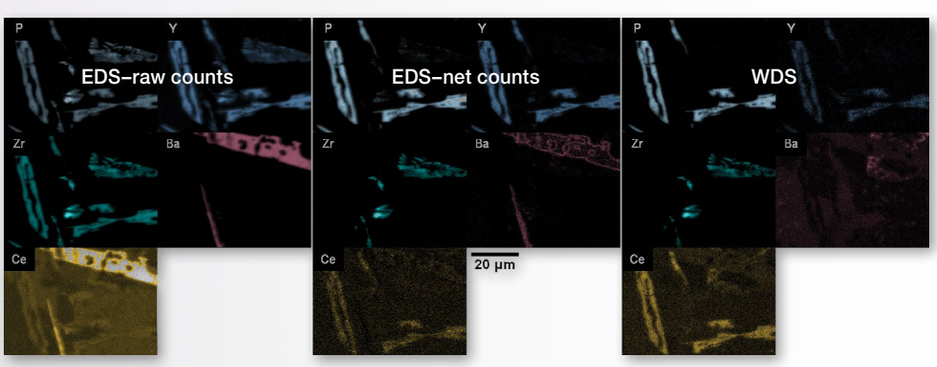
Parallel Beam WDS

Unlike like older WDS technology parallel beam WDS uses grazing incident and polycapillary optics to optimally focus X-rays for greater sensitivity and mitigates the use of high-energy, high-current microscopy. A built-in expert system manages spectrometer operations, saving valuable time and work. The result is WDS operation with EDS ease-of-use.

WDS and EDS – Working together in the SEM

WDS offers significant resolution improvements with peak overlaps virtually eliminated. Peak-to-background sensitivity enhances trace element detection. Parallel Beam WDS increases intensity in the low energy spectral region, where most overlaps occur.

WDS is typically operated by driving the crystal directly to the peak, and counting time is devoted only to the points of real interest. For minor elements, WDS then becomes fast relative to EDS, in which most counted X-rays will originate from the major elements. Parallel Beam WDS empowers the SEM user to do quantitative analysis with the same rigor and accuracy achieved by electron-probe microanalysis.



Elemental distribution maps acquired from a lunar meteorite. There are several phases in the mapped area that contain elements that have severe X-ray interferences (peak overlaps). For example, P Kα, Y Lα, and Zr Lα have strong peak overlaps with EDS. Ti Kα, Ba Lβ, and Ce Lα have strong peak overlaps with EDS. EDS net counts maps and quantitative maps use the background removal and peak deconvolution algorithms used for EDS quantitative analysis and apply them to the spectrum at every pixel in EDS spectral images. In so doing, X-ray interferences can be solved. For example, in the EDS–Raw Counts maps, P, Y, and Zr appear to be in the same phase, and Ba and Ce appear to be in the same phase. However, EDS – Net Counts maps show that P, Y, and Ce occur in the same phase. The WDS maps, which rely on the significantly better spectral resolution of WDS, for P, Y, Zr, and Ce are very similar to the EDS – Net counts maps. However, WDS indicates Ba occurs in a different phase than in the EDS maps.

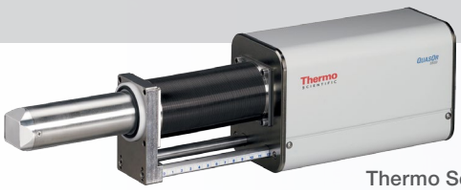
Electron Backscatter Diffraction Detectors

When to use EBSD

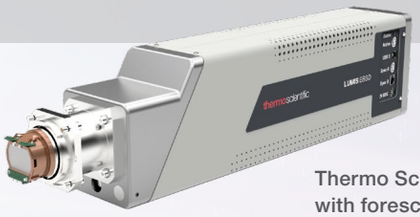
- Understanding grain properties in metals (size, morphology, distribution)
- Grain boundary analysis
- Crystallographic texture analysis
- Phase identification
- Strain/deformation analysis

Electron backscatter diffraction (EBSD) compliments both EDS and WDS and is used to characterize the structure of materials. EBSD is used to solve problems across a wide range of applications, including materials science, earth science and microelectronics. EBSD datasets are extremely rich, providing a wealth of structural information, such as grain morphology, grain boundary properties, macro- and micro-texture analysis and phase identification.

Thermo Scientific EBSD portfolio has two high-performance CMOS detectors, Quasor II and Lumis, seamlessly integrated into Pathfinder for a powerful, intuitive and fast user experience.



Thermo Scientific Quasor II EBSD detector



Thermo Scientific Lumis EBSD detector with forescatter detector

Quasor II

High productivity SEM-EBSD

Designed to speed up productivity with clear images, fast collection rates, and accurate indexing of electron backscatter diffraction patterns, the Thermo Scientific™ Quasor™ II EBSD detector is the ideal tool for analysts looking to increase throughput in their SEM lab and gain a richer understanding of the materials that they study.

Develop SEM-based methods for quality control and failure analysis:

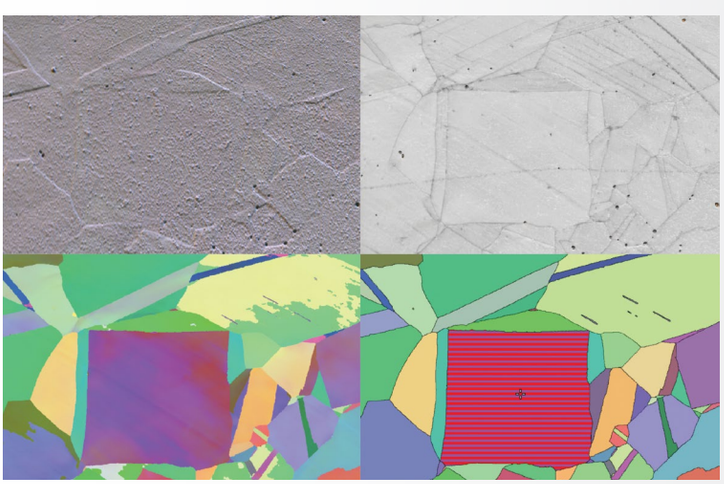
- Perform phase identification and transformation analysis following heating and cooling
- Identify phases and size grains
- Monitor heat affected zones after welding
- Run predictive fracture analysis in metals
- Validate additive manufacturing processes

Lumis

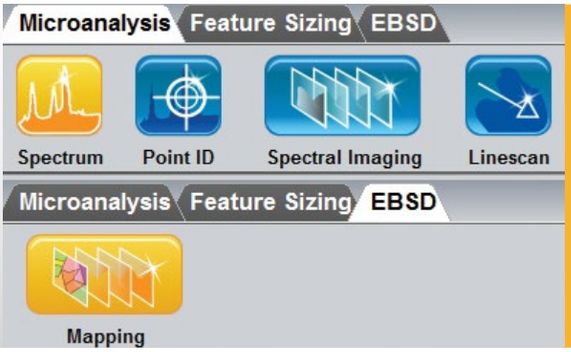
Resolution, Sensitivity and Speed for EBSD

Incorporating advanced CMOS sensor technology, optics and indexing algorithms, the Thermo Scientific™ Lumis™ EBSD detector enables the ultra-fast analysis of high-resolution backscatter diffraction patterns with sensitivity down at ultralow beam currents.

- Ultimate EBSD detector for beam sensitive or dose-restricted materials, or situations where higher probe current may introduce contamination or sample drift
- CMOS sensors provide exceptional sensitivity at high frame rates, increased quantum efficiency and improved noise management
- Indexing algorithms generate over 1000 backscatter diffraction patterns per second
- Reverse zoom optics create optimal EBSD images with high-efficiency light transfer
- Custom optical assembly combined with a large format sensor for the highest resolution EBSD analysis
- Integrated 5 diode forescatter assembly for rapid color identification of features of interest

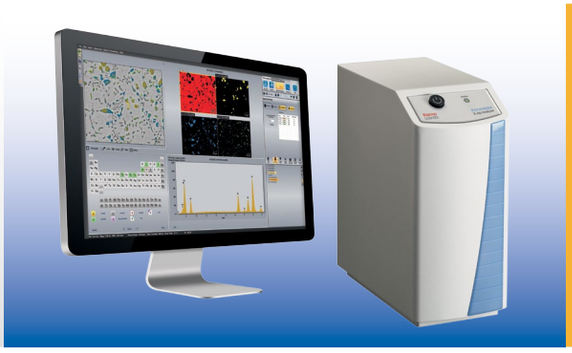


Top Left: The Concurrent Forescatter, Top Right: Pattern Quality, Bottom Left: Euler Orientation and Bottom Right: Flood Fill Grain Reconstruction maps for 316L Stainless Steel. The maps show local changes in orientation due to the presence of deformation and FCC twinning.



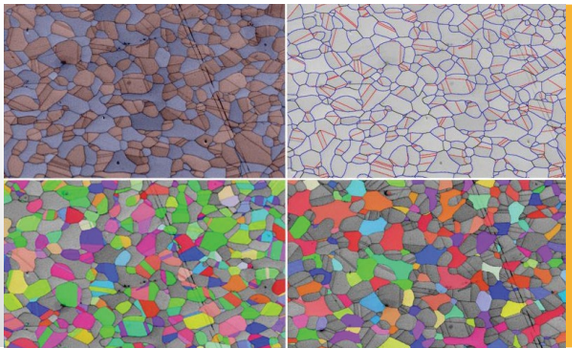
Pathfinder Microanalysis Software

- EDS, WDS and EBSD all in one system all with the same software
- All the tools you need, when you need them
- Unique Direct-to-Phase analysis



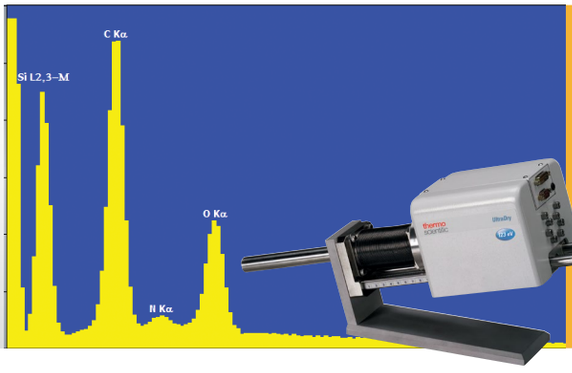
Pathfinder Analyzer

- Intelligent X-ray pulse processing for high resolution spectra at high throughputs
- Advanced noise immunity technology for high sensitivity analysis and trace element detection
- Adaptive drift correction for robust data collection over longer acquisition periods
- Automatically adapts to changes in KV and beam current to provide optimum acquisition parameters



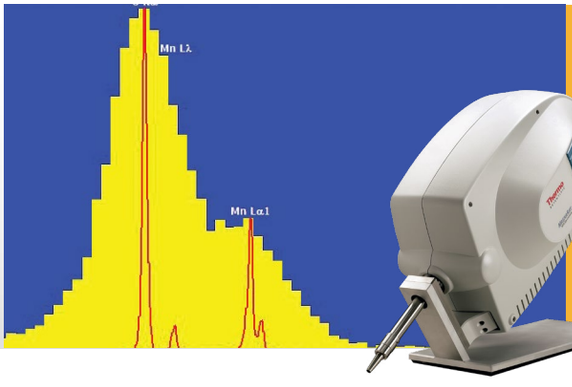
Lumis and Quasor II EBSD

- Crystallographic and microstructural information for materials science, geological science and advanced device design
- High-sensitivity, high-resolution analysis from CMOS sensor
- Collection rates up to 1000 frames per second with > 99% pixels indexed
- Full suite of data processing software including grain sizing, boundary characterization, texture analysis and phase identification



UltraDry EDS Detector

- Built for speed and sensitivity
- Thin window and windowless technologies
- Drives ultra-fast live-time Pathfinder analysis
- Crystal sizes: 10mm², 30mm², 60mm², 100mm²



MagnaRay WDS Detector

- Proprietary hybrid optical system
- Ultimate SEM/WDS speed and sensitivity
- Concurrent EDS and WDS operation
- Resolve overlapping peak and trace element problems

Find out more at **thermofisher.com/pathfinder**

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