thermo scientific

DATASHEET

Themis Z TEM

Uncompromised atomic characterization across the widest range of materials

Low damage, high sensitivity imaging and analysis of materials in 2D, 3D and 4D. Themis Z TEM delivers it all at the highest resolutions with a single objective lens configuration.

Easy and Fast Access to Atomic Information

The combination of proven technologies such as our spherical aberration (Cs) correctors, monochromator, piezo enhanced stage, CETA™ CMOS camera and sensitive Energy Dispersive Spectroscopy (EDS) detectors, delivers an ultra stable imaging and spectroscopic platform. By synchronizing these technologies through our advanced software and automation modules, the Thermo Scientific™ Themis Z transmission electron (TEM) microscope makes accessing atomic scale information more rapid, efficient, and repeatable than ever.

Widest Range of Materials Research at the Atomic Scale

With the combination of a wide gap objective lens (the Thermo Scientific Super Twin), superior optics and analytics, the Themis Z TEM delivers both performance and flexibility in one tool. The probe corrected Themis Z TEM, for example, delivers the highest (60 pm) STEM resolution as well as providing *in situ*, dynamic and 3D EDS and tomography imaging without the need for non-standard holders or sample types. Higher quality atomic characterization data is available from more materials types than ever before.

Our powerful and advanced software allows specialized techniques like our integrated Differential Phase Contrast (iDPC™) imaging for the study of magnetic and electrical properties and for optimized Z contrast across the whole of the periodic table and in particular low Z materials — replacing ABF as the industry standard. OptiSTEM and OptiMono are new Thermo Scientific packages which enable users access to the highest STEM and energy resolution experiments. The highest quality atomic level chemistry and bonding state research on sensitive materials is enabled by simultaneous EDS and electron energy loss spectroscopy (EELS) with speeds up to 1000 spectra/s.

Key Benefits

Best atomic characterization. Optimized electron optical performance and chemical detection enables the best combination of imaging and analysis in 2D and 3D.

Most repeatable data. Sophisticated automated routines such as OptiSTEM and OptiMono minimize variable data acquisition allowing focus on research instead of the tool.

Optimum EDS performance. Guaranteed by offering a portfolio of detector geometries to suit the specific research requirements of the widest range of specimens and experiments.

Best *in situ* and dynamic research. Fast cameras, chemical detectors, smart software, and our wide gap objective lens enable *in situ* data acquisition with minimal compromise to resolution and analytical capabilities.

Best environmental stability. Features like the large (weekly fill) liquid nitrogen dewar and ultra stable base minimize external environmental influences ensuring the highest quality data from long and short term experiments.

Widest range of materials science research covered in one tool. Best combination of optics, chemical detection and the wide gap pole piece ensure that the even the most difficult, lightest and most sensitive materials can be characterized at the atomic scale.

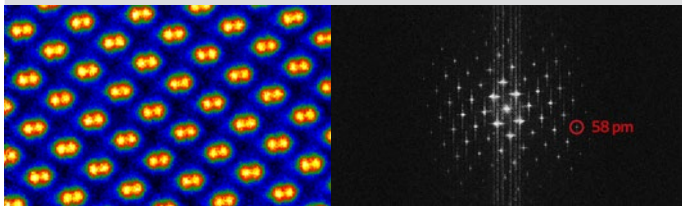

Figure 1. HAADF STEM image of [211] oriented GaN at 300kV.

ThermoFisher SCIENTIFIC

Best Atomic Characterization

The new probe corrector tuning software by Thermo Scientific, DCOR+, coupled with drift corrected frame imaging (DCFI) ensures the most repeatable, high quality, atomic resolution images. Combined with recursive mapping capabilities, this also guarantees the best chemical analysis. Our look back functionality within our acquisition software ensures that you never miss anything since results can be stored and analyzed later.

More Reliable and Quantitative Analysis and Imaging

The integrated Faraday cup provides an accurate calibration of the beam current measurement. These currents are pivotal for a quantitative and reliable imaging and analysis performance. The Faraday cup measurement guarantees experimental repeatability on different Thermo Scientific tools.

Ultimate Performance for Materials Science Challenges

The truly multi modal capability enabled by our company's advanced, integrated software allows scientists the most complete set of characterization workflows in one tool configuration. Delivering multi signal detection from up to four signals simultaneously and at very fast speeds enables new scientific data to be obtained from sensitive samples which have typically been very difficult to characterize with a TEM.

Specifications

Themis 200

	Energy spread	Information limit	STEM resolution
Image corrector	0.8 eV	90 pm	164 pm
Probe corrector	0.8 eV	110 pm	80 pm
Uncorrected	0.8 eV	110 pm	164 pm

Note: All specifications are at 200 kV. For a list of specifications of other acceleration voltage please contact your sales representative.

Themis 300

	Energy spread*	Information limit	STEM resolution
Image corrector	0.8 eV	80 pm	136 pm
Probe corrector	0.8 eV	100 pm	80 pm
Uncorrected	0.8 eV	100 pm	136 pm
X-FEG/monochromator + image corrector	0.2–0.3 eV**	80 pm	136 pm

* For X-FEG (monochromated systems) unless otherwise specified.
** Depending on energy filter option.
Note: All specifications are at 300 kV. For a list of specifications of other acceleration voltage please contact your sales representative.

Themis Z

	Energy spread*	Information limit	STEM resolution
Image corrector	0.8 eV	70 pm	136 pm
Probe corrector	0.8 eV	100 pm	60 pm
Uncorrected	0.8 eV	70 pm	60 pm
X-FEG/monochromator double corrected (probe + image corrector)	0.2–0.3 eV**	60 pm	60 pm

* For X-FEG (monochromated systems) unless otherwise specified.
** Depending on energy filter option.
Note: All specifications are at 300 kV. For a list of specifications of other acceleration voltage please contact your sales representative.

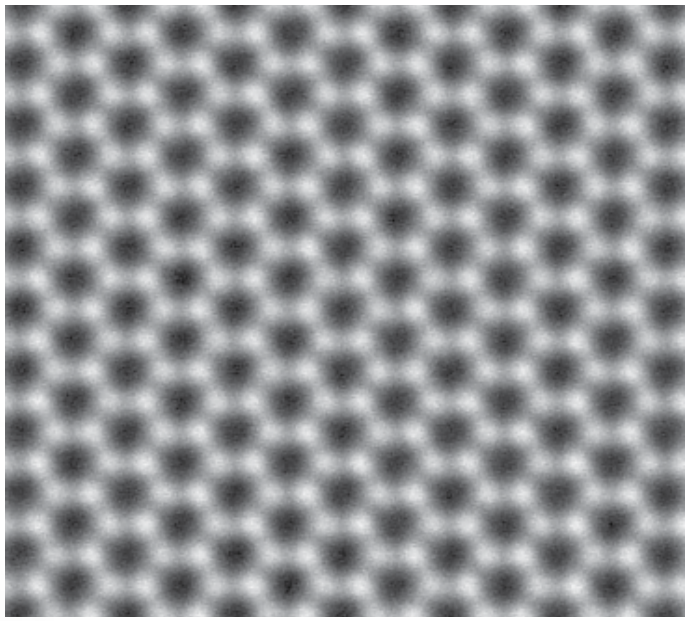

Figure 2. HAADF STEM image of a graphene lattice imaged at 60kV.

Technical Highlights

Source

- Ultra-stable, high brightness Schottky field emitter gun (X-FEG, for more details see separate product data sheet)
- Flexible high tension range:
- Themis 300 TEM and Themis Z TEM: From 60 to 300 kV (60, 80, 120, 200, 300 kV);
- Themis 200 TEM: From 80 to 200kV (80, 120, 200 kV)
- Electron gun monochromator for high energy resolution EELS and improved spatial resolution and contrast, especially at low kV in STEM mode

Optical Column and Correctors

- Three lens condenser system with indication of convergence angle and size of illuminated area for quantitative measure of electron dose and illumination conditions
- New DCOR+ software makes probe corrector tuning easy and faster
- Patented mechanical stacking of column modules minimizes instabilities caused by excessive deflector excitations
- ConstantPower™ lens design for ultimate thermal stability in mode switches minimizes image drift
- Low hysteresis design to minimize cross-talk between optical components for ultimate reproducibility
- Symmetric Ruska-Rieke S-Twin objective lens with wide pole piece gap design of 5.4mm and “space to do more” allowing the use of special holders such as heating, cooling and STM/AFM holders
- Objective aperture in the back focal plane of the objective lens for optimum TEM dark field application work
- Automatic apertures for remote control operation and reproducible recall of aperture positions during aperture change
- Field upgradeable probe Cs-corrector
- Rotation-free imaging for easy operation and clear orientation relationship between the imaging and diffraction
- Deep sub-Angstrom resolution with low specimen drift
- Field-free imaging in Lorentz mode with 2nm resolution for magnetic property studies
- On special request Cs-corrected field free imaging in Lorentz with <1nm resolution for magnetic property studies
- Integrated Faraday cup calibrated fluscreen current readout is linear over whole beam current range

Stage

- Computerized 5-axis, ultra-stable specimen piezo-stage for accurate recall of stored positions, and tracking of the areas visited during sample navigation
- The new piezo stage allows for movements as fine as 20pm for centering of feature of interest in the field of view.
- Tilt range ± 40 degrees for analytical double tilt holder to orientate the maximum amount of zone axes of one crystal in polycrystalline material. With tomography holder even ±75 degrees to minimize the missing wedge in 3D reconstructions*

Linear drift compensation provided by piezo stage can be used to mitigate limitations caused by thermal drift unavoidable during *in situ* heating or cooling experiments

thermo scientific

Analytics and Detectors
- The Super-X option and advanced, integrated software provides, together with the Gatan Ultrafast EELS or DualEELS option, up to 1000sp/s of simultaneous EDS and EELS data acquisition
- Analytics for live peak identification and background fitting during ultra-fast EDS acquisition

Software
- Differential phase contrast STEM technique (DPC) enables live measurements of intrinsic magnetic and electric fields
- Integrated DPC (iDPC) software for ultimate imaging contrast in STEM on materials across the whole periodic table. This low dose technique expands the use cases to the materials scientist and replaces ABF as the technique of choice for light elements. It is invaluable when applied to samples which typically damage under short exposures to the electron beam like Zeolites for example
- OptiSTEM+ software for “single click” optimization of 1st and 2nd order probe forming aberrations to deliver the ultimate STEM resolution to all users on our probe corrected tools**
- OptiMono software for completely automated monochromator alignment and tuning to the highest achievable energy resolution on monochromated systems
- TrueImage™ Atlas focus series software for quantitative HR-TEM applications (for more details see separate product data sheet)
- Fully digital system for remote controlled operation using the SmartCam suite
- Advanced, integrated software enables fast and up to four simultaneous STEM signal acquisition
- Smart scanning technology for high image quality in STEM

Other features
- Environmental enclosure to relax the acoustic and room temperature variation requirements with Themis Z
- New cold trap design for up to one week of operation to maximize up-time

EDX Microanalysis Option***
- Super-X: High-sensitivity, windowless EDX detector system based on SSD technology (patented)
- Output count rate: up to 200 kcps
- Energy resolution
- ≤ 136 eV for Mn-Kα and 10 kcps (output)
- ≤ 140 eV for Mn-Kα and 100 kcps (output)
- 0.7 srad solid angle
- 120 mm^2 combined detector area
- Fast mapping: pixel dwell times down to 10 µs
- High P/B ratio (Fiori number) > 4000
- Excellent in-hole performance (<1% hole counts)
- Low system background in EDX (<1% spurious peaks)
- Detection of all elements down to boron

Available Detector Options
- HAADF detector
- On-axis triple DF1/DF2/BF detectors
- Ceta 16M camera
- Gatan US1000/US4000 cameras
- Gatan energy filter series

Available Holders
- Single tilt holder
- Double tilt holder
- Tomography holder
- Thermo Scientific *in situ* Holders
- Please ask for a list of functional holders

Installation Requirements
- Please contact your sales representative for a complete pre-installation requirement document

* Tilt range 35° with Super-X option.
** Ultimate performance guaranteed on corrected tools.
*** Dual-X option available. Details upon request.

Find out more at **thermofisher.com/EM-Sales**

ThermoFisher SCIENTIFIC