PRODUCT DATA

FEI COMPANY™

Any sample, all data, any dimension

Quanta™ 3D FEG

Expand your boundaries for 3D nanocharacterization, prototyping and analysis

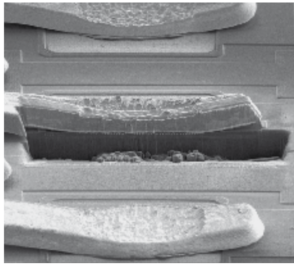
The Quanta 3D FEG is the most versatile high-resolution, low-vacuum SEM/FIB for 2D and 3D material characterization and analysis. Innovative electron and ion optics combined with Quanta's unique environmental SEM operating mode will expand your laboratory's capabilities, providing better, faster and more comprehensive materials characterization, analysis and sample preparation.

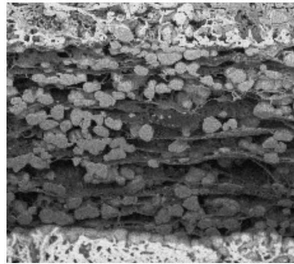
The Quanta 3D FEG's novel, field-emission electron source delivers clear and sharp electron imaging. Increased electron beam current enhances EDS and EBSP analysis. Featuring three imaging modes – high-vacuum, low-vacuum and ESEM™, it accommodates the widest range of samples of any SEM system. It is engineered to provide the widest range of data – imaging and microanalysis – from all specimens, with or without preparation. In-situ study of the dynamic behavior of materials at different humidity levels (up to 100% RH) and temperatures (up to 1500 °C) is also within the Quanta 3D FEG's capabilities.

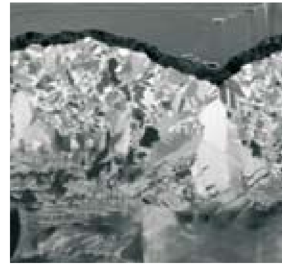
Quanta 3D FEG's unprecedented high-current FIB enables fast material removal. Automated FIB sectioning recipes enable accurate cross-sectioning. On top of the site-specific milling and excellent imaging capabilities of the FIB, a large selection of gas chemistries is available to deposit materials or further enhance the FIB milling rate or material selectivity. Quanta 3D FEG features live SEM imaging while milling, making it a superior solution for fast preparation of large samples over a wide range of materials.

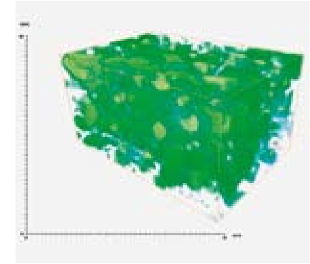
Building on FEI's long experience in DualBeam™ technology, Quanta 3D FEG provides you with a very powerful, easy to use solution for the investigation of all samples. Helping you to expand your boundaries and get more data from any sample.

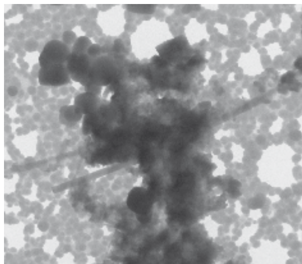
- *Increase your imaging and analysis capabilities: collect surface and subsurface information*
- *Minimize the time for imaging and analysis: Quanta's DualBeam™ geometry is designed to provide optimal ion milling and electron imaging at the beam coincident point*
- *Minimize the amount of sample preparation: low and ESEM-vacuum capability enables charge free imaging and analysis of non-conductive specimens and/or hydrated specimens*
- *Increase sample throughput by using Quanta's high-current FIB for fast material removal*
- *Increase milling rates and avoid re-deposition by using dedicated gas chemistries*
- *Increase your characterization capabilities, ultra-low specimen chamber vacuum (up to 4000 Pa) enables characterization at different humidity levels (up to 100 % RH) and temperatures (up to 1500 °C)*

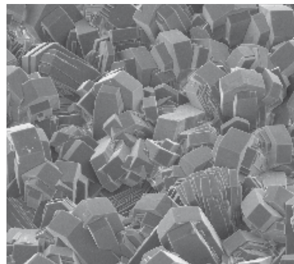

Large-area cross-section

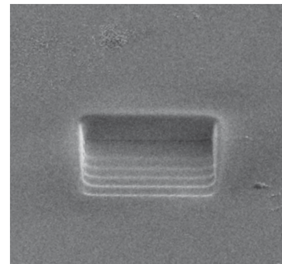

Cross-section made on cryo-cooled sample

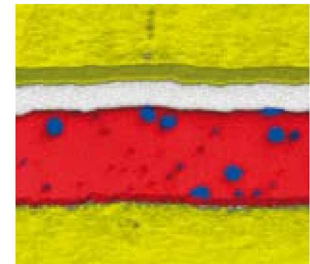

Channeling contrast using FIB-induced SE-Imaging


3D reconstruction based on serial sectioning


Wet STEM analysis


Imaging non-conductive sample


Milling non-conductive sample using charge neutralization mode


EDS analysis on cross-section

Quanta 3D FEG essential specifications

Electron beam resolution

- High-vacuum
  0.8 nm at 30 kV (STEM)*
  1.2 nm at 30 kV (SE)
  2.5 nm at 30 kV (BSE)*
  2.9 nm at 1 kV (SE)
- Low-vacuum
  1.5 nm at 30 kV (SE)
  2.5 nm at 30 kV (BSE)
  2.9 nm at 3 kV (SE)
- Extended low-vacuum mode (ESEM)
  1.5 nm at 30 kV (SE)

Ion beam resolution

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

Electron optics

- High-resolution field emission – SEM column optimized for high-brightness/high-current
- 60 degree objective lens geometry with through-the-lens differential pumping and heated objective apertures
- Accelerating voltage: 200 V – 30 kV (optional down to 100 V)
- Probe current: up to 200 nA - continuously adjustable
- Magnification 30 x – 1280 kx in "quad" mode

Ion optics

- High-current ion column with Ga liquid-metal ion source
- Source lifetime: 1000 hours guaranteed
- Acceleration voltage: 2 – 30 kV
- Probe current: 1 pA – 65 nA in 15 steps
- Beam blanker standard, external control possible
- 15-position aperture strip
- Magnification 40 x – 1280 kx in "quad" mode at 10 kV
- Charge neutralisation mode for milling of non-conductive samples

Chamber vacuum

- High-vacuum: < $6e^{-4}$ Pa
- Low-vacuum: 10 to 130 Pa
- ESEM-vacuum: 10 to 4000 Pa
- Pump-down time (high-vacuum): < 3 minutes

Vacuum system

- 1 x 240 l/s TMP
- 2 x PVP oil-free (scroll-pumps)
- 2 x IGP (for electron column)
- 1 x IGP (for ion column)
- Proprietary through-the-lens differential pumping
- Beam gas path length: 10 or 2 mm
- Seamless transition between high and low-vacuum
- Imaging gas in low-vacuum and ESEM: water vapor or auxiliary gas

* optional

Detectors

- Everhardt-Thornley SED
- Low-vacuum SED (used in low-vacuum)
- Gaseous SED (GSED) (used in ESEM mode)
- IR-CCD
- Solid-State BSED*
- Gaseous analytical BSED (GAD) (used for low-vacuum analytical applications)*
- 14-segment Annular STEM*
- CDEM*

Digital image processor

- Dwell: 50 ns – 25 ms adjustable in steps of 100 ns
- Up to 4096 x 3536 pixel resolution
- File type: TIFF (8, 16 or 24 bit), BMP, JPG or AVI
- Single frame or 4-quadrant image display
- 4-quadrant live
- 256 frame average or integration
- Movie recorder

Chamber

- 379 mm left to right
- 21 ports
- 10 mm E- and I-beam coincidence point = analytical working distance
- Angle between electron and ion columns: 52°

5-axis motorized stage

- Eucentric goniometer stage
- X = 50 mm
- Y = 50 mm
- Z = 25 mm
- Maximum sample height = 50 mm
- T = -15° to + 75°
- R = n x 360°
- Minimum step: 300 nm
- Repeatability @ 0° tilt; 2 µm
- Repeatability @ 52° tilt; 4 µm

Gas chemistry

- "Zero-collision" GIS design concept
  - Individual gas injectors with separate injections systems reconfigurable in the future
  - 5 µm placing accuracy without user interaction
  - GIS control available for automation
- Up to 5 gas injectors for enhanced etch or deposition
- Gas chemistry options:
  - Platinum metal deposition
  - Tungsten metal deposition
  - Gold deposition
  - Insulator deposition (SiO_2)
  - Enhanced metal etch (Iodine)
  - Insulator Enhanced etch (XeF_2)
  - Delineation etch
  - Selective Carbon Mill (SCM)
  - Carbon deposition
  - Empty crucibles for FEI-approved user supplied materials

System control

- 32-bit graphical user interface with Windows XP, keyboard, optical mouse
- Image display: 1 x 19" LCD, SVGA 1280 x 1024
- Support PC (incl. 2nd 19" LCD monitor and DVD R/W)*
- Multi-functional control panel*
- Joystick for stage control*

Standard utilities

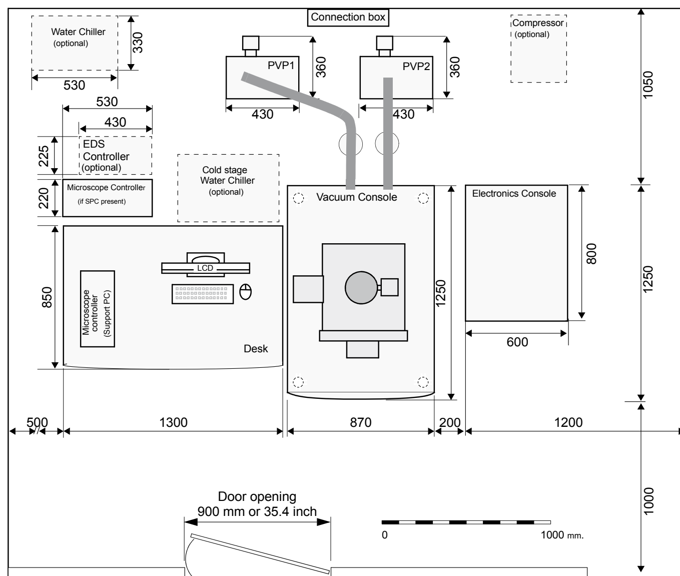
- "Beam per quad" graphical user interface concept
- Image histogram and measurement software
- Deposition and milling of: lines, boxes, open boxes, polygons, circles, cross-section and cleaning cross-section
- Directly imported BMP file for 3D milling
- Digital video recording (.avi)
- SW temperature control for optional heating and cooling stage

Documentation

- On-line help
- Quanta 3D FEG operating instructions on CD

Common system options

- Serial sectioning automation software (AutoSlice and View™)
- Automation software for multi-site milling (AutoFIB™)
- Automation software for unattended TEM sample preparation (AutoTEM™)
- 3D reconstruction software
- Image analysis and archive software
- SW controlled Peltier cooled specimen stage
- SW controlled WETSTEM system
- SW controlled 1000 °C heating stage
- SW controlled 1500 °C heating stage
- Remote control SW
- Video printer
- Specimen holder kit, TEM specimen holder kit
- Gas injectors
- BSED detector
- STEM detector
- Fast electrostatic electron beam blanker
- Supplies (compressor, mains matching transformer, UPS)
- Omniprobe for in-situ TEM sample lift-out
- Univeral sample loader system for fast sample transfer
- Cryo system



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Common 3rd-party accessories

- EDS
- EBSD
- WDS
- Nanomanipulator and accessories

Consumables

- Replacement Ga-ion source
- Aperture strips for electron and ion column
- CDEM detector
- Gas chemistry crucibles

Installation requirement

- Power: voltage 230 V (-6 %, +10 %), Frequency 50 or 60 Hz (+/- 1 %), Power consumption: < 3.0 KVA for basic microscope
- Environment: temperature 20 °C ± 3 °C, relative humidity below 80 % RH
- Stray AC magnetic fields < 100 nT asynchronous, < 300 nT synchronous
- Acoustics: < 60 dBC
- Compressed air 4-6 bar - clean, dry and oil-free
- Door width: 90 cm
- Weight: column console 700 kg
- Weight: electrical console 150 kg

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TÜV Certification for design, manufacture, installation and support of focused ion- and electron-beam microscopes for the NanoElectronics, NanoBiology, NanoResearch and Industry markets.

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TOOLS FOR NANOTECH

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