VEGA3

LaB₆ W EDX Detectors

TESCAN
PERFORMANCE IN NANOSPACE

3rd Generation of VEGA SEMs

The VEGA series was designed with respect to a wide range of SEM applications and needs in today's research and industry. After 12 years of continuous development VEGA has matured to its 3rd generation. This new generation provides users with the advantages of the latest technology, such as new improved high-performance electronics for faster image acquisition, an ultra-fast scanning system with compensation for static and dynamic image aberrations or scripting for user-defined applications, all while maintaining the best price to performance ratio.

■ High Resolution Imaging with LaB$_6$ Emitter

TESCAN offers LaB$_6$ (lanthanum hexaboride) electron source as an option. The LaB$_6$ provides higher current density at lower cathode temperatures compared to tungsten emitters. It offers greater brightness, a reasonably improved resolution over the whole range of accelerating voltages and a longer cathode lifetime. The LaB$_6$ emitter is the right choice for applications where large beam currents and improved resolution are required.

■ Modern Optics

- A unique four-lens **Wide Field Optics™** design with a proprietary Intermediate Lens (IML) offering a variety of working and displaying modes, for instance with enhanced field of view or depth of focus, etc.
- State-of-art design of the scanning coils and electronics enables an ultra-fast imaging rate down to 20 ns/pixel with minimized dynamic distortion effects.
- Real time **In-Flight Beam Tracing™** for high precision real-time computation of optical parameters.
- Column design without any mechanical centering elements enables fully automated column set-up and alignment.
- Unique live stereoscopic imaging using advanced **3D Beam Technology** opens up the micro and nano-world for an amazing 3D experience and 3D navigation.

■ Analytical Potential

- The SB chamber is equipped with a 3-axis motorized stage, all other VEGA chambers (LM, XM and GM) provide superior specimen handling using a 5-axis fully motorized compucentric stage and ideal geometry for EDX and EBSD.
- First-class YAG scintillator-based detector.
- Selection of optional detectors and accessories.
- Full operating vacuum can be reached within a few minutes with powerful turbomolecular and rotary fore vakuum pumps.
- Investigation of non-conductive samples in the variable pressure mode (UniVac) version.
- Several chamber suspension type options ensure effective reduction of ambient vibrations in the laboratory.Unique integrated active vibration isolation for analytical GM chamber delivered as standard.
- 3D measurements on a reconstructed surface by using the 3D metrology software.

■ Rapid Maintenance

Keeping the microscope in peak condition is now easy and requires a minimum of microscope downtime. Every detail has been carefully designed to maximize microscope performance and minimize operator's efforts.

■ Automated Procedures

Filament heating and alignment of the gun for optimal beam performance is performed automatically with just one click. There are many other procedures which reduce the time for tuning-up the microscope, including automated manipulator navigation and automated analyses. The SharkSEM remote control interface enables access to most of the microscope features, including microscope vacuum control, optics control, stage control, image acquisition, etc. The compact Python scripting library offers all these features.

VEGA3 Configurations

■ **VEGA3 SB**

A high vacuum model of SEM with 3-axis motorized stage for investigation of small conductive samples.

■ **VEGA3 SB – EasyProbe**

The EasyProbe is a favorable package of a scanning electron microscope fully integrated with a selected EDX microanalyser. EasyProbe is available in both high vacuum and variable pressure variant. The system is delivered with a touch screen.

■ **VEGA3 LMH / XMH / GMH**

The large / extra-large / giant-chamber models with an extended motorized manipulator operate at high vacuum for the investigation of conductive samples with extraordinary imaging quality.

■ **VEGA3 SBU / LMU / XMU / GMU**

The variable-pressure SEMs supplement all the advantages of the high vacuum models with an extended facility for low vacuum operations, enabling the investigation of non-conductive specimens in their natural uncoated state.

■ **About VEGA3 XM and GM configurations**

The XM and GM configurations extend their analytical capabilities, providing the ability to perform fine sample surface observations even with extra-large specimens. In today's microscopy there are many applications where breaking off a small piece of the sample is impossible or highly inconvenient, particularly in situations where further analysis of the object is needed or in e.g. forensic applications so as not to affect the evidence. Besides the ability to investigate the sample surface with extra-large specimens, the GM chamber extends the features of VEGA3 SEMs with great analytical potential. A Large number of ports enables all detectors and techniques (SE, BSE, LVSTD, EDX, EBSD).
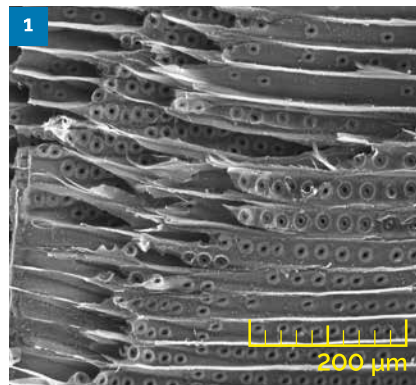
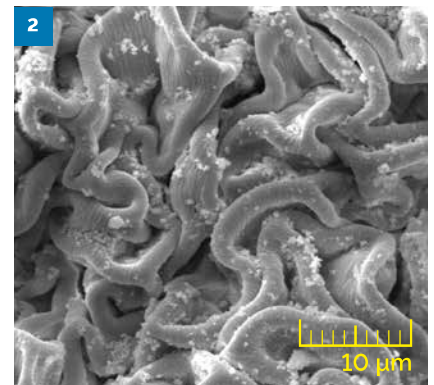**Fig. 1:** Au-coated wood sample imaged at 20 keV

Fig. 2: A pharmaceutical sample imaged at 10 keV
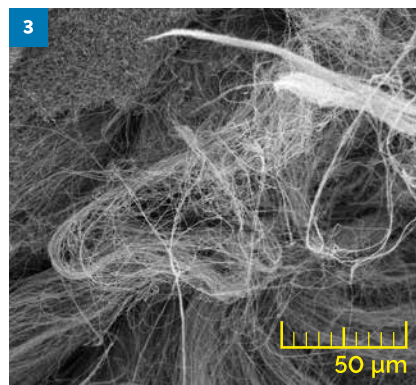

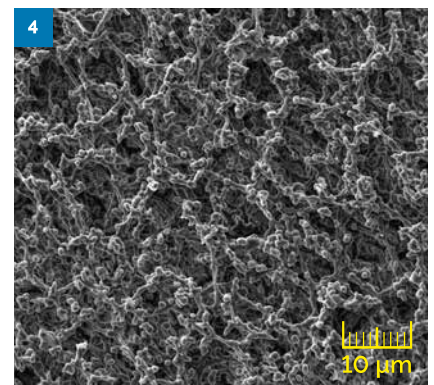**Fig. 3:** Carbon nanotubes imaged at 5 keV

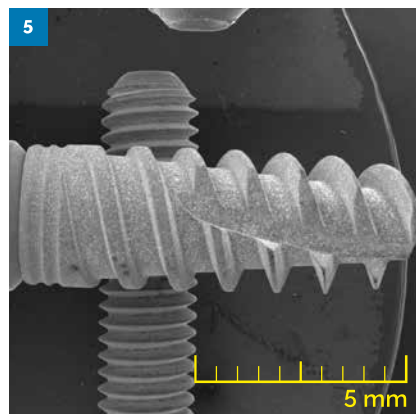**Fig. 4:** Particles in a filter imaged at 5 keV

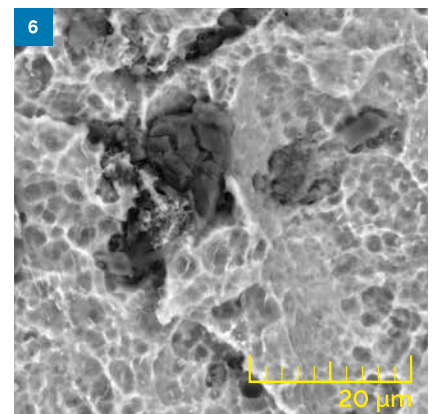**Fig. 5:** A Ti dental implant imaged at 20 keV in the WIDE FIELD mode

Fig. 6: A Ti dental implant imaged at 20 keV in the RESOLUTION mode, with the BSE detector for material contrast
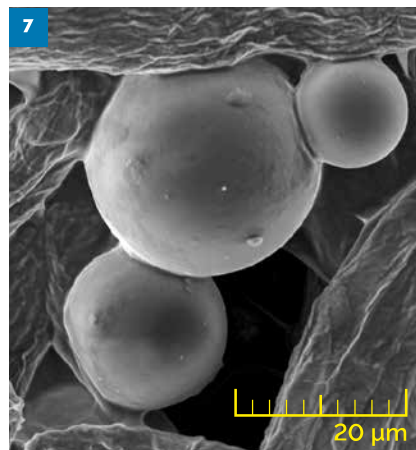

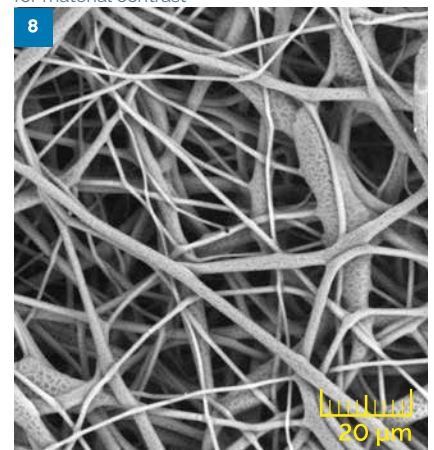**Fig. 7:** Uncoated particles of a softener on filter paper imaged at 5 keV

Fig. 8: Uncoated PLGA polymer fibers imaged at 10 keV in low vacuum mode

Technical specifications

	SB Chamber	LM Chamber	XM Chamber	GM Chamber
Internal size	160 mm	230 mm	285 mm (w) × 340 mm (d)	340 mm (w) × 315 mm (d)
Door	120 mm (width)	148 mm (width)	285 mm (w) × 320 mm (h)	340 mm (w) × 320 mm (h)
Number of ports	10	11+	12+	20+
Chamber	mechanical	pneumatic or optionally	pneumatic or optionally active	integrated active vibration
Suspension		mechanical or active vibration isolation	vibration isolation	isolation system

	Specimen stage in SB Chamber	Specimen stage in LM Chamber	Specimen stage in XM Chamber	Specimen stage in GM Chamber
Type	eucentric	compucentric	compucentric	compucentric
Movements	X = 45 mm - mot. Y = 45 mm - mot. Z = 27 mm, Z` = 6 mm Rotation: 360° mot. Tilt: -90° to +90°	X = 80 mm Y = 60 mm Z = 47 mm Rotation: 360° cont. Tilt: -80° to +80°	X = 130 mm Y = 130 mm Z = 100 mm Rotation: 360° cont. Tilt: -30° to +90°	X = 130 mm Y = 130 mm Z = 100 mm Rotation: 360° cont. Tilt: -80° to +90°
Specimen height	maximum 36 mm	maximum 81 mm	maximum 145 mm	maximum 145 mm

Detectors	SBH/ SBH EasyProbe	SBU/ SBU EasyProbe	LMH/XMH/GMH	LMU/XMU/GMU
SE detector	☑ / ☑	☑ / ☑	☑ / ☑ / ☑	☑ / ☑ / ☑
Retractable BSE detector	☐ / ☐	☑ / ☑	☐ / ☐ / ⊘	☑ / ☑ / ⊘
Motorized R-BSE detector	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☑
Fixed BSE	☐ / ⊘	☐ / ⊘	☐ / ⊘ / ⊘	☐ / ⊘ / ⊘
Retractable Dual Scintillator BSE Detector[4,5]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Retractable 4-Quadrant semiconductor BSE Detector[4,5]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
LVSTD detector	⊘ / ⊘	☐ / ⊘	⊘ / ⊘ / ⊘	☐ / ☐ / ☐
Easy EDX	☐ / ☑	☐ / ☑	☐ / ☐ / ☐	☐ / ☐ / ☐
STEM detector	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
HADF R-STEM	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
CL detector[3,4,5]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Rainbow CL detector[3,4,5]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Al-coated BSE[4,5]	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
BSE/CL detector	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ⊘	☐ / ☐ / ⊘
EBIC	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
EDX[1]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
WDX[1,2]	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
EBSD[1]	☐ / ⊘	☐ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐

Accessories	SBH/ SBH EasyProbe	SBU/ SBU EasyProbe	LMH/XMH/GMH	LMU/XMU/GMU
Probe current measurement	☑ / ☑	☑ / ☑	☑ / ☑ / ☑	☑ / ☑ / ☑
Touch Alarm	☑ / ☑	☑ / ☑	☑ / ☑ / ☑	☑ / ☑ / ☑
Chamber view camera	☐ / ☐	☐ / ☐	☑ / ☑ / ☑	☑ / ☑ / ☑
Peltier Cooling Stage	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Beam Blanker	☐ / ☐	☐ / ☐	☐ / ☐ / ☐	☐ / ☐ / ☐
Control Panel	☐ / ☐	☐ / ☐	☐ / ☐ / ☐	☐ / ☐ / ☐
Load Lock[6]	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Water Vapor Inlet	⊘ / ⊘	⊘ / ⊘	⊘ / ⊘ / ⊘	☐ / ☐ / ☐
Touchsreen LCD	⊘ / ☑	⊘ / ☑	⊘ / ⊘ / ⊘	⊘ / ⊘ / ⊘
Nanomanipulators	⊘ / ⊘	⊘ / ⊘	☐ / ☐ / ☐	☐ / ☐ / ☐
Optical Stage Navigation	⊘ / ⊘	⊘ / ⊘	⊘ / ☐ / ☐	⊘ / ☐ / ☐

☑ standard, ☐ option, – not available, [1] third-party products, [2] LM/XM chamber: integrated active vibration isolation necessary, [3] compact version as an option [4] motorised mechanics as an option for LM and XM chambers, [5] equipped with motorised mechanics for GM chamber, [6] manual and motorized options available

Software (Standard)

Software (Standard)	SBH/SBH EasyProbe	SBU/SBU EasyProbe	LMH/XMH/GMH	LMU/XMU/GMU
Image Processing	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Analysis & Measurement	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Object Area	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Hardness	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Tolerance	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Multi Image Calibrator	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Switch-Off Timer	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
3D Scanning	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
X-Positioner[2]	☑/∅	☑/∅	☑/☑/☑	☑/☑/☑
EasySEM™	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Live Video	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Histogram	☑/☑	☑/☑	☑/☑/☑	☑/☑/☑
Easy EDX Integration Software	☑/☑	☑/☑	☐/☐/☐	☐/☐/☐

Software (Optional)

Software (Optional)	SBH/SBH EasyProbe	SBU/SBU EasyProbe	LMH/XMH/GMH	LMU/XMU/GMU
Particles Basic	☐/☐	☐/☐	☐/☐/☐	☐/☐/☐
Particles Advanced[2]	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
Image Snapper[2]	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
DrawBeam Basic	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
DrawBeam Advanced	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
Sample Observer	☐/☐	☐/☐	☐/☐/☐	☐/☐/☐
Input Director	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
System Examiner	☐/☐	☐/☐	☐/☐/☐	☐/☐/☐
TESCAN TRACE GSR[2]	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
EasyEDX Integration Software	☐/☑	☐/☑	☐/☐/☐	☐/☐/☐
3D Metrology (MeX)[1]	☐/☐	☐/☐	☐/☐/☐	☐/☐/☐
Cell Counter	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
Coral	☐/∅	☐/∅	☐/☐/☐	☐/☐/☐
SYNOPSYS Avalon™ (Camelot™)	∅/∅	∅/∅	☐/☐/☐	☐/☐/☐

☑ standard, ☐ option, – not available, [1] third-party products, [2] only possible with optional position readout stage for SB chamber

User-Friendly Software

- Multi-user environment localized in different languages
- Easy control of the SEM even for inexperienced users; four levels of user expertise/rights, including an EasySEM™ mode for quick routine investigations
- Image management and report creation
- Built-in self-diagnostics for system readiness checks
- Network operations and remote access/diagnostics

Software Tools

Modular software architecture enables several extensions to be attached.
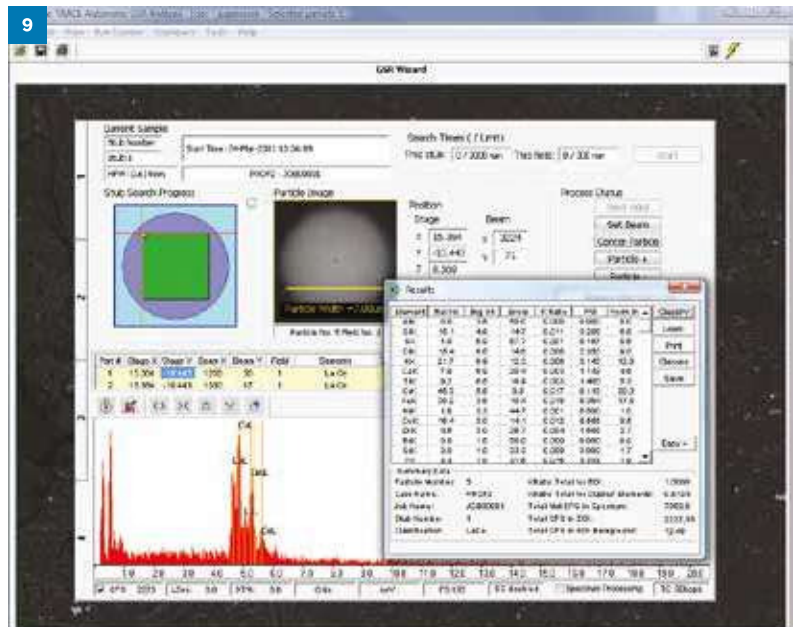
Fig. 9: Screenshot showing TESCAN TRACE GSR module.

Fast and Easy Way to Results

The intuitive EasySEM™ EasySEM touch screen control interface enables rapid sample examination within minutes. A high level of system automation and self-diagnostics, running in the background, ensure valuable results even for inexperienced users. Optional fully integrated EasyEDX microanalysis brings quantitative elemental analysis results directly into the live SEM image with only one touch. Point and area analysis as well as quantitative line profile and array mapping (up to 1024 points) functions are available.

Technical specifications

	SB/SB EasyProbe	LM/XM/GM
Electron Gun	Tungsten heated cathode	Tungsten heated cathode / optionally LaB$_6$
Resolution		
In high-vacuum mode SE	3 nm at 30 keV 8 nm at 3 keV	3 nm at 30 keV / 2 nm at 30 keV[1] 8 nm at 3 keV / 5 nm at 3 keV[1]
In low vacuum mode BSE, LVSTD[3] (available only for UniVac)	3,5 nm at 30 keV	3,5 nm at 30 keV / 2,5 nm at 30 keV[1]
Working vacuum		
Chamber – High – vacuum mode	< 9 × 10^{-3} Pa[2]	< 9 × 10^{-3} Pa[2]
Chamber – Medium – vacuum mode[4] (available only for UniVac)	3 – 150 Pa	3 – 150 Pa
Chamber – Low – vacuum mode (available only for UniVac)	3 – 500 Pa	3 – 500 Pa[5] (optionally: 3 – 2000 Pa[5])
Column vacuum	< 9 × 10^{-3} Pa[2]	< 9 × 10^{-3} Pa[2]
Gun vacuum for LaB$_6$	–	< 3 × 10^{-5} Pa
Magnification continuous from	3 × – 1,000,000 ×	2 × – 1,000,000 × (LM), 1 × – 1,000,000 × (XM/GM)
Electron optics working modes		
High-vacuum mode	Resolution, Depth, Field, Wide Field, Channelling	
Low-vacuum mode	Resolution, Depth	
Field of view	7,7 mm at WD$_{analytical}$ 10 mm 24 mm at WD 30 mm	
Accelerating voltage	200 V to 30 kV	
Probe current	1 pA to 2 µA	
Scanning speed	From 20 ns to 10 ms per pixel adjustable in steps or continuously	
Scanning features	Focus window (shape, size and position continuously adjustable), Dynamic Focus – in plane tilted or folded plane up to ± 70 deg, Point & Line Scan, Image rotation, Image shift, Tilt compensation, 3D Beam – defined tilting scanning axis around XY axis, Life Stereoscopic Imaging, Other scanning shapes available through the optional DrawBeam software	
Image size	16,384 ×16,384 pixels, adjustable separately for live image (in 3 steps) and for stored images (11 steps), selectable square or 4:3 or 2:1 rectangle .	
Microscope control	All microscope functions are controlled by keyboard, mouse and trackball via the program VegaTC using Windows™ platform. Control panel and touchscreen optionally available.	
Automatic procedures	In-Flight Beam Tracing™ beam optimization, Spot Size a Beam Current Continual, WD (focus) & Stigmator, Contrast & Brightness, Scanning Speed (according to Signal- Noise Ratio), Gun Heating, Gun Centering, Column Centering, Vacuum Control, Compensation for kV, Look-Up Table, Auto-diagnostics	
Remote control	Via TCP/IP, open protocol	

[1] with LaB$_6$ option, [2] a pressure of < 5 × 10^{-4} Pa can be displayed with an optional WRG vacuum gauge (on request) , [3] LVSTD not available for EasyProbe, [4] not available with LaB$_6$ option, [5] with a low vacuum aperture inserted

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