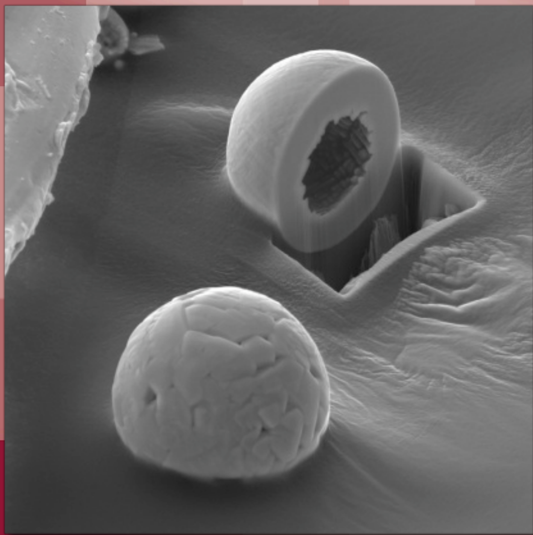
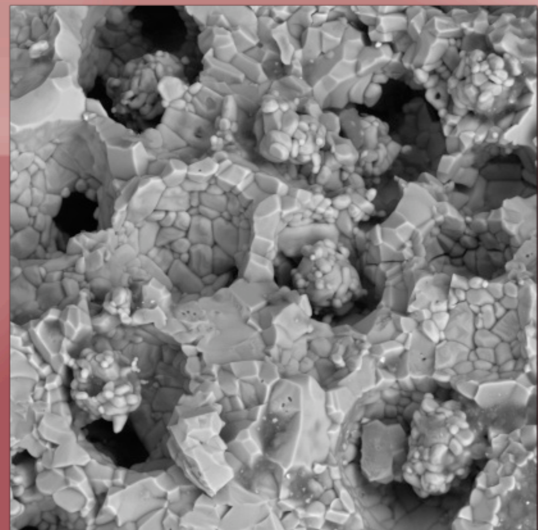
LYRA3 GM

A multifunctional Tool for Nanotechnology





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LYRA3 GM

A multifunctional Tool for Nanotechnology

Recent advancements in nanotechnology have lead to a growing need for a powerful "multi-functional nanotechnology tool" capable of nano-manipulation, nano-structuring (i.e. surface modification), nanoimaging and nano-analysis in one single instrument. In most lab environments multiple instruments are required to provide complementary analytical information. Access to one single instrument can provide a user with several benefits.

The newest generation FIB-SEM Nanotechnology workstation from TESCAN, the LYRA GM, delivers state of the art integration of a best in class Focused Ion Beam column and Field Emission Scanning Electron Microscope, while integrating an unprecedented range of nano-structuring, imaging, and nano-analytical tools. The integration of so many complementary analytical tools will allow researchers to characterize complex samples and solve analytical problems rapidly.

Analytical Flexibility

The LYRA GM can integrate a variety of nano-analytic techniques. A newly designed chamber, with more than 20 ports, the LYRA GM Nanotechnology workstation is the first in its class to fully realize the integration of a "Time of Flight" secondary ion mass spectrometer and in situ "SPM/AFM", making the LYRA GM one of the most versatile Nano-manipulation and characterization tools in the world. The following analytical applications can be fully realized in one single instrument

- SPM/AFM (Scanning Probe Microscope- Atomic Force Microscope)
- TOF (Time of Flight SIMS)
- EBSD (Electron Backscattered Scanning Diffraction)
- WDX (Wavelength Dispersive X-Ray Spectrometry)
- EDX (Energy Dispersive X-Ray Spectrometry)
- CL (Cathodoluminescence)
- EBIC (Electron Beam Induced Current)

Benefits for users

Users are provided with several benefits accessing to one single instrument like:

- Multiple analytical techniques can be performed simultaneously from the same point of interest while milling through a sample with a Focused Ion Beam.

- Complementary information from several techniques can be realized on one single platform, enabling researchers to analyze nano-structures just after preparation or even during production.

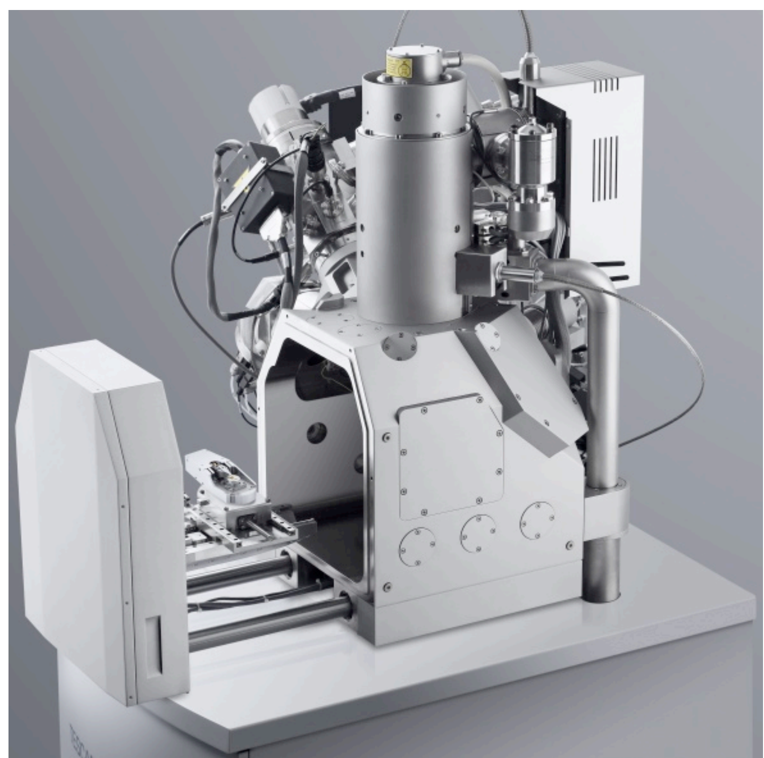
- Critical in-situ measurements, in the same workstation, will benefit experiments where the sample cannot be exposed and whereby contamination and oxidation is not an option

- One integrated instrument is efficient compared to two or more separate pieces of equipment (calculating e.g. the cost of ownership of multiple systems, throughput to providing results and surface cleanliness, taking into consideration transportation of samples between multiple instruments).

FESEM-FIB + SPM/AFM

The combination of Scanning Probe Microscopy (SPM/AFM) and Scanning Electron/Focused Ion Beam Microscopy (SEM/FIB) is the perfect complement of imaging speed and resolution from millimeter field of views down to the atomic scale.

The Curlew^{TM} in situ SPM/AFM developed by SPECS (G) provides the possibility of analysis, probing, and manipulation of the same sample feature by SPM and SEM/ FIB techniques without the need for time-consuming feature back-tracing. In addition it adds sub-nanometer surface sensitivity resolution and the ability to image insulating surfaces to SEM and FIB systems. The many electron-/ion matter interaction signals providing spetroscopic and crystallographic surface information can be superimposed with SPM topography data. The Curlew^{TM} in situ SPM gives new perspectives with respect to surface analysis, probing and manipulation at the nanometer scale.



A Multifunctional Tool for Nanotechnology

Complementary Techniques: FESEM-FIB + TOF

A unique combination of TOF-SIMS with FIB and SEM was implemented for the first time. For this purpose, an orthogonal TOF analyzer was developed by Tofwerk Company (CH) enabling ion mass spectrometry of high sensitivity together with continual FIB etching, resulting in a 3D map of mass distribution within the sample. A variety of other techniques allow a 3D tomography approach based on sequential FIB slicing followed by analysis e.g. by EBSD, CL, EBIC and others and subsequent data-processing to create 3D objects with analytical information.

Highlights

- Automatic set up of the coincidence point of the electron and ion beams
- The Draw Beam Software gives an end user access to the most advanced patterning and 3D characterization capabilities like powerful multilayer pattern editing tool, corrections of proximity effect, live imaging of the milling process, etc.
- Sophisticated software for SEM/FIB/GIS control, image acquisition, archiving, processing and analysis.
- The TESCAN unique Wide Field Optics[TM] design provides necessary field of view for critical applications such as TEM sample preparation.

Software Tools

Software Tools	
Image Processing and Operations	●
Measurement	●
Object Area	●
Hardness	●
Tolerance	●
Multi-Image Calibrator	●
Switch-Off Timer	●
3D Scanning	●
Positioner	●
Scriptor	●
Live Video	●
Particles Basic	○
Particles Advanced	○
Image Snapper	○
DrawBeam Basic	●
DrawBeam Advanced	○
3D Tomography	○
Sample Observer	○
EasyEDX Integration Software	○
3D Metrology (MeX)*	○
Input Director	○

● standard, ○ option, *third-party dedicated software by Alicona Imaging GmbH

GM Chamber

GM Chamber	
Internal Size	340 mm (width) x 310 mm (depth)
Door width	340 mm (width) x 320 mm (height)
Number of ports	20 +
Chamber suspension	Integrated active vibration isolation system

Detectors

Detectors	GMH	GMU
SE-ET type detector	●	●
Retractable BSE detector	●	●
Motorized R-BSE detector	○	○
LVSTD - Low Vacuum Secondary TESCAN Detector	-	○
TE detector	○	○
CL detector	○	○
SITD - Secondary Ion TESCAN Detector	○	○
EBIC	○	○
EDX*	○	○
WDX*	○	○
EBSD*	○	○

* third-party - products; - not available

Accessories

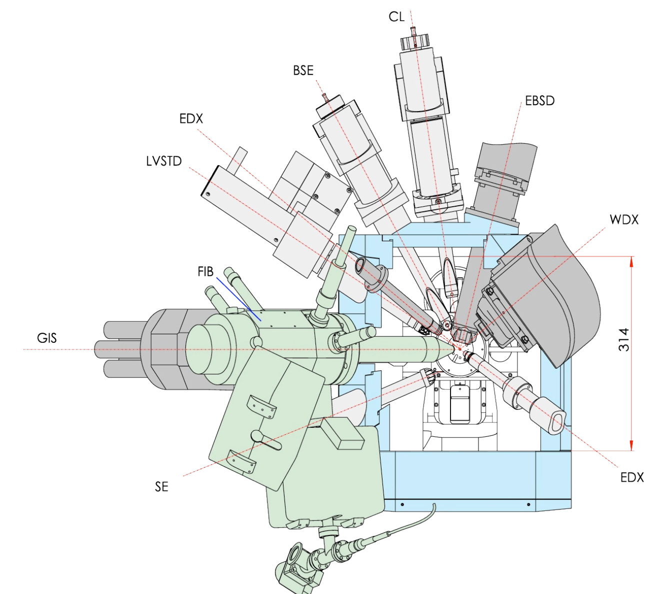
Accessories	GMH	GMU
Probe current measurement	●	●
Touch alarm	●	●
Chamber view camera	●	●
Peltier cooling stage	○	○
Beam blanker SEM	○	○
Control Panel	○	○
Load Lock	○	○
Water vapor inlet	-	○

● standard, ○ option, - not available

Other Options

Other Options	GMH	GMU
Gas Injection System for 5 gases*	○	○
Gas Injection System for 1 gas*	○	○
Decontaminator	○	○
TOF Mass Spectrometer*	○	○
AFM/STM*	○	○

○ option, - not available, *third-party products



Specimen Stage at GM Chamber

Specimen Stage at GM Chamber	
Type	compucentric
Movements	5-axis fully motorized X = 130 mm, Y = 130 mm, Z= 100 mm Rotation = 360° continuous Tilt = -30° to + 90°
Specimen height	maximum 145 mm

LYRA3

Electron Optics

	GMH	GMU
Resolution		
In high-vacuum mode SE	1.2 nm at 30 kV 2.5 nm at 3 kV	1.2 nm at 30 kV 2.5 nm at 3 kV
In low-vacuum mode LVSTD	- -	1.5 nm at 30 kV 3 nm at 3 kV
In high-/low-vacuum mode BSE	2 nm at 30 kV	2 nm at 30 kV
Electron optics working modes		
High-vacuum mode	Resolution, Depth, Field, Wide Field, Channelling	Resolution, Depth, Field, Wide Field, Channelling
Low-vacuum mode	-	Resolution, Depth
Magnification	Continuous from 2x to 1,000,000x	Continuous from 2x to 1,000,000x
Maximum field of view	67 mm	67 mm in high-vac mode 12 mm in low-vac mode
Accelerating voltage	200 V to 30 kV	
Electron Gun	High Brightness Schottky Emitter	
Probe current	2pA to 100 nA	

Ion Optics

Ion column	Canion / Cobra / ExB mas filtered Canion C31X
Resolution	< 5 nm at 30 kV / < 2.5 nm at 30 kV (at SEM-FIB coincidence point)
Magnification	Minimum 150x at coincidence point and 10 kV (corresponding to 1 mm view field), maximum 1,000,000x
Accelerating Voltage	0.5 kV to 30 kV
Ion gun	Ga Liquid Metal Ion Source
Probe current	2pA to 40 nA
SEM-FIB Coincidence at	WD 9 mm for SEM - WD 12 mm for FIB
SEM-FIB angle	55º

Vacuum System

	GMH	GMU
System pressure:		
Chamber - High-vacuum mode	< 9×10^{-3} Pa*	< 9×10^{-3} Pa*
Chamber - Low-vacuum mode	-	7-150 Pa
Electron Gun	< 3×10^{-7} Pa	< 3×10^{-7} Pa
SEM Column	< 9×10^{-3} Pa*	< 9×10^{-3} Pa*
FIB Gun	< 5×10^{-6} Pa	< 5×10^{-6} Pa
	* pressure < 5×10^{-4} Pa reachable	* pressure < 5×10^{-4} Pa reachable

Microscope control	All microscope functions are PC-controlled using trackball, mouse and keyboard via control software using the Windows™ platform.
Scanning speed	From 20 ns to 10 ms per pixel adjustable in steps or continuously
Scanning features	Focus Window, Dynamic focus, Point & Line scan, Image rotation, Image shift,Tilt compensation, 3D Beam, Live Stereoscopic Imaging (SEM), Other scanning shapes available through DrawBeam Software
Image size	Up to 8,192 x 8,192 pixels in 16-bit quality, size is adjustable separately for live images (in 3 steps) and for saved images (in 10 steps), for square and rectangular 4:3 or 2:1 aspect ratios.
Automatic procedures	In-Flight Beam Tracing™ beam optimization, Spot Size and Beam Current Continual, WD (focus) & Stigmator, Contrast & Brightness, Scanning Speed (according to Signal- Noise Ratio), Gun On, Gun Off , Gun Centering, Column Centering, Vacuum Control, Compensation for kV, Look Up Table, Auto-diagnostics
Remote control	Via TCP/IP

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We are constantly improving the performance of our products, so all specifications and external designs of instruments are subject to change without notice.

TESCAN PERFORMANCE IN NANOSPACE
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