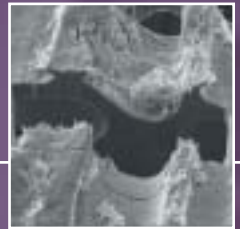
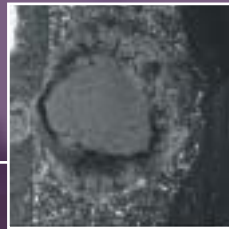




"Any sample, all data, any dimension"



Quanta™ Series

Flexible SEM Solutions for industrial
and institutional characterization
and microanalysis requirements





Quanta™ - The All in One SEM solution:
Ready to serve a broad range of applications,
now and in the future



Quanta W



Quanta FEG



Quanta 3D

Control your SEM future

Technologies, materials and samples are changing faster than ever before, and so is the diagnostics function in analytical laboratories. Analytical tools need to accommodate materials with very different properties while collecting more data in less time. There is an increasing demand for non-destructive analysis, and functionality that can accommodate advanced analytical requirements long into the future.

The Quanta™ Series from FEI is the advanced, flexible solution for current and future Structural Diagnostics™ and automation applications. 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 maximum imaging and microanalysis data – from all specimens, with or without preparation.

The All in One, single tool advantage

The Quanta does with a single tool what used to require multiple systems. What's more, it leaves the specimen intact should this specimen need to be investigated further or used again to complement the diagnostics data set. Quanta is the versatile sample diagnostics and data management solution ready to serve all your advanced applications, today and in the future.

FEI leadership

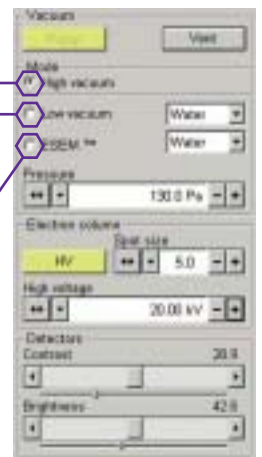
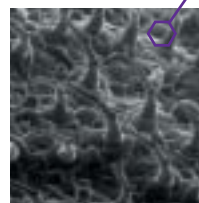
FEI Company is the Structural Process Management Company™ serving analytical lab, life science, semiconductor and data storage markets. Our technology base represents more than 100 years of advanced engineering for SEM, SIMS, TEM, FIB, and DualBeam™ solutions. With FEI, you can invest in your SEM future with confidence.

Global service and applications support

FEI service and application support is organized from three regions: Europe (including Latin America), North America, and Asia Pacific (including Australia). Our application support laboratories in these regions welcome you for demonstrations, training and application support.

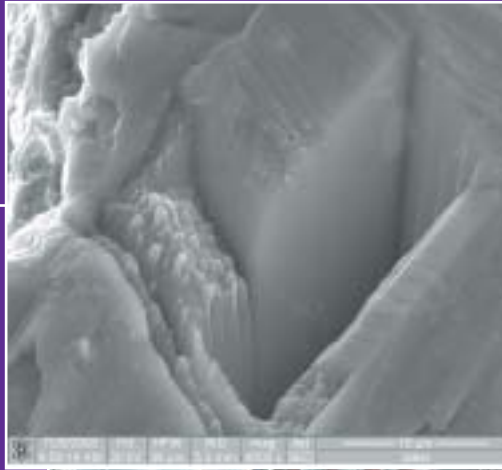
Remote diagnostics and software upgrades

Our service engineers are able to perform remote diagnostics, delivering improved repair efficiency and faster time to repair. Software upgrades are available as part of service contract agreements.

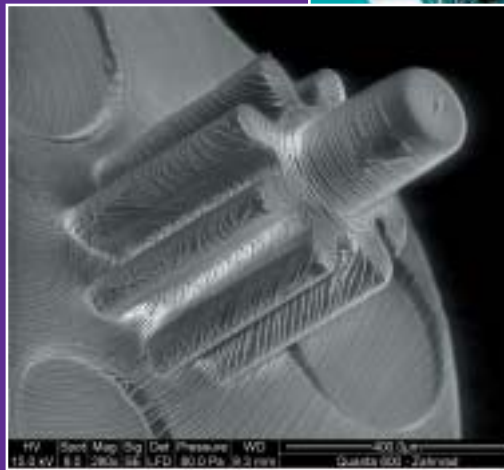
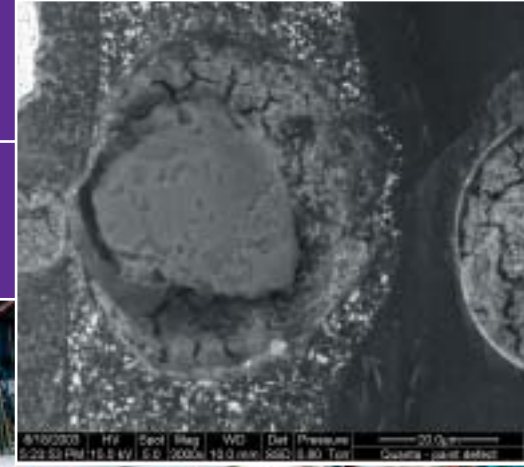


Quanta: the system for automotive failure analysis and quality control

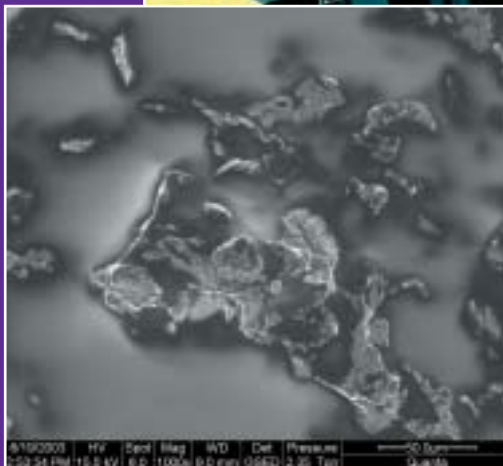
High vacuum, subsurface
Aluminium.



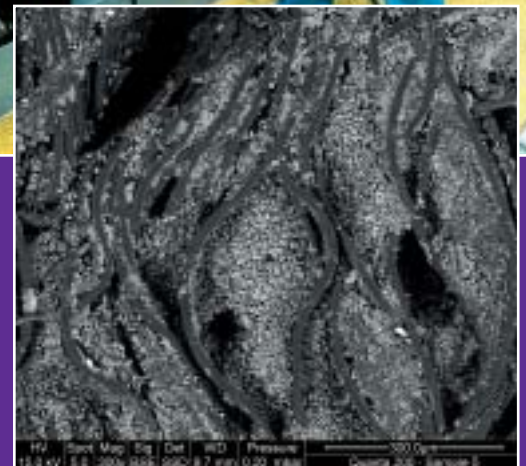
Low vacuum, phase distribution
Car paint cross-section.



Low vacuum, surface
Gearwheel, low magnification.



Low vacuum, morphology
Oil film on metal.



Low vacuum, phase distribution
Fibres in rubber.

Increase the value of your data and operation

◉ Automation

The industry standard Quanta software supplied is easy to operate and feature-packed. In addition to 4-quad imaging the Quanta has auto-focus, auto-stigmator, auto-contrast and brightness, and an extensive on-line help function. The multi-user software allows every operator to store and create his own toolset. Regions of interest can be dragged, centered and zoomed with a mouse-click. A digital video (AVI) facility in 3 (live) quads enables the user to record experiments. The Quanta also features a fully networkable image archiving system.

The user interface is designed for efficient user-interaction during data collection. Once the data collection process turns into a routine operation – a repeatable sequence that yields the same type of data – the standard scripting adapter allows the operation to be fully automated. For more complex procedures, users can work with FEI to develop customized scripts. FEI is committed to increasing the value of your system's performance through automated data collection solutions.

◉ Safeguard sample authenticity – safeguard credibility

The credibility of analytical data output is strongly dependent on preserving the original state of samples. Because samples for the Quanta do not require coating or other preparation prior to analysis, the FEI Quanta series preserves a specimen's authenticity while providing images with great detail and superb depth of focus. Once a sample is investigated in the Quanta SEM it can be studied again, without additional preparation or alteration. Interpret your analytical results with confidence that it is the most accurate data attainable.

◉ Reproduce data with confidence

In many industrial SEM applications, including failure analysis and forensics, the findings of the analytical lab can have tremendous legal consequences. Thus, absolute reproduction of artifact free data is a vital quality requirement of today's analytical labs. With conventional SEMs, the ability to reproduce data depends on the exact duplication of sample preparation techniques.

By eliminating the need for sample preparation, Quanta delivers improved reproduction and reliability of data.

◉ Reduce time to result

Making non-high-vacuum compatible samples (such as bulky, oil contaminated metal fragments) suitable for conventional high-vacuum SEM environments is time consuming and can lead to unacceptable delays in the data collection process. Eliminating the sample preparation phase and instead analyzing in low-vacuum or ESEM mode significantly reduces your time to result. Embedded microanalysis, accessible through the Quanta user interface, is a significant contributor to achieving the shortest possible time to result.

◉ Improve your return on investment

- Quality and repeatability of data
- Faster time to result
- Greater flexibility and higher utilization
- Prepared for any application and any sample that might come your way

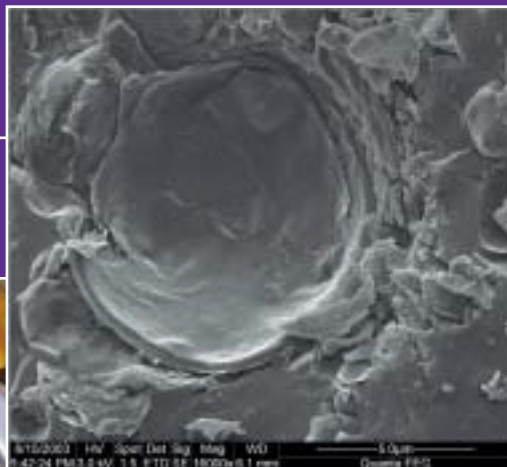
Capable of analyzing unprepared specimens, the Quanta All in One SEM will be used more often and earlier on in the data collection process. From any perspective, the Quanta can significantly improve the return on your SEM investment.



Easy to use 4 quad interface.

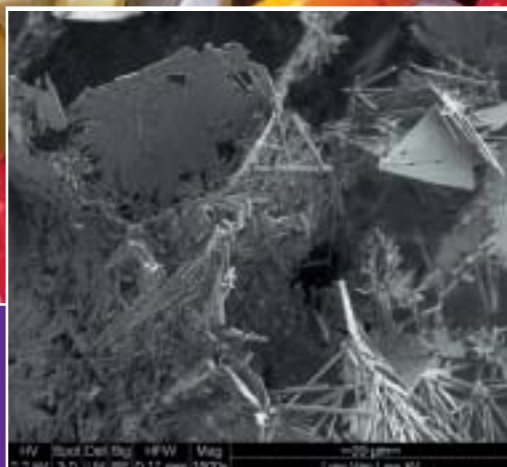
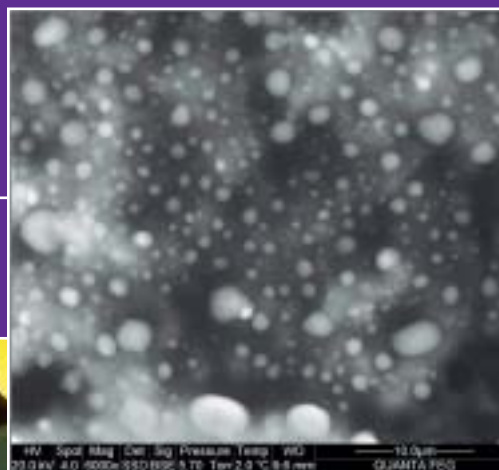
Quanta: the system for pharmaceutical diagnostics applications

High vacuum, cryo
Skin cream.



ESEM™, morphology

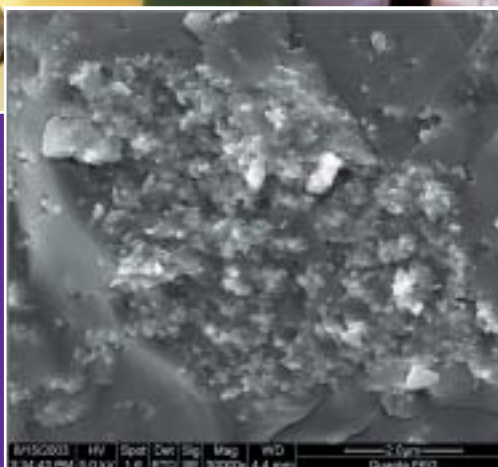
Darkfield STEM image of pharma emulsion at 100% humidity.



Low vacuum, surface
Beam sensitive drug crystals.



ESEM™ in-situ dynamic
experiment
Hydration experiment of
effervesce tablet.



High vacuum, cryo
Toothpaste.

Any sample

The differentiating feature of the Quanta SEM series is FEI's proprietary vacuum and imaging technology. It allows data collection for any sample in a true All in One SEM high-vac, low-vac and ESEM system.

⬢ SEM without compromise

The exciting new analytical capabilities in low vacuum and ESEM modes do not limit the use of Quanta in high vacuum mode. What worked for you using conventional SEM will work for you with Quanta. Quanta's high vacuum mode imaging and analytical performance is not compromised by the All in One design concept. It's a conventional SEM in high vacuum mode. Switching from high vacuum to low vacuum is seamless, activated and executed by a single mouse click.

⬢ Eliminate sample charging

Charging of non-conductive or poorly coated specimens is a common nuisance for high vacuum SEM users. Quanta combats this with its low vacuum operation mode. The charge build-up can be avoided by injecting gas into the specimen chamber while

in low vacuum mode. Quanta's low vacuum mode accommodates all non-conductive specimens. Unlike other low vacuum SEMs, it behaves like a high vacuum SEM with the SE detector standard and similar resolution specifications.

⬢ Difficult samples no longer exist

Sample data collection using conventional SEM on moist/wet, hot or dirty specimens has often been declined in the past with the justification "not possible". This is no longer the case. The high pressure allowed in the Quanta specimen chamber, significantly higher than in other low vacuum SEMs, provides the necessary environment to collect data even from moist/wet specimens (up to 100% relative humidity), heated specimens (up to 1500 °C), or oil or emulsion-coated specimens.

⬢ Large or small samples

The Quanta series provides the necessary required sample space to navigate large and irregular specimens without requiring mechanical adjustments. Three stages are available with motorized 50 mm (2-inch), 100 mm (4-inch) and 150 mm (6-inch) stage x/y travel. In particular, the motorized z-range, which is 60 mm and 65 mm for the 100mm and 150 mm stage respectively, doubles the amount of usable z-space compared to most other low vacuum SEMs. Your benefit: analyze larger specimens without mechanically adjusting sample height and interrupting the workflow.

Any sample – Quanta vs other SEM solutions

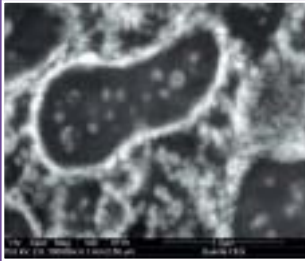
	Conductive	Non-conductive	Moist/Wet	Dirty	Hot/Outgassing	Large/Thick	In-situ Modification	Subsurface Imaging & Analysis
C-SEM	+	-	-	-	-	+	--	--
LV-SEM	+	+	-	+	-	+	--	--
FE-SEM	++	+	--	--	--	+	-	--
Quanta W	+	+	+	++	+	++	-	-
Quanta FEG	++	++	+	++	+	++	-	--
Quanta 3D	+	+	+	++	+	+	++	++

Quanta: full service analytical data solution

STEM imaging

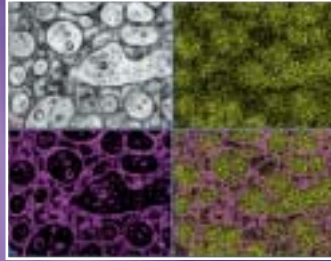


Brightfield STEM of a TEM sample.

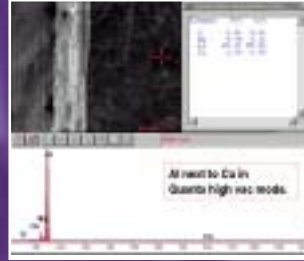


Darkfield STEM of a TEM sample.

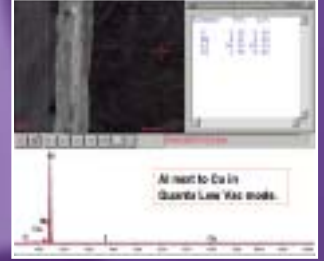
True Energy Dispersive Spectrometry (EDS) analysis



Brightfield STEM image (top left) with elemental EDS mapping of a TEM sample.

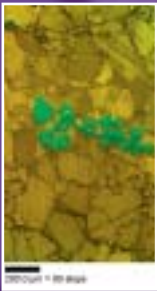


EDS spectrum in high vacuum of Cu (without scattering).



EDS spectrum in low vacuum of Cu (without scattering).

Electron Backscattered Diffraction (EBSD)



Ca EDS mapping.

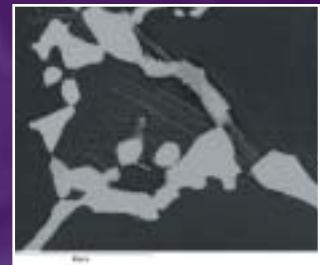


IPF crystal orientation map.



Uncoated Calcite sample.

Wavelength Dispersive X-ray Spectrometry (WDS)



Superalloy.



WDS spectrum of Superalloy (Mo and Nb).

In-situ dynamic experiments



Hydration/dehydration NaCl.



Tensile experiment of stretching polymer.

All data

With analytical attachments, Scanning Electron Microscopy becomes an extremely versatile technique. All Quanta microscopes can be equipped with state-of-the-art contrast mechanisms, diffraction techniques, cathodoluminescence (CL) energy dispersive spectrometry (EDS), Wavelength Dispersive X-Ray Spectrometry (WDS), and STEM technology, and are able to reveal data from dynamic in-situ experiments.

○ Morphological characterization

The principle contrast mechanism offered by secondary electron emission is known as the “edge effect”. Due to this edge effect, small micrometer- to nanometer-sized topographical features appear as bright features in the SE image to reveal the sample’s morphology. To reveal the edge effect, the standard Quanta configuration, unlike most other low vacuum SEMs, includes the necessary secondary electron detectors for all vacuum modes.

○ Surface characterization

Due to the penetration nature of high acceleration-voltage primary electron beams, true surface details only become visible at low acceleration voltages (< 5 kV). The Quanta range provides state-of-the-art imaging capabilities down to 200 V to reveal surface detail not visible at high accelerating voltages.

○ Phase distribution

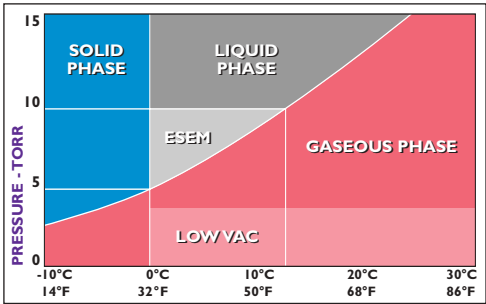
Distribution of materials with different atomic composition is made visible using backscattered electron detectors. The solid state backscattered electron detector for the Quanta range is optimized to differentiate phases of even very small atomic number differences.

○ Quantitative microanalysis

The ability to collect high quality quantitative microanalysis data in all vacuum modes may seem obvious when the system is equipped with an Energy Dispersive Spectrometer (EDS), but collecting this data in a gaseous environment (low vacuum or ESEM mode) is not trivial. The key issue is to keep the primary beam away from the gas, as beam scattering causes the beam to lose coherence, and hence the spatial resolution in the EDS spectrum is lost. Quanta’s Gaseous Analytical Detector (GAD) provides the necessary geometry to reduce the beam skirt effects compared to other low vacuum SEMs, for high quality EDS data, even in low vac.

○ In-situ materials testing

Failure analysis labs typically feature in-situ dynamic testing devices such as stress, strain, and environmental testing machines. The Quanta can also be used to study and record (avi) sample characteristic changes in a dynamic environment. Quanta accurately controls the sample’s environment for studies such as humidity cycling storage tests in pharmaceuticals, crystallization and melting cycles in ceramics, and stress-strain tests using optional tensile stages in metallurgy.

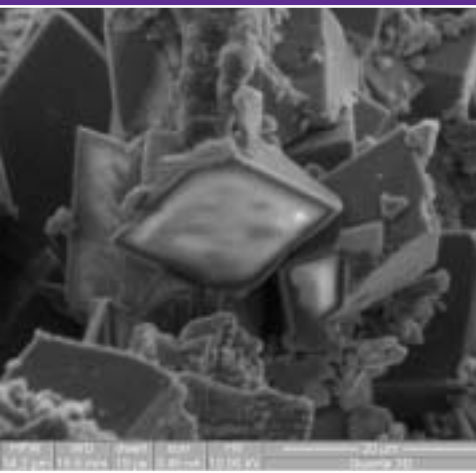


Phase diagram for H₂O

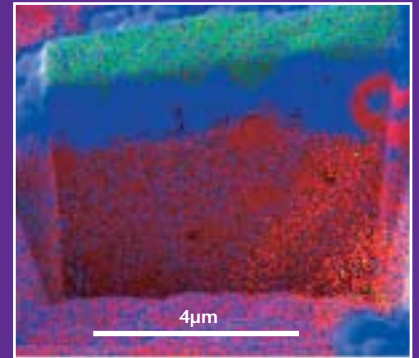
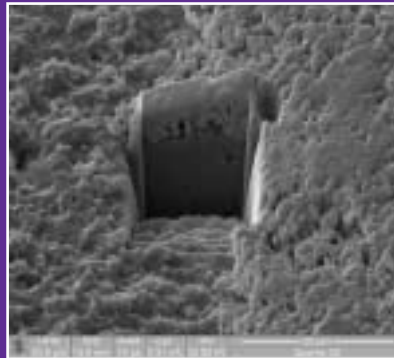
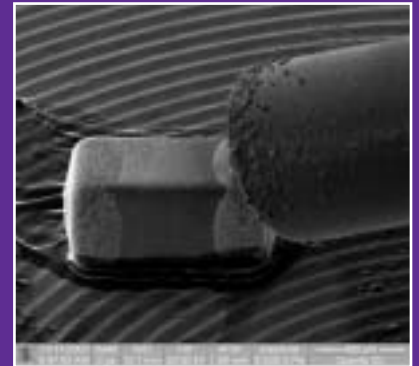
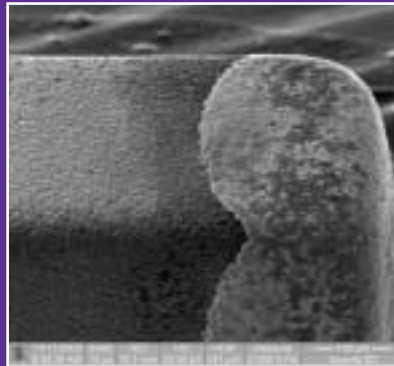
Quanta vs other SEM solutions

	Morphological Characterization	Surface Characterization	Phase Distribution	Quantitative Microanalysis	In-situ Testing	Sub-surface Imaging & Analysis
C-SEM	-	+	-	-	-	-
LV-SEM	+	+	+	-	-	-
FE -SEM	-	++	+	-	-	-
Quanta W	++	+	+	+	+	-
Quanta FEG	++	++	+	+	+	-
Quanta 3D	++	+	+	+	+	++

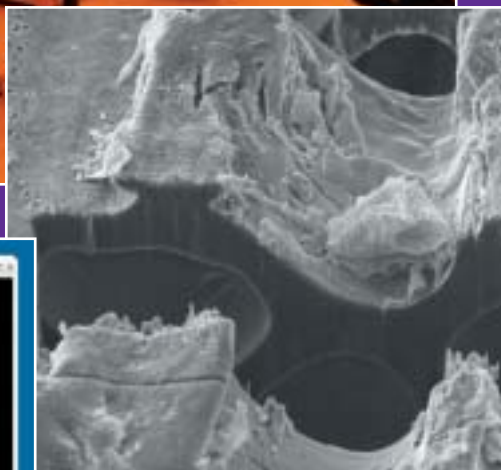
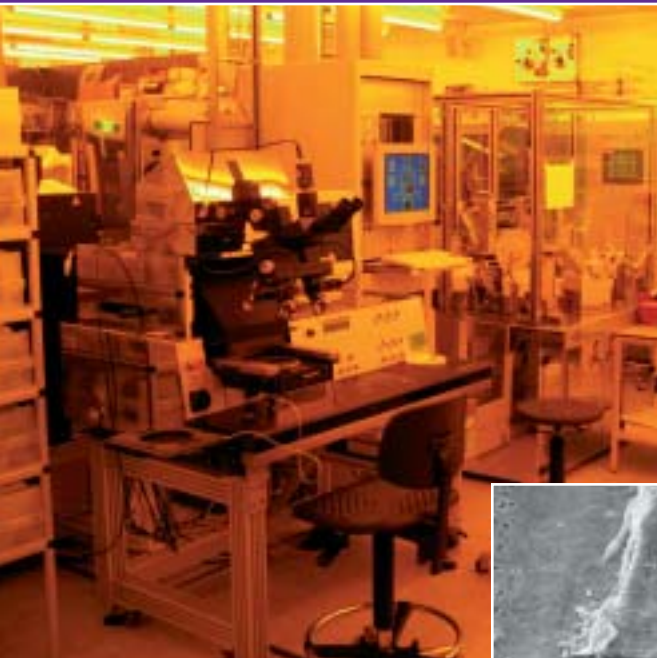
Quanta 3D: the ultimate tool for subsurface imaging and analysis



Low vacuum
Sectioned crystal in
sandstone.



Images show deposition on Pt, milling and elemental map of ceramic capacitor.
(Ni = red; Sn = blue; Pt = green)



Low vacuum
toothpick cross-section.



Realtime milling process
milling of welded materials.



Realtime milling process
milling of a protectively coated foodcan.

Quanta 3D: any sample, all data, any dimension

Quanta 3D brings new capabilities to materials characterization. It combines scanning electron microscopy (SEM) with focused ion beam (FIB) sample characterization and analysis both above and below the surface, and sample modification using material removal and deposition.

Exploring the Third Dimension in Microscopy













Focused ion beam (FIB) technology is a proven technology that is now finding application in research areas traditionally supported by SEM. The value of FIB is that it is complementary to SEM, delivering the ability to explore a third dimension of data, below the surface of a sample, and enabling a greater understanding of material characteristics and structures. Quanta 3D is unique to other dual column instruments in that it is the first multi-mode SEM to harness the added power of the FIB.

The greater mass of the ion permits the FIB to become a microsurgical tool that removes material from a site-specific area to allow SEM imaging of the internal structure. FEI's proprietary ion optics deliver a high accuracy, high stability beam, while fully automated apertures allow you to optimize beam size and probe current for milling, material deposition, or gas-assisted etching.

The presence of FIB on a SEM extends the applications possible for a single microscope. Both beams are aimed to exactly the same point on the sample (the coincidence point), giving the ability to perform milling, modification or deposition while acquiring live images. The geometric configuration of the Quanta 3D makes it possible to add analytical techniques (EDS, EBSD, WDS) while still offering ports for CL or Cryo. Additionally, the FIB can be used to obtain high contrast images for material grain studies.

New Capabilities to Expand Your Research

Do you know whether your sample is hiding secrets from you? Quanta 3D will reveal the answers by giving you access to information buried below the sample surface.

	rectangle	cross-section	line and circle	bitmap
Top				
Side				
3D				

Standard available patterning and deposition toolkit.

Milling

FIB is most commonly used to mill through the surface of the sample to reveal a cross sectional view of its underlying structure. This gives you access to areas that you would not be able to see using only SEM, for example, a subsurface defect in material layers. FIB milling can also be used for the preparation of site-specific thin samples which can then be analyzed either in situ with STEM, or in a TEM for more in-depth understanding of the sample.

Deposition

Beam-induced deposition is performed by introducing a material (Pt, W, C, etc...) close to the sample surface and catalyzing it with the ion or electron beam. Deposition can be used to apply a protective layer over the sample surface, or to create structures either from the bottom up, or from the top down. FIB is best suited for rapid material deposition over a large (define?) area. E-beam deposition delivers the highest accuracy.

Patterning

Quanta 3D utilizes a digital pattern generator to enable creation of any pattern imaginable. Grayscale bitmap files are used to define the desired pattern, with gray level determining the dwell time. Automation allows you to repeat these patterns accurately over a defined area of your sample.



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Image courtesy: page 4 Nedcar and page 10 Philips research labs.