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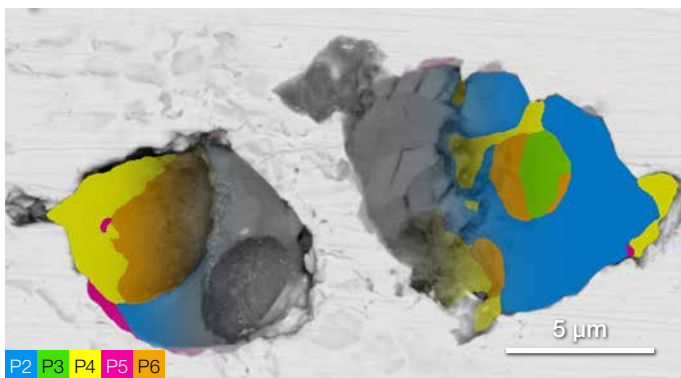
Apreo ChemiSEM System
High-performance imaging with integrated chemical analysis and structural characterization

The Thermo Scientific™ Apreo ChemiSEM™ System is the go-to choice for high-performance and high-quality imaging. Built around an automated workflow that combines elemental composition with structural analysis, it makes high-quality data easily accessible to everyone.

The Apreo ChemiSEM System supports high-volume research facilities and industrial environments with fully integrated analytics and comprehensive results for every sample and every level of experience. For multi-purpose labs with a wide variety of users and sample types, the system's new Smart Frame Integration (SFI), autofocus, and autostigmation functions eliminate manual alignments by automatically optimizing image acquisition settings and acquiring data. The system is always aligned and ready for imaging, giving you more time to focus on getting the data you need.

Key features

High-resolution imaging performance: The Thermo Scientific™ Trinity™ Detection System and automation streamline data collection for a variety of applications

Optimized analytical solutions: The TrueSightPro Detector, ChemiSEM Technology, and TruePix EBSD Detector deliver full characterization of your sample

Comprehensive workflows: MAPS Software, custom scripting, and CleanConnect™ compatibility give you full control over your analysis

The Apreo ChemiSEM System features three advancements that help simplify operation and ensure reliable results: Thermo Scientific™ ChemiSEM™ Technology, the new TruePix Electron Backscatter Diffraction (EBSD) Detector, and the unique Thermo Scientific™ Trinity™ In-Column Detection System.

Phase analysis of complex inclusions in steel using ChemiPhase. ChemiPhase efficiently identifies various inclusions along with their composition and area fraction. It also easily detects unexpected materials, extracting a comprehensive set of information in a single analysis.

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ChemiSEM Technology uses a fully automated live quantification algorithm to highlight features that would have been unnoticed with imaging alone and provide more complete information about your samples. It's always on and easy to use, providing faster results and helping to remove user bias.

The TruePix EBSD Detector expands what you can do with the Apreo ChemiSEM System. It's controlled with our new dedicated EBSD software, which guides you through everything from defining settings to collecting and processing results.

And the Trinity In-Column Detection System improves performance by simultaneously acquiring topographical, surface, and compositional information without the need for additional ETD or BSD detectors.
It offers unique options for signal filtering and delivers an ultimate resolution of 0.9 nm at 1 kV without additional beam deceleration.

By integrating high-resolution imaging with elemental and structural analysis, the Apreo ChemiSEM System offers powerful tools to help you address a wide range of materials.

Electron optics

- High-resolution field emission SEM column with:

  – High-stability Schottky field emission gun to provide stable high-resolution analytical currents

  – Compound final lens with a combined electrostatic, field-free magnetic, and immersion magnetic objective lens (optional)

  – 60° objective lens geometry that allows tilting of larger samples

  – Automated, heated apertures to ensure cleanliness and touch-free aperture changes

- SmartAlign Technology: user-alignment-free technology

- Through-the-lens differential pumping for low vacuum (optional) reduces beam skirting for the most accurate analysis and highest resolution

- Beam deceleration with stage bias from –4,000 V to +600 V

- Continuous beam current control and optimized aperture angle

- Double stage scanning deflection

- Easy gun installation and maintenance: auto bake-out, auto start, no mechanical alignments

- PivotBeam Mode for selected area electron channeling, also known as "rocking beam" mode (Apreo ChemiSEM S model only)

- Expected source lifetime of more than 36 months

Electron beam resolution

	Apreo ChemiSEM System	Apreo ChemiSEM S System
High vacuum		
30 kV (S/TEM)	0.7 nm	0.7 nm
15 kV (BD)	0.9 nm	0.5 nm
15 kV (6.4 nA, WD 10 mm)		1.9 nm
1 kV	1.2 nm	0.9 nm
1 kV (BD)	1.0 nm	0.8 nm
1 k (BD, WD 10 mm)		1.0 nm
Low vacuum (optional)		
3 kV (80 Pa)	1.8 nm	1.8 nm
15 kV (80 Pa)	1.2 nm	1.2 nm

BD: Beam deceleration mode. WD: Working distance. Resolutions are at optimum working distance unless otherwise specified. By default, upon final installation, the resolution is proven in the system's acceptance test at 1 kV and 30 kV in high vacuum and with immersion switched on, if applicable.
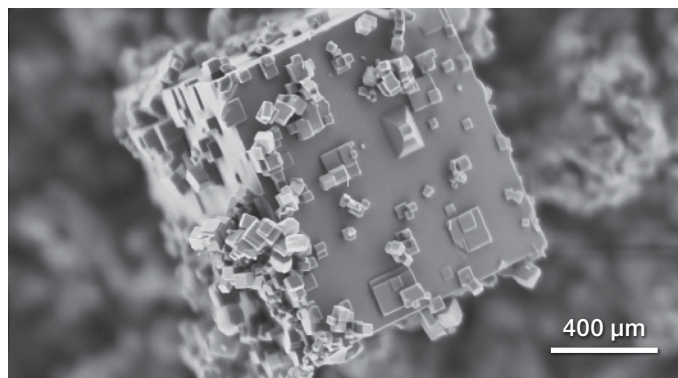
Electron beam parameter space

Beam current range: 1 pA to 50 nA (400 nA configuration also available)

- Accelerating voltage range: 200 V – 30 kV

- Landing energy range: 20 eV – 30 keV

- Max. horizontal field width: 3 mm at 10 mm WD (corresponds to 29x minimum magnification)

Chamber

- Inner width: 340 mm

- Analytical working distance: 10 mm

- Ports: 12

Low-kV characterization (500 V) of magnesium oxide particles using beam deceleration (BD). BD improves topographical details and reduces charging artifacts.

Detectors

The Apreo ChemiSEM System can detect up to four signals simultaneously from any combination of the available detectors or detector segments (optional):

- Trinity Detection System (in-lens and in-column)
  - T1 segmented lower in-lens detector
  - T2 upper in-lens detector
  - T3 in-column detector (optional)
- ETD: Everhart-Thornley SE detector
- DBS: Retractable segmented under-the-lens BSED (optional)
- CL: Cathodoluminescence Detector (optional)
- Low-vacuum SE detector (optional)
- DBS-GAD: Lens-mounted gaseous analytical BSED (optional)
- STEM 3+ Retractable segmented detector (BF, DF, HADF, HAADF) (optional)
- IR-CCD
- Thermo Scientific™ Nav-Cam™ Camera (chamber-mounted)

ChemiSEM Technology

- TrueSight; Detector size: 25 or 70 mm^2
- Up to 125 eV @ Mn Kα_1 spectral resolution
- Detection range Be-Am
- Light element sensitivity down to silicon (Si Lα)

Full integration of all SEM-EDS functions in a single user interface

- Project-based data storage
- Project data tree for easy data management
- Industry-standard data formats
- Dedicated analytical mode with seamless data blending between point, line, and mapping modes
- Choice of any electron image type available in the xT SEM user interface
- Single-click reporting
- Sum and escape peak removal
- Automatic peak identification
- Synthetic and background spectral overlays
- Accurate quantification over a wide range of working distances, beam currents, and beam energies
- User-definable selections for included, excluded, or absent elements

- Automatic or user-defined KLM line selection for quantitative analysis
- Background removal by digital filtering
- Standardless quantitative analysis using filtered least squared fitting
- Quantification using PROZA matrix correction for superior light element performance
- Qualitative and quantitative line scans with termination by time or statistics
- ChemiSEM Technology using electron image processing for accelerated quant mapping
- Always-on quantitative mapping with fully deconvolved X-ray maps
- Gross count mapping with per-element line selection
- Quantitative mapping using square kernelization (optional)
- Overlay of all map types onto the electron image
- User-definable or auto-generated elemental color selection
- Navigation montage to acquire and stitch multiple frames
- Compatible with MAPS software for advanced automation with tiling and stitching over multiple frames
- Spectral extractions using point and rectangle
- Line scan extract from X-ray maps with flexible line direction, width, and point selection
- Normalization for comparison of multiple spectra
- Drift compensation mapping based on DCFI
- Compound analysis of borides, carbides, oxides, and nitrides by stoichiometry
- ChemiPhase for live or offline phase determination using multi-variate statistical analysis
- ChemiView for optional offline reprocessing and report generation for all types of data

TruePix Standard Geometry EBSD System

- Hybrid pixelated direct electron detection EBSD system
- Single detector consisting of a single Timepix-based module
- Zero readout noise, high signal to background
- Zero distortion due to lens/ fiberoptic coupling or phosphor
- Single particle counting
- Energy thresholding
- 2000 FPS full frame read out
- Detector insertion, calibration, pattern optimization, and map set up automated in under one minute

EBSD acquisition and processing software

- Fully integrated online and offline data processing system

- Automated pattern optimization: System acquires >20 EBSPs from random points on the area to be mapped and finds the optimal calibration of background

- Maximum exposure determination: System determines maximum exposure before saturation, with automatic frame integration if exposure time exceeds maximum

- Automatic flatfielding and contrast enhancement (advanced calibration routines also available)

- Automated pattern center calibration for different camera insertion positions, working distance, and specimen tilt

- Blended overlay of any type of map

- Grain sizing histograms

- Noise removal and pixel enhancement

- Fully customizable templated reporting

- Indexing of all seven crystal systems and 11 Laue groups

- Simultaneous indexing of multiple phases

- Fast Fourier transform and band contrast pattern quality metrics

- Low SEM magnification pattern center correction

- Kinematic simulation of best fit and overlays onto the EBSP

- Euler, IPF X/Y/Z (rolling, normal, transverse), Euler orientation maps, phase selection, and misorientation mapping

Vacuum system

- Complete oil-free vacuum system

- 1 × 240 l/s TMP

- 1 × PVP-scroll

- 2 × IGP

- Chamber vacuum (high vacuum) $<6.3 \times 10^{-6}$ mbar (after 12 hours pumping)

- Evacuation time: ≤3.5 minutes

- Low-vacuum mode (10–500 Pa chamber pressure) (optional)

- Automatic pressure limiting aperture (PLA) loader

Sample holders

- Standard multi-purpose holder uniquely mounts directly onto the stage, hosts up to 18 standard stubs (12 mm diameter), three pre-tilted stubs, cross-section samples, and two pre-tilted row-bar holders (optional) (38° and 90°); no tools required to mount a sample

- Each optional row-bar accommodates six STEM grids

- Wafer and custom holders (optional)

Stage and sample

Type	Eucentric goniometer stage, 5*axis, motorized
XY	110 x 110 mm
Repeatability	<3.0 µm (@ 0° tilt)
Motorized Z	65 mm
Rotation	n × 360°
Tilt	−15° / +90°
Max. sample height	85 mm clearance to eucentric point
Max. sample weight	500 g in any stage position; up to 5 kg at 0° tilt
Max. sample size	122 mm diameter with full X and Y rotation (larger samples possible with limited stage travel or rotation)

The Apreo ChemiSEM System supports a variety of industrial applications, particularly those that require characterization of large and heavy materials. It simplifies preparation by eliminating the need to cut or reduce the size of samples.

System control

- 64-bit GUI with Windows 10, keyboard, optical mouse

- 24-inch LCD display, WUXGA 1920 × 1200 (second monitor optional)

- Customizable graphical user interface

- Auto-focus, auto-stigmation, and auto lens alignment functions

- Smart Frame Integration (automated setting of acquisition parameters)

- Image registration

- Navigation montage

- Undo and Redo functionality

- Joystick (optional)

- Knob board manual user interface (optional)

Image processor

- Dwell time ranges from 25 ns to 25 ms/pixel

- Up to 6144 × 4096 pixels

- File type: TIFF (8-, 16-, 24-bit), JPEG, or BMP

- Single-frame or 4-view image display

- SmartScan Mode (256-frame average or integration, line integration and averaging, interlaced scanning)

- DCFI (drift compensated frame integration) mode

- Digital image improvement and noise reduction filter

Accessories (optional)

- Sample and chamber cleaning: CryoCleaner, integrated plasma cleaner

- Thermo Scientific™ QuickLoader™ Load Lock for fast sample transfer

- CleanConnect Sample Transfer Device

Software options

- Maps Software for automated large-area acquisition using tiling and stitching

- Thermo Scientific™ AutoScript™ 4 Software: Python-based application programming interface

- TopoMaps for image colorization, image analysis, and 3D surface reconstruction

- Remote control software with RAPID (remote diagnostic support)

Documentation

- Interactive user guidance

- Operating instructions handbook

- Free access to online resources for owners

Warranty and training

- 1-year warranty

- Choice of service maintenance contracts

- Choice of operation and application training contracts

Installation requirements

(Refer to preinstall guide for detailed data)

- Power:

  - Voltage 100 – 240 V AC (–6%, +10%)

  - Frequency 50 or 60 Hz (±1%)

  - Consumption: <3.0 kVA for basic microscope

- Earth resistance <0.1 Ω

- Environment:

  - Temperature 20°C (±3°)

  - Relative humidity below 80%

  - Stray AC magnetic fields <40 nT asynchronous, <100 nT synchronous for line times, 20 ms (50 Hz mains), or 17 ms (60 Hz mains)

- Minimum door size: 0.9 m wide × 1.9 m high

- Weight: 980 kg (system console)

- Dry nitrogen recommended for venting

- Compressed air, 4 – 6 bar, clean, dry, and oil-free

- System chiller

- Acoustics: site survey required

- Floor vibrations: site survey required

- Active vibration isolation table (optional)

Consumables (partial list)

- Replacement Schottky electron source module
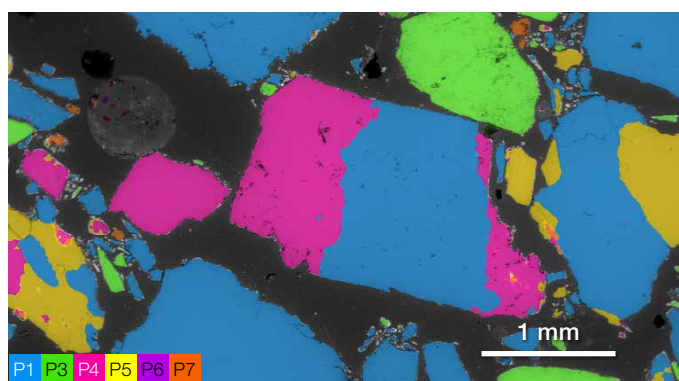
Phase analysis of cement. ChemiPhase efficiently quantified and mapped the distribution of all different phases in the analyzed area, enabling an assessment of cement quality and the identification of potential inhomogeneities.

Learn more at **thermofisher.com/apreo-chemisem**

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