Product Data

Versa 3D™ DualBeam™

Versatility for demanding 3D characterization, prototyping and *in situ* research needs

Building on the history and success of FEI's pioneering DualBeam, low vacuum and ESEM™ expertise, FEI introduces the most versatile DualBeam instrument to date. The Versa 3D offers state-of-the-art imaging and analytical performance to deliver a greater range of 3D data from even your most challenging samples.

Versa 3D's highly configurable platform allows customers to adapt the system's capabilities to their specific requirements. The high vacuum-only version is ideal for routine conductive or coated samples. An alternative version, combining high and low vacuum modes, gives the flexibility to work with a range of samples including uncoated, non-conductive samples. Optional ESEM mode allows electron beam imaging of uncoated, non-conductive or naturally hydrated samples and supports in situ analysis and dynamic experimentation.

In high vacuum mode, the high current Focused Ion Beam (FIB) enables fast material removal and low voltage clean-up for low-damage surface finishing. Gas chemistries are available for depositing materials or further enhancing the FIB milling rate or selectivity. Nonconductive samples are easily milled with the automated Drift Suppression milling mode which is also supported in the optional AutoSlice and View™ G3 software; for collecting serial slice electron images in both high and low vacuum after high vacuum FIB slicing. Automation can be extended to gather EDS or EBSD data from successive slices. With advanced automation, Versa 3D can acquire images at high vacuum, low voltage and use high or low vacuum for higher voltage imaging and analysis, optimizing conditions for each detector to enhance 3D data segmentation for quantitative 3D reconstruction.

The ultra-large chamber allows addition of a variety of accessories and detectors to support a broad range of imaging and analytical techniques, accessing information from every angle. The new widescreen display provides additional imaging area to view results. New software (SmartSCAN™ and DCFI™) and electronics offer even greater imaging stability for increased performance in all operating modes. Developments in field emission electron source technology ensure clear, sharp electron images as well as increased electron beam current for enhanced EDS, WDS and EBSD analysis.

With Versa 3D the choice is yours to optimize the system for conductive samples in high vacuum; non-conductive samples with low vacuum; or expand the horizons of research to dynamic applications.

Key Benefits

- DualBeam functionality to examine surface and sub-surface areas of any sample (sample modification at the nm and um scale)
- Combination of high current FIB cutting/deposition and low voltage FIB cleaning to quickly cut/deposit materials and produce the highest quality, low damage sample surfaces
- High quality TEM and atom probe sample preparation with low voltage cleaning for atomic level study by TEM/atom probe
- Full complement of software* to perform advanced tasks like 3D volume slicing for characterization, sample preparation and prototyping from CAD or image files
- Flexibility of electron beam vacuum configuration for examining conductive samples in high vacuum-only or conductive and non-conductive samples in high and low vacuum configured system
- Auto Slice and View G3* enables 3D characterization of a wide range of materials types with a suite of detectors* to obtain information from every angle
- ESEM* option enables dynamic experiments involving gas* and thermal control*

Versa 3D essential specifications

Electron optics
- High-resolution field emission SEM column optimized for high-brightness/ high-current
- Schottky thermal field emitter
- 60 degree objective lens geometry with through-the-lens differential pumping
- Heated objective apertures to extend aperture lifetime
- Accelerating voltage: 200 V – 30 kV
- Beam deceleration stage bias* from -50 V to -4 kV
- Landing voltage range:
  - Standard: 200 V to 30 kV
  - Beam Deceleration* 50 V - 30 kV
- Probe current: up to 200 nA -continuously adjustable
- Magnification 30 x – 1280 kx in "quad" mode
- Electron source lifetime: 12 month lifetime

Ion beam resolution
- 7 nm at 30 kV at beam coincident point (5 nm achievable at optimal working distance)

High Throughput ion column optics
- High-current ion column with Ga liquid-metal ion source for use in high vacuum
- Acceleration voltage: 0.5 – 30 kV
- Probe current: 1.5 pA – 65 nA in 15 steps
- Superior high current performance, with
  - up to 60 A/cm^2 beam current density
  - up to 65 nA max beam current
- Landing voltage range I-beam: 500 V - 30 kV
- Lowest voltage (500 V) for ultimate sample preparation quality
- Beam blanker standard, external control possible
- 15-position aperture strip
- Magnification 40 x – 1280 kx in "quad" mode at 10 kV
- Charge neutralization mode for milling of non-conductive samples
- Ion source lifetime: 1,000 hours guaranteed

Chamber vacuum
- Optional configurations for electron imaging:
  - HiVac (high vacuum-only)
  - HiVac/LoVac (high and low vacuum)
  - HiVac/LoVac/ESEM (high, low and ESEM vacuum)
- Pump-down time (high vacuum): <210 Seconds
- High vacuum: < 6e-4 Pa
- Low vacuum*: 10 to 200 Pa
- ESEM vacuum*: 10 to 4000 Pa

Low Vacuum Option
- Patented "through-the-lens differential pumping" in low vacuum equipped systems
- Control of beam spread (skirting) in low vacuum with x-ray cone for beam-gas-path-length of 10 or 2 mm
- Seamless transition between high and low vacuum
- Imaging gas in low vacuum: water vapor

ESEM Option
- Extended vacuum range to 4000 Pa
- Imaging gas in ESEM: water vapor or auxiliary gas
- Software interface enabled for dynamic stage controllers* such as the Cold Stage*, WetSTEM*, 1000 °C Hot Stage* and 1500 °C Hot Stage* (sold separately)

Electron Beam Resolution Table (nm)	Versa 3D Configuration		
	HiVac	HiVac/LoVac	HiVac/LoVac/ESEM
High Vacuum Mode			
30 kV SE resolution	1.2	1.2	1.2
30 kV SE resolution with PC*	1.0	1.0	1.0
30 kV STEM resolution	0.8	0.8	0.8
30 kV BSE resolution	2.5	2.5	2.5
15 kV SE resolution	1.5	1.5	1.5
15 kV SE resolution	1.3	1.3	1.3
1 kV SE resolution	2.9	2.9	2.9
1 kV SE resolution with BD*+ICD* and PC*	2.0	2.0	2.0
Low Vacuum Mode*			
30 kV SE resolution		1.5	1.5
30 kV BSE resolution		2.5	2.5
3 KV SE resolution		3.0	3.0
ESEM Mode*			
30 kV SE resolution			1.5
3 kV SE resolution			3.0

* optional components
(PC= Plasma Cleaner, BD= Beam Deceleration)

* = optional

Vacuum system
- 1 x 240 l/s TMP
- 1 x PVP oil-free (scroll-pump)
- 2 x IGP (for electron column)
- 1 x IGP (for ion column)

Chamber
- E- and I-beam coincidence point at analytical WD (10 mm SEM)
- Angle between electron and ion columns: 52°

Standard 5-axes motorized stage:
- X,Y: 110 mm
- Z: 65 mm motorized
- T: -15° to +90°
- R: n x 360° (endless)
- X,Y repeatability: 2.0 µm
- Sample weight: 500 g in any stage position (up to 2 kg at 0 deg tilt)
- Maximum clearance between stage and coincidence point: 85 mm at eucentric height
- Maximum sample size:
  - 150 mm diameter with full rotation (larger samples possible with limited rotation)

Optional high precision 5-axes motorized stage*:
- X,Y: 150 mm, piezo-driven
- Z: 10 mm motorized
- T: -10° to +60°
- R: n x 360° (endless), piezo-driven
- X,Y repeatability: 1.0 µm
- Maximum size: 150 mm diameter with full rotation (larger samples possible with limited rotation)
- Maximum clearance between stage and coincidence point: 55 mm
- Weight: max. 500 g

Sample holders
- Single stub mount, mounts directly onto stage
- Vise Specimen Holder to clamp irregular, large or heavy specimens to the specimen stage*
- Universal Mounting Base (UMB) for stable, flexible mounting of many combinations of samples and holders such as flat and pretilt stubs, and row holders for TEM grids*
- Various wafer and custom holder(s) available by request*

Detectors
- Everhart-Thornley SE detector (ETD)
- IR camera for viewing sample/column
- Chamber integrated NavCam*
- High performance SE and SI (secondary ion) detector (ICE)*
- Retractable low voltage, high contrast solid-state electron detector (DBS)*
- In-column Detector (ICD) for use with Beam Deceleration*
- Retractable STEM detector with BF/DF/HAADF segments*
- Integrated beam current measurement*

System control
- 32-bit GUI with Windows® 7, keyboard, optical mouse
- Microscope Control Computer
  - Intel Processor/ 2.66 GHz or better
  - 500 GB system hard drive
  - 12 GB RAM
  - Firewire and Ethernet support
- One 24 inch LCD displays, SVGA 1920 x 1200
- Support PC* and (second) 24” LCD display (matching system monitor) with Windows 7 & MagicSwitch™ (software controlled Switchbox for one keyboard and mouse system control)*
- Additional 24 inch LCD display*, SVGA 1920 x 1200
- Joystick*
- Manual User Interface (multifunctional control panel)*

Image processor & supporting software
- Dwell time range from 25 ns to 25 ms/pixel
- Up to 6144 x 4096 pixels
- SmartSCAN™ (256 frame average or integration, line integration and averaging, interlaced scanning)
- Drift Compensated Frame Integration (DCFI)
- Single frame or 4-quad image display
- ‘Beam per quad’ graphical user interface concept, with up to 4 simultaneously active quads
- Color mixing of detector signals
- Live LUT coloring of signals to quickly identify grey levels of interest
- File type: TIFF (8, 16, 24-bit), BMP or JPEG standard
- Support for single command to save of all Quadrant images
- Direct AVI recording
- Serial TIFF collection/saving
- FEI Movie Creator (software to create AVI from TIFF series including data bar content control)
- FEI SPI™, iSPI™, iRTM™ for advanced, real-time process monitoring and endpointing
- Patterns supported: lines, rectangles, polygons, circles, donut, ross-section and cleaning cross-section
- Image registration
- Directly imported BMP file or streamfile for 3D milling and deposition
- Material file support for milling/deposition ‘minimum loop time’, beam tuning and independent overlaps

Common accessories
- Gas Injection System: up to 5 units for enhanced etch or deposition (other accessories or options may limit number of GIS available)
- GIS - Beam chemistry options
  - Platinum deposition
  - Tungsten deposition
  - Carbon deposition
  - Insulator deposition II
  - Gold deposition
  - Enhanced Etch™ (iodine, patented)
  - Insulator enhanced etch (XeF2)
  - Delineation Etch™ (patented)
  - Selective Carbon Mill (patented)
  - Empty crucibles for FEI approved user supplied materials
- *in situ* sample lift-out system (Omniprobe™ 100.7, AutoProbe or other manipulators)
- Charge Neutralizer
- Integrated Fast Beam Blanker
- EDS: integration kit (EDAX/Oxford Instruments) and options
- QuickLoader™: loadlock for fast sample transfer
- Exclusive cryo solution for DualBeam
  - FEI/ Quorum PP2000T for universal cryo preparation and cryo stage
  - FEI / Quorum CryoMAT for material science cryo applications

* = optional

Consumables (partial list)

- Replacement Ga-ion source
- Replacement Schottky electron source module
- Aperture strips for electron and ion columns
- Gas Injection System crucible

Software options

- AutoSlice and View™ – automated sequential mill and view to collect series of slice images for 3D reconstruction
- EBS3™ – automated sequential mill and acquire EBSD maps to collect series of texture or orientation maps for 3D reconstruction
- EDS3™ – automated sequential mill and acquire EDS data to collect series of chemical maps for 3D reconstruction
- 3D reconstruction software
- iFast Recorder for recording and repeating functions
- iFast Developer's Kit – automation package to control the instrument including image/pattern matching and custom recipe development and editing. Includes recipe hosting and sharing on FEI Connect
- AutoTEM™ wizard - automated sample preparation with section wizard
- GDStoDB™ and NanoBuilder™ – respectively basic and advanced FEI proprietary CAD based (GDSII) solutions for FIB and beam deposition optimized nanoprototyping of complex structures
- Knights Technology CAD navigation
- Web enabled data archive software
- Image analysis software

Installation requirements

[Refer to preinstall guide for detailed data]

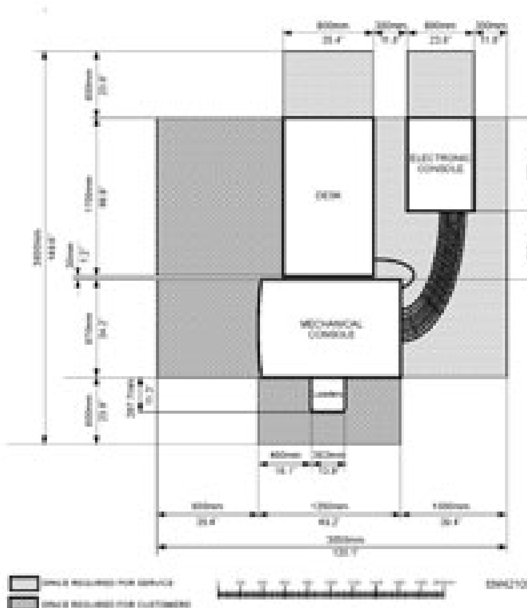
- Power:
  - voltage 230 V (+ 6%, - 10%),
  - frequency 50 or 60 Hz (± 1%)
- Power consumption: < 3.0 kVA for basic microscope
- Earth resistance: < 0.1 Ohm
- Environment:
  - temperature 20 °C ± 3 °C,
  - relative humidity below 80% RH,
  - stray AC magnetic fields:< 100 nT a-synchronous, < 300 nT synchronous for line times > 20 ms (50 Hz mains) or > 17 ms (60 Hz mains)
- Door width: 120 cm
- Weight: column console 850 kg
- Dry nitrogen:
  - system (0.7 to 0.8 bar, max 10 l/min during vent);
  - dry pump (1.0 bar, 2 l/min)
- Compressed air 4 to 6 bar - clean, dry and oil-free
- System chiller
- Acoustics guidelines: < 50 dBC (no acoustic pump enclosure) < 65 dBC (with acoustic enclosure present) (site survey required as acoustic spectrum relevant)
- Floor vibrations: site survey required as floor spectrum relevant
- Vibration isolation table available as option

Warranty and training

- 1 year warranty
- Choice of service maintenance contracts
- Choice of operation / application training contracts

Documentation and support

- On-line help
- Prepared for RAPID™ (remote diagnostic support)
- Free access to FEI.com for Owners on-line resources
- Free membership in the FEI FIB User Club



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TÜV Certification for design, manufacture, installation and support of focused ion- and electron-beam microscopes for the Electronics, Life Sciences, Research and Natural Resources markets.

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