

A grayscale photograph of a scanning electron microscope (SEM) instrument, showing various components like the column, detector, and control panel. A blue square is overlaid in the center, containing the text 'GAIA3'.

GAIA3

TESCAN GAIA3 brings together an ultra-high resolution electron column and high-performance ion column fitted onto a single chamber. Built on the proven (MAIA3) FE-SEM platform, GAIA3 extends all of its qualities with the ability to modify surfaces with a focused ion beam. The outstanding imaging capabilities of the GAIA3 begin with its novel FE-SEM with excellent resolution at low voltages. The objective lens is narrower than a conventional objective and InBeam SE and InBeam BSE detectors placed in the column give free space over the sample for unlimited FIB work and various analytical techniques.

Key Benefits

- Extraordinary SEM resolution with single-pole 60° objective lens
 - Best-in-class range of display modes – FIELD, RESOLUTION and DEPTH - based on TESCAN's unique Wide Field Optics
 - Superior specimen handling using a motorized compucentric stage
 - Field-free mode for observing magnetic samples
 - High probe current, up to 200 nA (SEM)
 - E-beam lithography with ultra-short dwell time down to 20 ns
 - Ultra-high FIB resolution and excellent performance at high current with a Cobra column and probe current 1 pA to 50 nA
 - Powerful DrawBeam toolbox including a number of basic and advanced programmable objects with various process parameters
- Besides the ability to investigate and modify the sample surface with enormous analytical potential, an extraordinary number of ports that enables all the detectors and techniques to focus on a common analytical workspace.

General Benefits

The imaging, analysis and control of matter at the nanometer scale are key factors in successfully conducting research today. Resolution, accuracy, reproducibility, robustness and flexibility are key characteristics for a leading-edge tool.

Following three generations of success in electron microscopy, GAIA3 is the next generation platform introduced by TESCAN. Combining unsurpassed nanometer resolution SEM performance with excellent COBRA-FIB capabilities, the new TESCAN GAIA3 offers a wide range of analytical compatibilities.

The greatest benefits of the GAIA3 is its low-voltage SEM imaging while maintaining a high resolution. This is essential especially for examining sensitive or non-conductive samples with a small interaction volume therefore giving excellent resolution and unique low voltage contrast.

COBRA-FIB is a top-level technology in terms of resolution for both imaging and milling. It is the sharpest FIB instrument for nano-engineering in its class.

System flexibility and tools

TESCAN is well known for its easy to use, robust, stable and dependable solutions for scientists. TESCAN instruments are suitable for both the occasional user, who is able to obtain outstanding results very simply with a few clicks, and experts. Expert modes are for those who can take advantage of the instrument's flexibility and extended controls. TESCAN systems include a comprehensive interface for a whole range of features which enable very complex observation (conditions) settings for advanced SEM and FIB work.

Stunning image quality and contrast can be achieved, especially at low voltages when using the GAIA3's inherent attributes, however, the design enables sharp imaging in SE and BSE modes over the entire energy range.

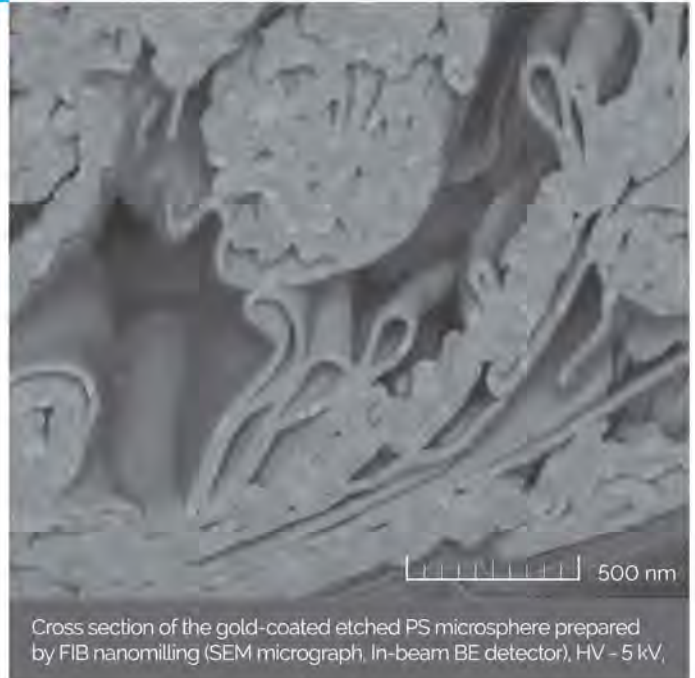
With novel Retractable STEM TEM lamella can be observed in-situ right after its extraction. TOF-SIMS with FIB and SEM enabling ion mass spectrometry of high sensitivity together with continual FIB etching, resulting in a 3D map of mass distribution within the sample.

Featuring resolution to the nanometer at 15 kV and better than 1.8 nm at 1 kV without beam deceleration with a single pole 60° objective lens.

Ultra-high resolution of 1.4 nm is possible at 1 kV with beam deceleration.

Offers a wide range of cutting-edge technologies

Excellent resolution at low beam energies



GAIA Software suite and automated operations

TESCAN's well-known user-friendly software, many automated procedures, remote access and scripting libraries enables all users to achieve exceptional results. Furthermore GAIA3 is able to offer experienced users access to detailed and expert system settings to maximise the customization of the observation settings. Multi-user localized environment, modular software architecture, network operations and wide range of extensions turn GAIA3 into most versatile instrument available.

Automatic set-up of the microscope and many other automated operations are characteristic features of the equipment. Automatic procedures like In-Flight Beam Tracing™ optimization for both electron and ion beams, gun heating and centering, column centering, vacuum control, compensation for kV focusing, contrast & brightness, spot optimization, auto-diagnostics, setup of FIB-SEM intersection point, GIS nozzles positioning and temperature control, automated FIB as well as SEM emission start etc. reduce the operator's tune-up time significantly.

■ Analytical potential of FIB/SEM analysis

The ever-increasing demands for sample throughput and precision of milled objects are met by integrating the most innovative focused ion beam technology. Gallium ion sources

with a unique design deliver an excellent imaging resolution combined with high-current and high-density ion beams. Thanks to innovated fast cross section milling approach, the milling speed is increased more than 2.5 times. The deposition of conducting or nonconducting materials, as well as enhanced and selective etching, can be performed with either the electron or ion beam when combined with the highly flexible gas injection technology. This enables the milling process to be carefully controlled. Moreover, by automatically combining several images, a complete 3D-model of the sample can be created.

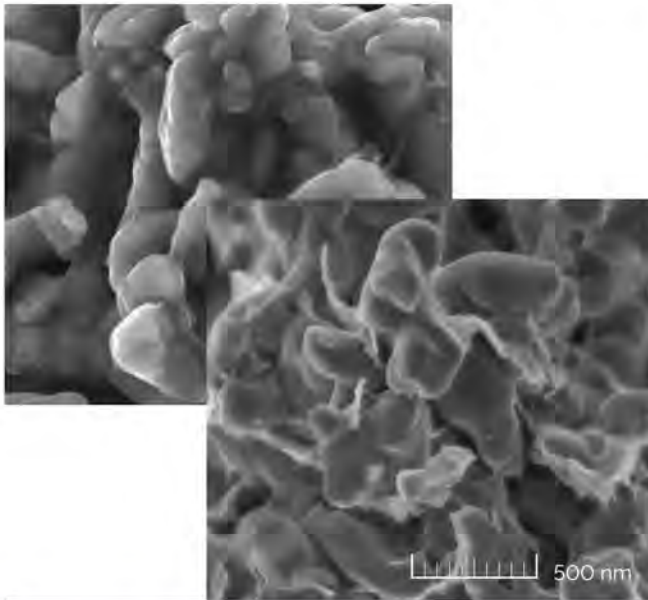
■ Precision in sample modification

The ability to integrate analytical methods is much easier to achieve with the GAIA3. Combining a SEM and ultra-high-resolution Cobra FIB column provides superior observation and modification experience. The 5-GIS system enables a variety of techniques for micro- and nanofabrication that can be used for the deposition or etching of samples. Of course a wide range of precursors are provided that significantly expand the number of ways the method can be used. The instrument can be optimized for specific customer requirements using presets and an intuitive scripting language as well as extended with a wide range of TESCAN's or 3rd-party detectors.

An integrated solution for your research

Unique imaging technologies and solutions including TESCAN's new detectors, process monitoring and advanced patterning software, technologies to compensate for charged samples and many more.

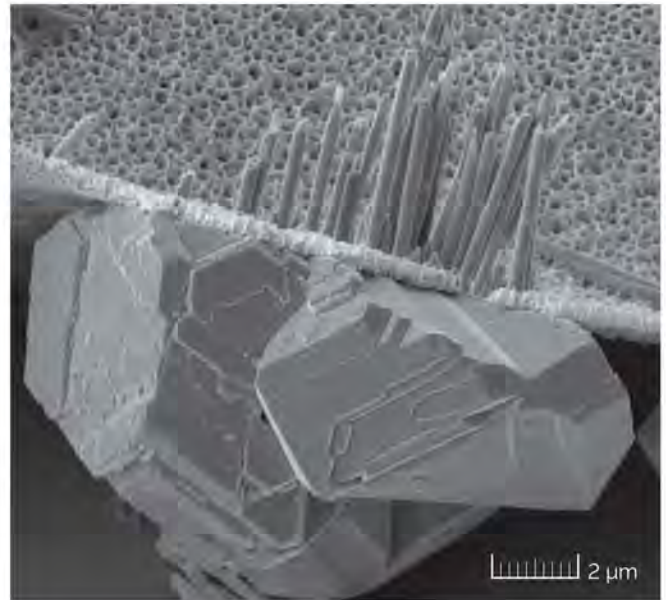
- In-Beam SE and BSE Detector for inside-the-column detection of electrons at short working distances
- Motorized Retractable annular backscattered scintilla-



Graphene on LiFePO_4 , HV - 5kV (left) and HV - 2kV (right)

tor-type electron detector with high sensitivity and atomic number resolution (0.1)

- Powerful DrawBeam, AutoSlicer software and many more



Silver nanowires and crystals fabricated by electrolysis. For nanowires shaping porous alumina etched then hydroxide was used.

Applications

■ Materials Science

- Analysis of difficult to image samples like non-conductive materials, magnetic samples and samples with charge compensation
- Patterning of complex nanostructures and high resolution imaging
- Maximum information from the sample with additional systems: 3D EBSD and EDS, WDS, TOF-SIMS, SPM, confocal Raman microscope

■ Life sciences

- Investigations of cell morphology, development of biocompatible materials, tissue engineering, microbiology

and many others

- Achieve your research goals thanks to variable pressure observations, tomographic methods, and complex solutions including correlative light-electron microscopy or cryo-SEM/cryo-FIB techniques

■ Semiconductors

- Enables pioneering accuracy in prototyping, Ion Beam Lithography (IBL), failure analysis of integrated circuits and thin-layer measurement
- Milling or depositing small specific structures, benefits of combining FIB with Electron Beam Lithography (EBL)

High-performance COBRA-FIB

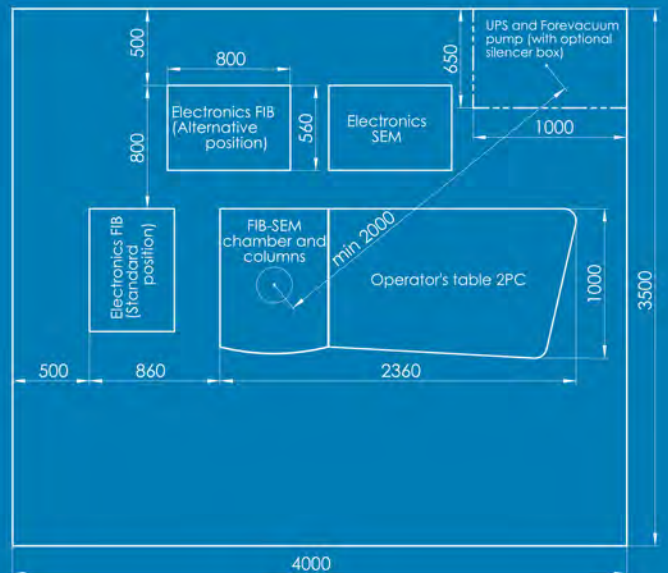
COBRA-FIB is an ultra-high resolution FIB column. In addition to its unsurpassed resolution guaranteed at 2.5 nm, sub-2 nm images have been performed with gallium at 1pA. High-current modes have also been optimized, providing an extremely well defined beam shape with unique milling performance.

- Optimized milling
- Real time In-Flight Beam Tracing™
- Powerful DrawBeam, AutoSlicer and 3D Tomography Software
- Simultaneous SEM imaging during FIB milling or deposition

Technical specifications

Resolution

Standard mode (In-Beam SE)	1.0 nm at 15 kV 1.8 nm at 1 kV 2.5 nm at 500 V
Beam Deceleration Mode (option)	1.4 nm at 1 kV 2.2 nm at 200 V
In-Beam BSE (option)	2.0 nm at 15 kV
Maximum Field of View	4.3 mm at WD _{analytical} 5 mm 7.7 mm at WD 30 mm
Accelerating Voltage	200 V to 30 kV / down to 50 V with BDT option
Probe Current	2 pA to 200 nA



Ion Optics

Resolution	<2.5 nm at 30 kV (at SEM-FIB coincidence point)
Magnification	minimum 150x at coincidence point and 10 kV
Accelerating Voltage	0.5 kV to 30 kV
Ion Gun	Ga Liquid Metal Ion Source
Probe Current	1 pA to 50 nA

Vacuum System

Chamber Vacuum	High Vacuum Mode: < 9×10^{-3} Pa* Low Vacuum Mode: 7 – 500 Pa** (UniVac only)
SEM Gun Vacuum	< 3×10^{-7} Pa
FIB gun Vacuum	5×10^{-6} Pa

* pressure < 5×10^{-4} Pa reachable
** with low vacuum aperture inserted

Chamber



Internal diameter	340 mm (width) x 315 mm (depth)
Door	340 mm (width) x 320 mm (height)
Number of ports	20+



Internal diameter	285 mm (width) x 340 mm (depth)
Door	285 mm (width) x 320 mm (height)
Number of ports	12+

Specimen Stage



Movements	X = 130 mm (-65 mm to +65 mm) Y = 130 mm (-65 mm to +65 mm) Z = 90 mm
Rotation	360° continuous
Tilt	-60° to +90°



Movements	X = 130 mm (-65 mm to +65 mm) Y = 130 mm (-65 mm to +65 mm) Z = 90 mm
Rotation	360° continuous
Tilt	-30° to +90°

Optional Accessories

- MonoGIS
- 5-GIS (5 independent precursor reservoirs with capillaries)
- Load Lock
- Control Panel
- Optical Stage Navigation
- Nanomanipulators
- Decontaminator/plasma cleaner
- Flood gun for FIB charge compensation

■ Installation Requirements

Power	230 V ±10%/50 Hz (or 120 V/60 Hz - optional), 2300 VA
Water cooling	closed cooling circuit (does not require ext. water supply)
Compressed air	600 – 800 kPa (6 – 8 Bars)
Compressed nitrogen for venting	150 – 500 kPa (1.5 – 5 Bars)
System dimensions	SEM/FIB/GIS 2.36 m x 1 m + Movable FIB-GIS electronics box: footprint 0.56 m x 0.8 m
Room for installation	min. 4 m x 3.5 m, minimum door width 1.0 m

■ Environmental Requirements

Temperature of environment	17 – 24 °C with stability better than 1 °C/hour
Relative humidity	< 65 %
Background magnetic field	synchronous < 3 x 10 ⁻⁷ T asynchronous < 1 x 10 ⁻⁷ T
Vibrations	For active isolation: < 10 µm/s below 30 Hz < 20 µm/s above 30 Hz
Acoustic noise	Less than 60 dBC
Altitude	max. 3000 m above sea level

Detectors

■ Standard

- SE Detector
- In-Beam SE Detector
- In-Beam BSE detector
- Motorized Retractable BSE
- pA Meter
- Touch Alarm
- IR TV Camera

■ Optional

- SITD (Secondary Ion
TESCAN Detector)
- Beam Deceleration
Technology (BDT) package
- Beam Deceleration
Technology (BDT) option*
- STEM
- R-STEM
- CL Detector (motorized)
- Rainbow CL Detector
(motorized)
- Compact CL
- Rainbow CL (Compact)
- EBIC
- EDX**
- WDX**
- EBSD**

- * option does not include
decontaminator
- ** fully integrated third party
products

Software extensions*

■ Standard

- Analysis & Measurement
- Histogram
- Image Processing
- 3D Scanning
- Hardness
- Multi Image Calibrator
- Object Area
- Switch-Off Timer
- Tolerance
- X-Positioner
- Live Video
- DrawBeam Basic
- EasySEM™

■ Optional

- Particles Basic
- Particles Advanced
- Sample Observer
- Image Snapper
- DrawBeam Advanced
- Input Director
- TESCAN TRACE GSR
- 3D Metrology (MeX)
- 3D Tomography
- 3D Tomography Advanced
- System Examiner
- Cell Counter
- AutoSlicer
- Coral (Correlative
microscopy module for Life
Sciences)
- SYNOPSIS Client
(Correlative microscopy
module for semiconductor
applications)

- For more information
about software items see
the specification Software
Extension Modules brochure

Uniquely integrated tools

- SPM** (Scanning probe
microscopy)
- GM Chamber only
- TOF-SIMS**

- ** fully integrated third party products



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