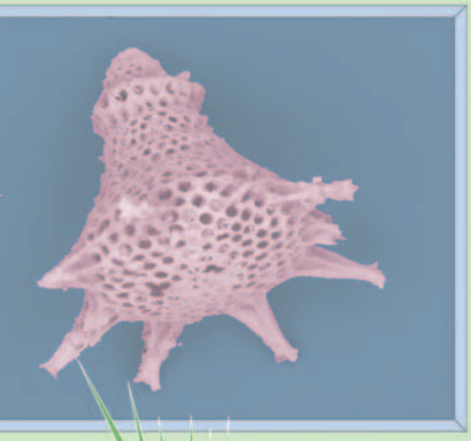
Hitachi High-Tech
HITACHI

Hitachi Tabletop Microscope

TM3000



Tabletop Microscope

The TM3000 is the advanced next-generation tabletop electron microscope from Hitachi.

Perfectly suited to applications in R&D, quality control and education.

The TM3000 builds on the phenomenal global success of its predecessor, with over 1000 instruments installed. Now more advanced microscopy needs are addressed whilst maintaining incredible ease of use - pushing back the boundaries for the tabletop electron microscopy.

[Key Features]

- Compact and portable (24% smaller footprint and 25% lighter)*.
- Simple operation with extensive auto functions.
- Wide magnification range of 15x to 30,000x – ensuring you get maximum benefit from the resolution and depth-of-field advantages of electron microscopy.
- Image insulating materials with ease - no need for specimen coating with the TM3000's charge-up reduction mode.
- Multiple beam conditions and versatile detector control to ensure you get the perfect image.

* Comparison with TM-1000 / Excluding PC and Diaphragm Pump

Specimen: Green foxtail
* Typical configuration of TM3000 with PC.
* Screen shows simulated image.

Compact and portable, with incredibly simple operation

● Tabletop installation

The space saving and lightweight design of TM3000 means it can be conveniently installed on a table*. No cooling water is needed, so installation is quick and easy and requires only a standard 100-240 V AC power supply.

(*) requires a table capable of supporting 100 kg.

* Typical configuration of TM3000 with PC.
* Screen shows simulated image.

● Environmentally-friendly pumping system

The TM3000 features a dry (oil-free) vacuum system, consisting of a diaphragm pump for rough evacuation and a high performance turbo-molecular pump for main pumping.

● Large specimen handling

The large specimen stage allows mounting of a specimen up to 70 mm diameter and 50 mm thick.
X/Y specimen motion: ±17.5 mm

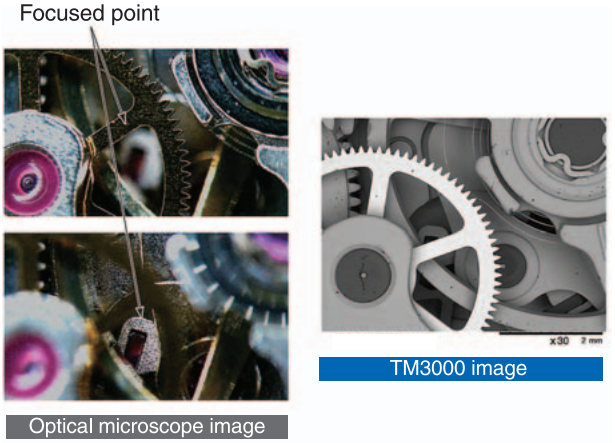
● Fast specimen exchange

The high-performance vacuum system provides fast pump-down, but specimen exchange also requires chamber venting. It takes just 1 minute to vent the TM3000 specimen chamber, twice as fast as the TM-1000.

Comparison of chamber venting time

● Topographic imaging with a large depth of focus

Complex specimen structures are easily observed with a resolution and depth of focus far beyond what is achievable by optical microscopy.

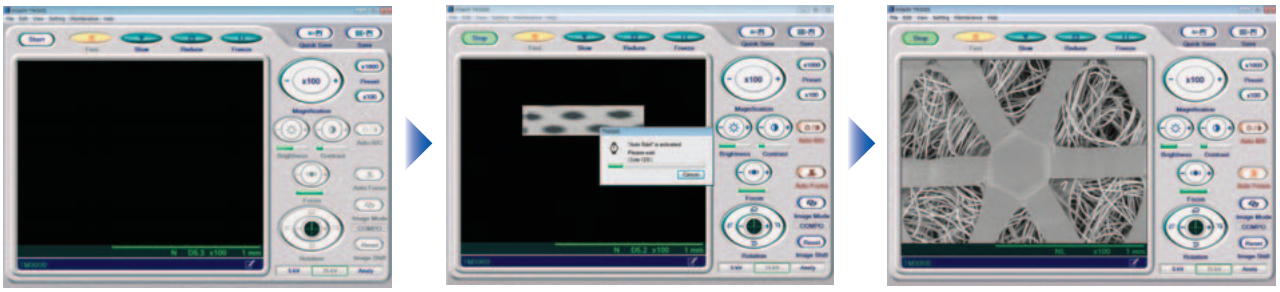


Specimen: Movement of wristwatch

With a width of just 330mm, laptop-PC based operation and no special installation requirements the TM3000 can be installed almost anywhere. Comprehensive auto-functions ensure it can also be used by anyone.

● Comprehensive auto-functions, with one-click "Start".

Imaging with the TM3000 couldn't be simpler. Pressing the "Start" button automatically turns the beam on, adjusts focus, brightness and contrast and displays the image at an easy-to-view starting magnification of 100x.



Specimen: Bandaid

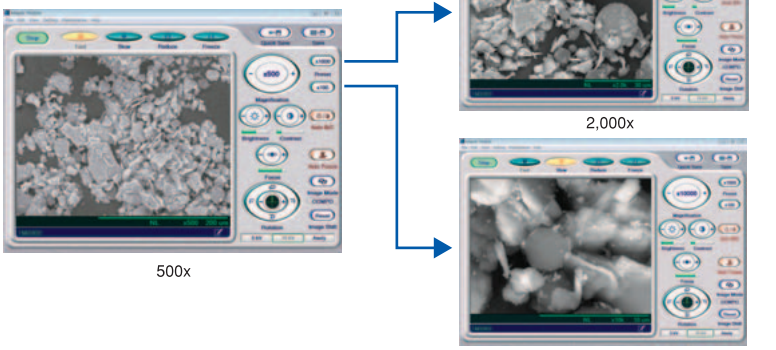
● Smooth magnification adjustment

Since magnification is increased simply by narrowing the scanned area, continuous magnification adjustment from x15 to x30,000 is achieved by simply dragging the mouse - making it quick and easy to find the area of interest.

Specimen: Cloth

● Preset magnification

Frequently used magnifications can be saved in memory (preset). The magnification can be changed to a preset value with a click of the mouse.



500x

2,000x

10,000x

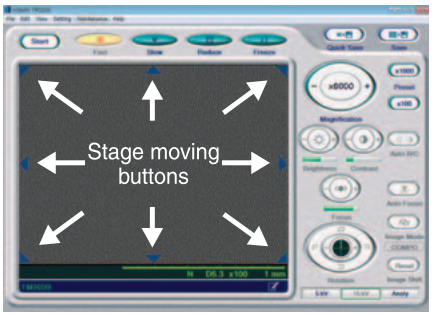
Specimen: Foundation

* Typical configuration of TM3000 with PC.
* Screen shows simulated image.

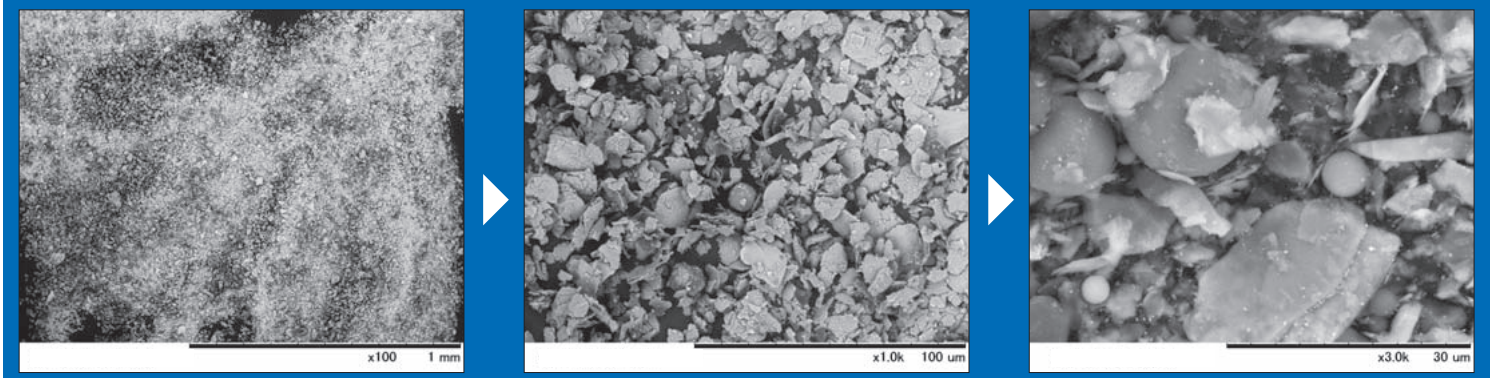
Motorized stage version

With the optional* motorized specimen stage, all functions of the TM3000 can be operated using the mouse alone. Sample navigation can be performed through the user interface - either by double-clicking a desired destination on the image or by clicking the stage move arrows.

* Please specify manual or motor-drive stage when ordering the TM3000



Versatility is assured – with a wide magnification range and multiple operating conditions.

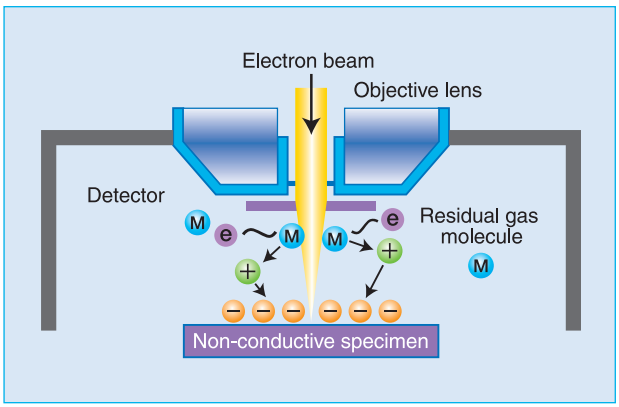


● Image non-conducting specimens with ease.

When an electrically non-conducting specimen is observed with a high-vacuum SEM, electrons accumulate on the specimen surface causing a charge-up phenomenon, which prevents normal imaging. Conventionally, to avoid this problem, the sample is usually vacuum coated with a thin layer of metal before observation. This process is not only time consuming, but the metal coating can interfere with imaging and EDX analysis. The TM3000 overcomes this problem with the "charge-up reduction mode" – using low-vacuum operation to eliminate the charge-up effect.

● Low-vacuum microscopy

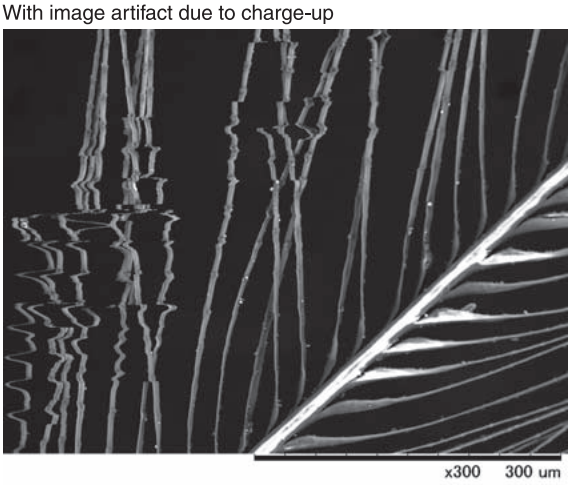
By utilizing a low vacuum level inside the specimen chamber, more gas molecules are present. These gas molecules (M) can collide with the electron beam to generate positive ions (+) and electrons (e). Each positive ion (+) can be neutralized by one of the excess electrons (−) on the specimen surface. In this way the excess electrons on the surface of the sample are removed and the charge-up effect is eliminated or reduced.



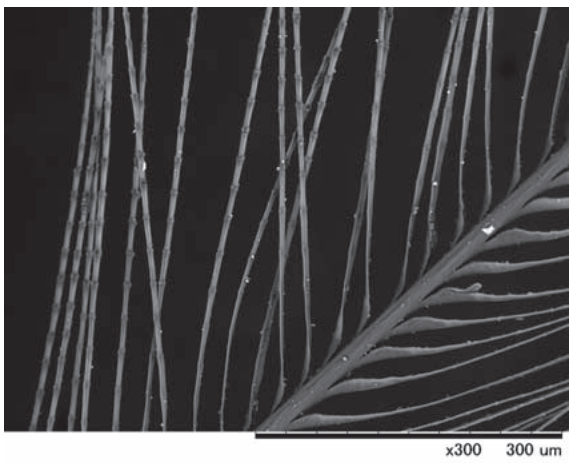
● Charge-up reduction mode

The TM3000 can operate either in "standard mode" or "charge-up reduction mode" depending on the extent of the specimen charging.

With image artifact due to charge-up

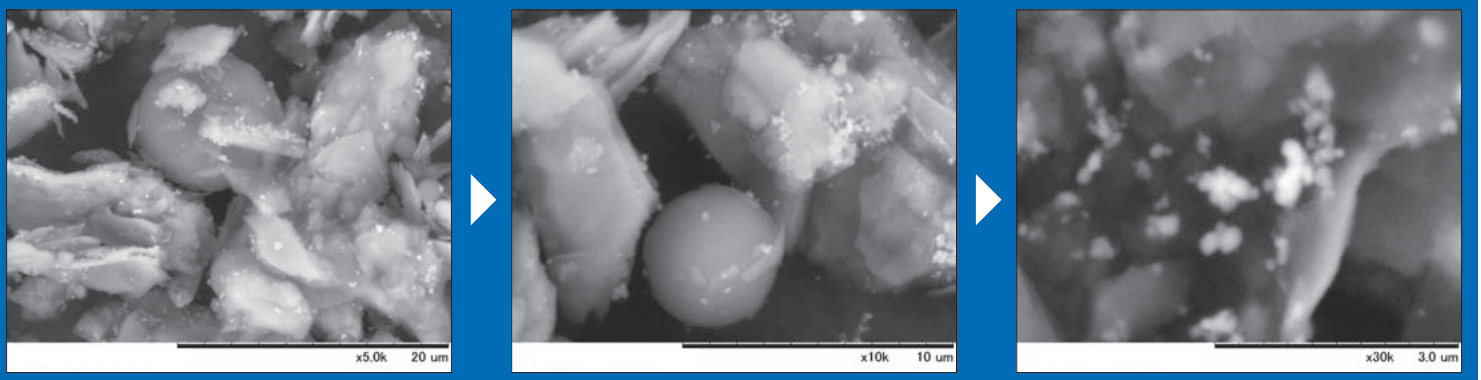


Without image artifact due to charge-up



Specimen: Bird's feather

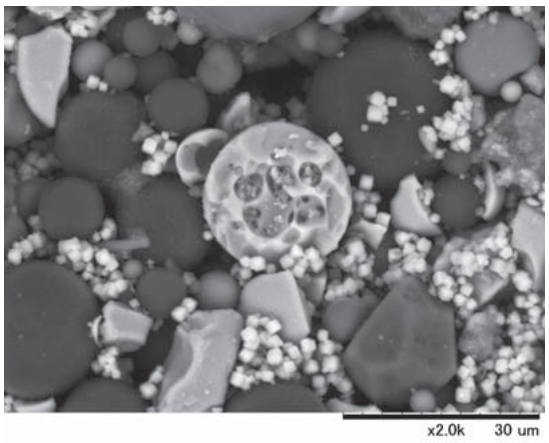
The versatile TM3000 can be used for almost any type of specimen.
Even non-conducting specimens or samples containing moisture can be imaged directly, throughout the whole magnification range of x15 to x30,000, without any special sample preparation.



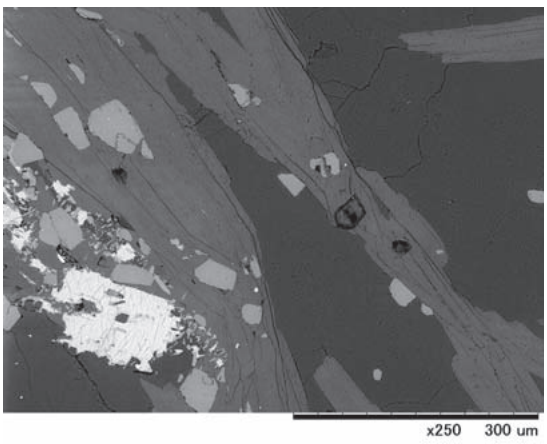
Specimen: Face powder

● Compositional imaging

In addition to traditional topographic imaging, the TM3000 can produce compositional images, where the different brightness levels represent different composition in the sample. In this mode, higher brightness corresponds to higher atomic number.



Specimen: Powder spray



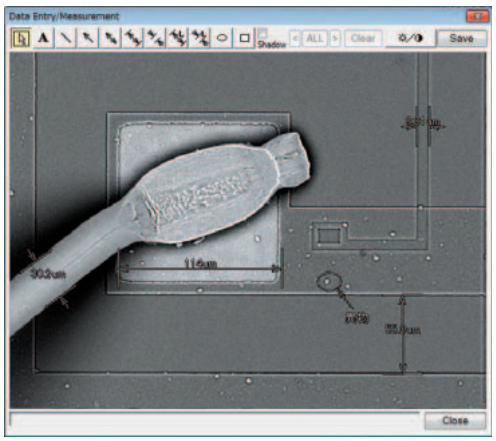
Specimen: Garnet - muscovite - albite schist

Specimen courtesy of: Nagoya University Museum
Designated Prof. Mamoru Adachi

● Tools for measurement and annotation

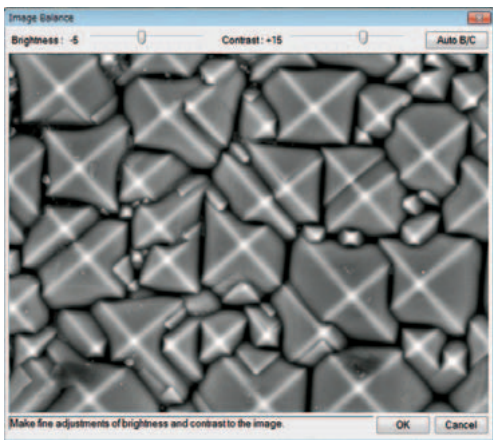
- Distance measurement
  Distance can be quickly and easily measured by dragging the mouse between two points of interest.
- Graphics/comment input
  Simple graphics and comments can be added to the image.

Simple length measurement and graphics/comment input



Specimen: Wire bonding

Brightness/contrast adjustment window



Specimen: Solar battery

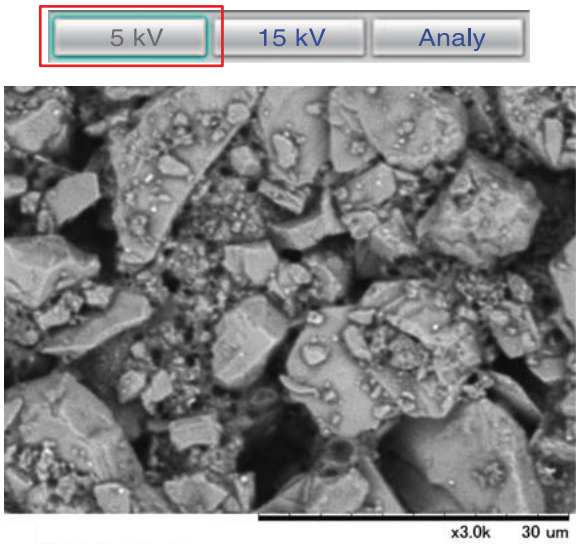
Three independent observation condition modes

The TM3000 features three beam conditions to choose from depending on the information required in the image. The '5 kV', '15 kV' and 'Analysis' modes greatly simplify operating condition setup, and no adjustment is required when switching between modes.

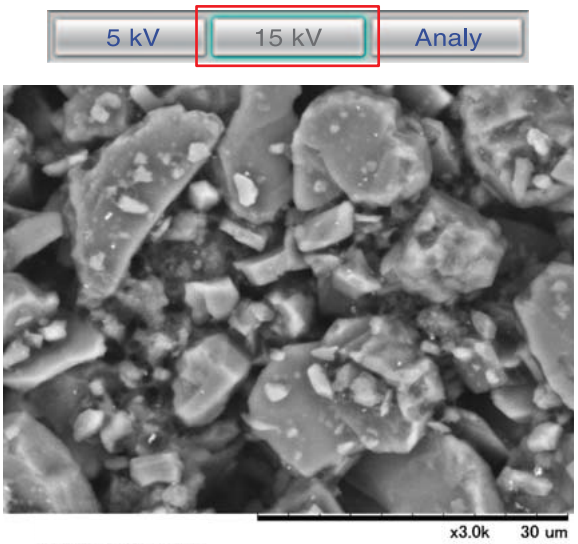
5 kV ..... emphasizes surface detail

15 kV ..... can be used throughout the magnification range and gives the best resolution

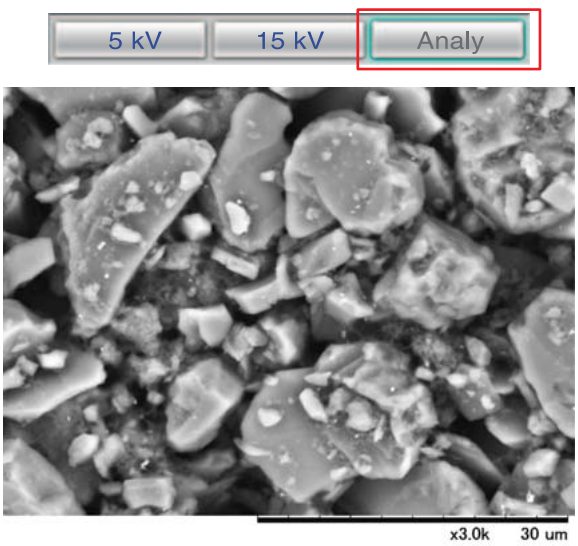
Analysis ..... used for elemental analysis or low contrast specimens



5 kV charge-up reduction mode



15 kV charge-up reduction mode



Analy (15 kV) charge-up reduction mode

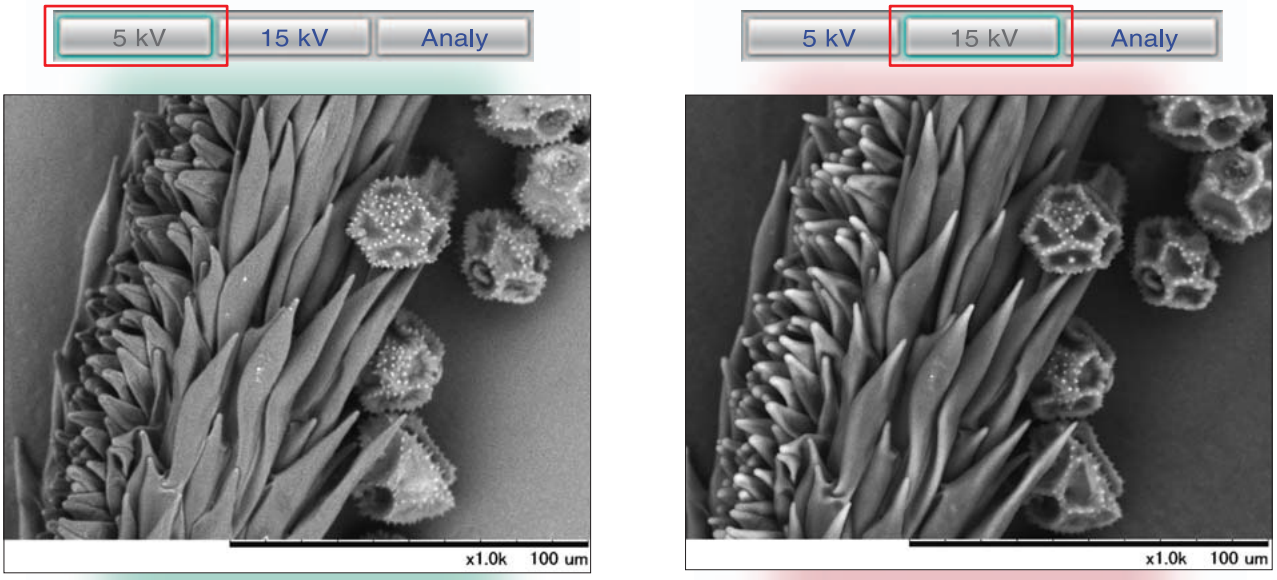
Specimen: Tooth paste

■ Accelerating voltages

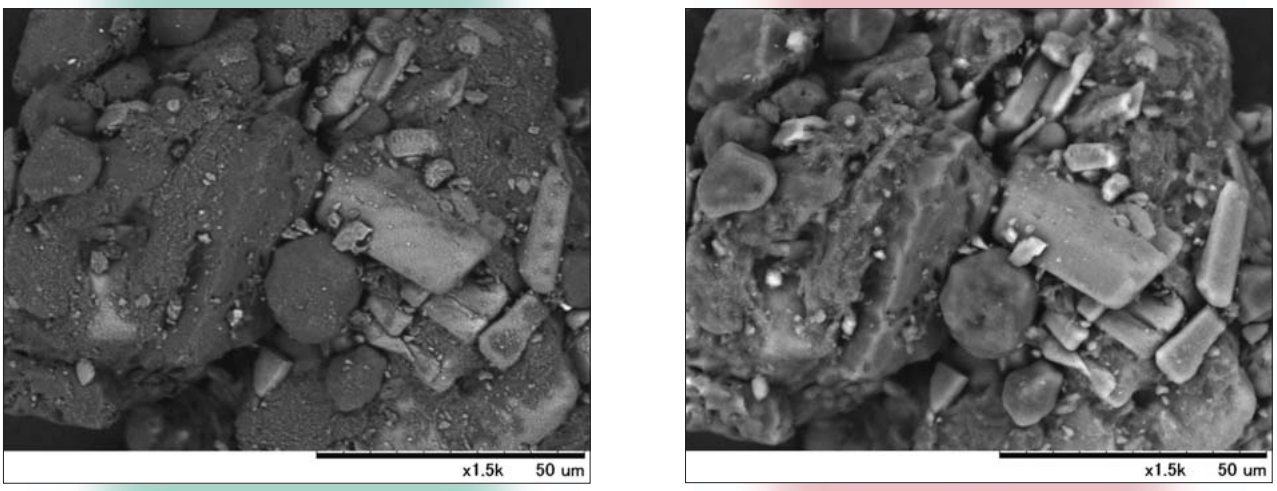
By providing different accelerating voltages in '5 kV' and '15 kV' modes, and using the high sensitivity backscattered electron detector, different types of imaging are possible with the TM3000. An accelerating voltage of 15 kV is used for most imaging applications and offers the best resolution. At 5 kV, the electron beam does not penetrate so far into the sample, so the images show more surface detail.

Accelerating voltage	15 kV	5 kV
Resolution	Best ← →	Lower
Image information	Subsurface ← →	Surface
Backscattered electron signal	High ← →	Lower

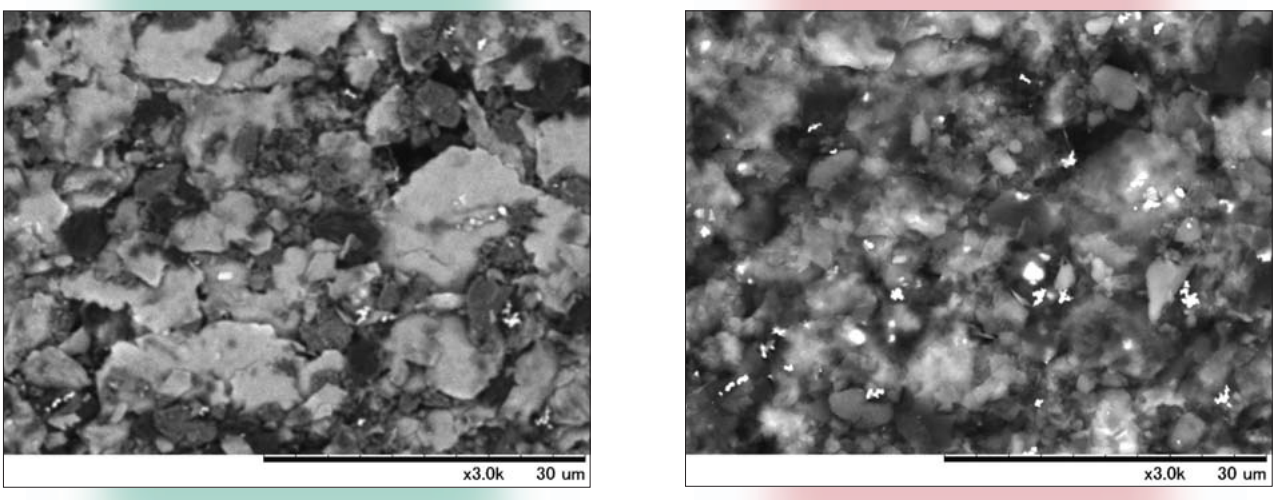
■ Difference in image appearance using different observation condition modes



Specimen: Pistil of dandelion



Specimen: Powdered medicine

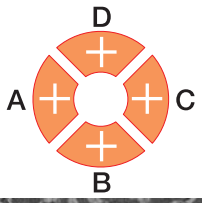


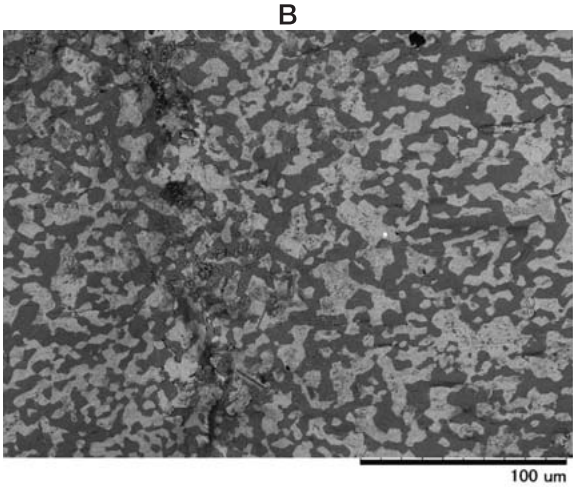
Specimen: Adhesive tape

Directional imaging using the 4-segment detector

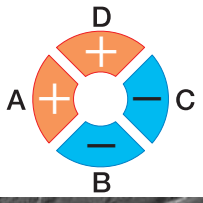
The TM3000 features a backscattered electron detector with 4 independent segments. By adding or subtracting the signals from the segments in different combinations it is possible to emphasize compositional or topographic detail in the image, as well as produce 'shadowed' images which highlight the sample from a particular direction.

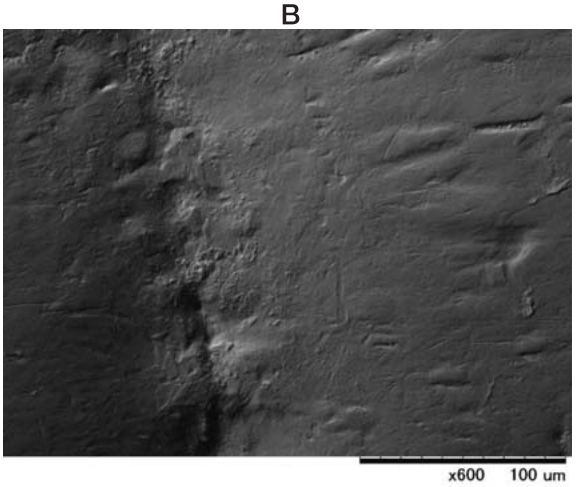
Compo



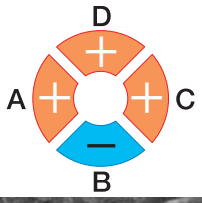


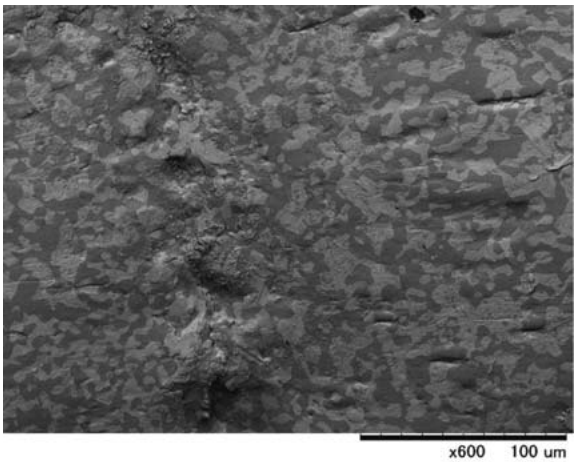
Topo



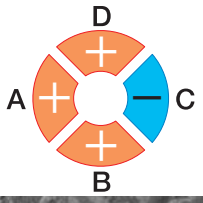


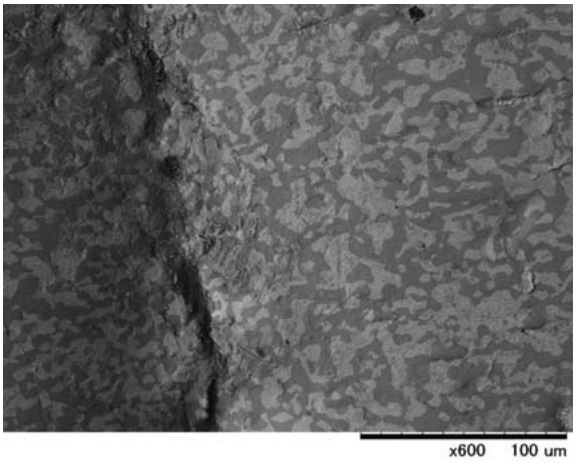
Shadow 1





Shadow 2

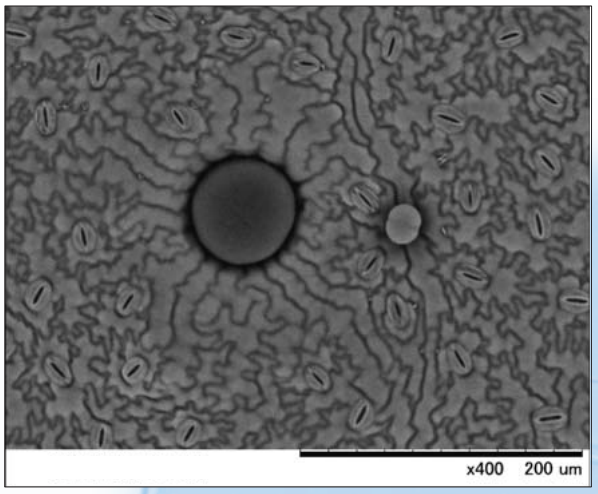




Specimen: Solder

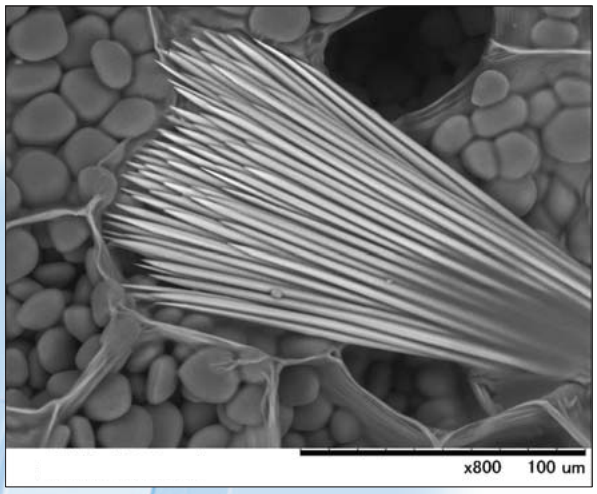
Application Gallery

■ Food and Medicine



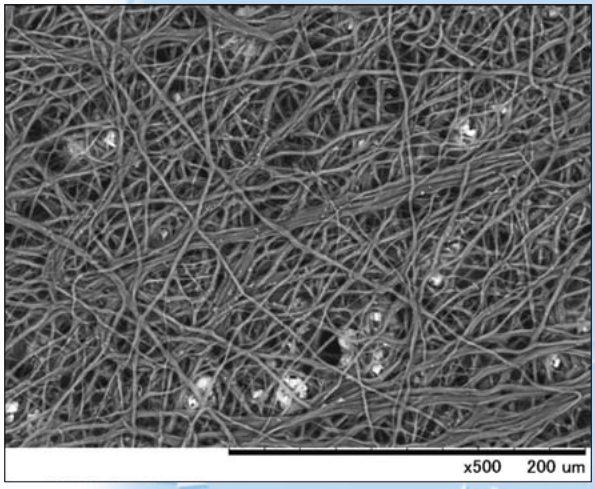
15 kV, charge-up reduction mode

Specimen: Perilla (Japanese Basil) leaf



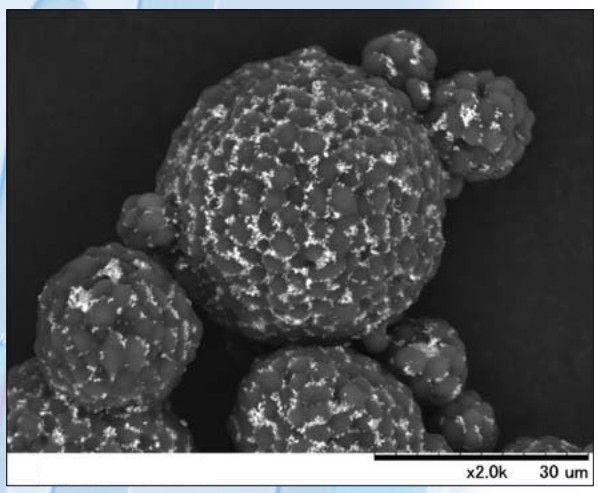
15 kV, charge-up reduction mode

Specimen: Cross section of Chinese yam



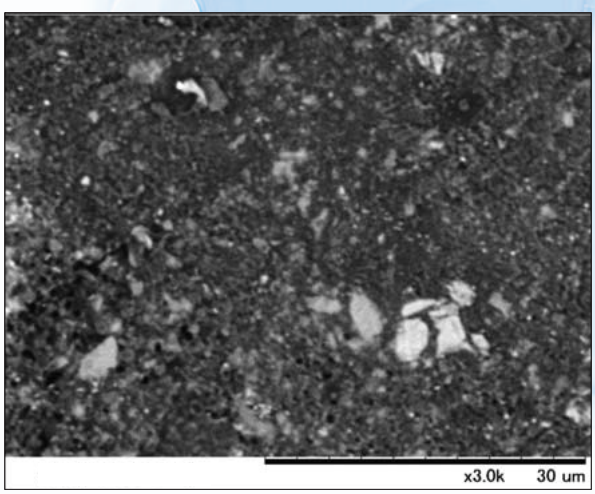
15 kV, charge-up reduction mode

Specimen: Egg shell membrane



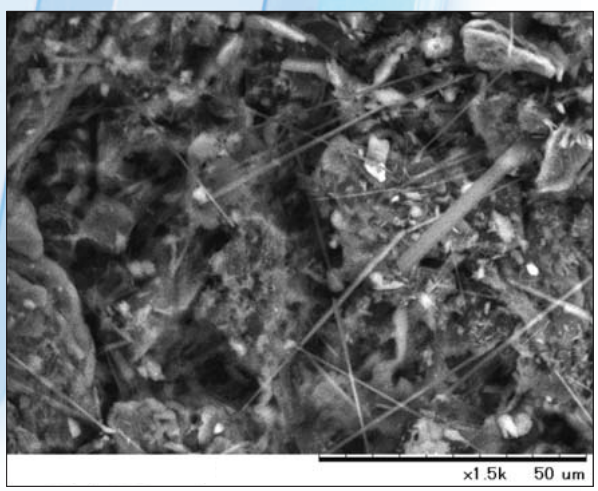
15 kV, charge-up reduction mode

Specimen: Yeast containing zinc



5 kV, charge-up reduction mode

Specimen: Pellet surface

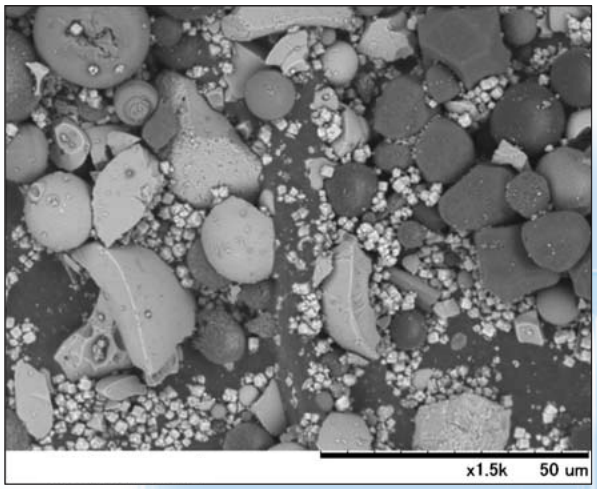


15 kV, charge-up reduction mode

Specimen: Headache remedy tablet

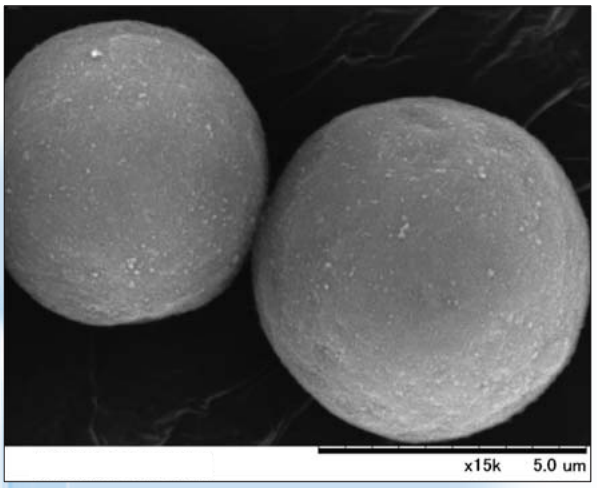
Application Gallery

■ Processed materials



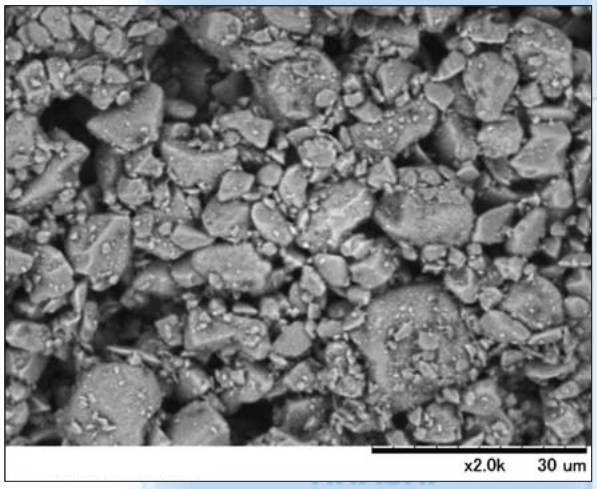
5 kV, charge-up reduction mode

Specimen: Powder spray



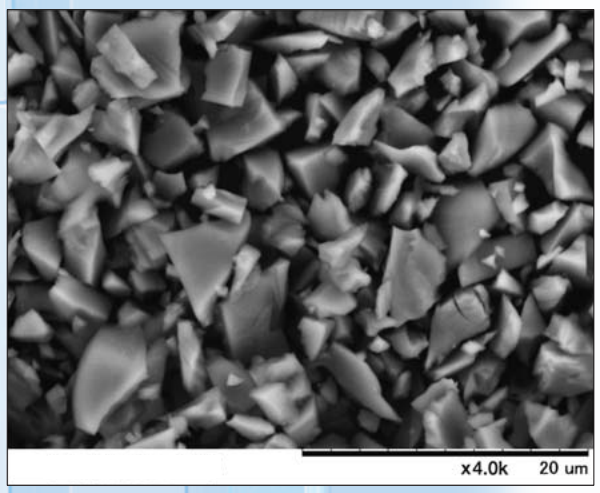
15 kV, standard mode

Specimen: Toner (Pt coated)



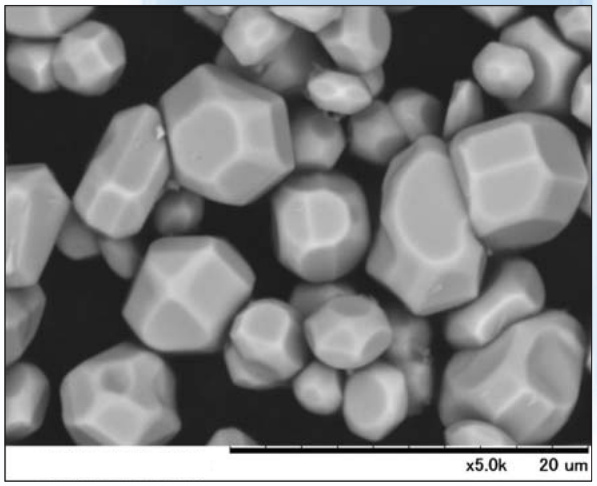
5 kV, charge-up reduction mode

Specimen: Coated paper



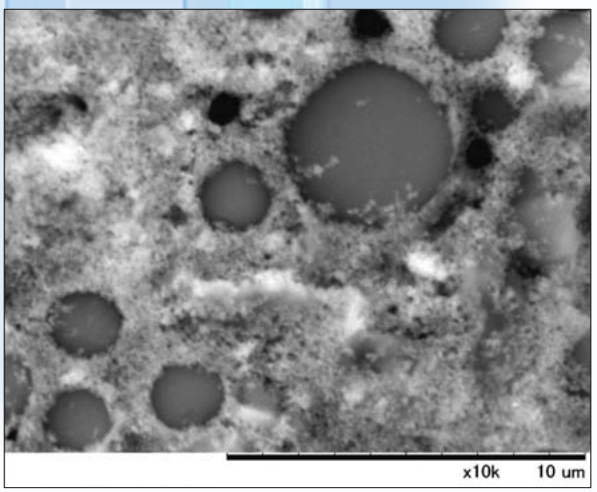
15 kV, standard mode

Specimen: Alumina particle



15 kV, charge-up reduction mode

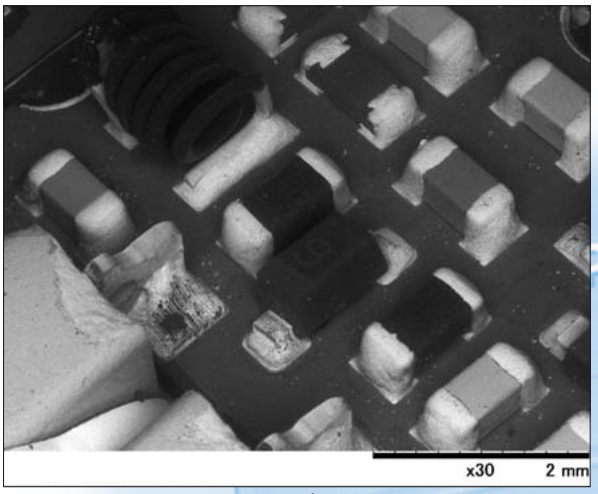
Specimen: Fluorescent material



15 kV, charge-up reduction mode

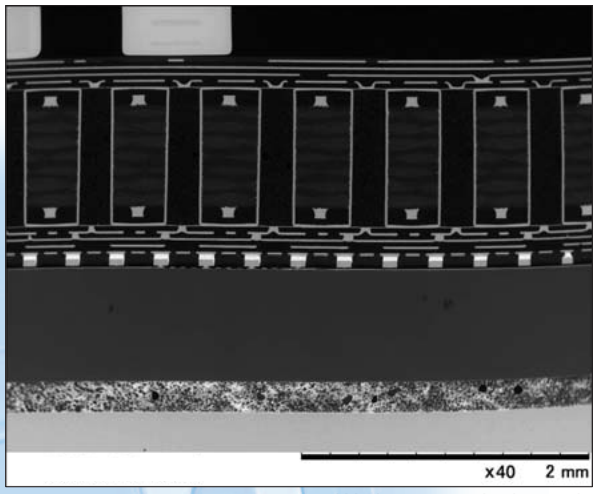
Specimen: Sunscreen lotion

■ Electronic and metallic materials



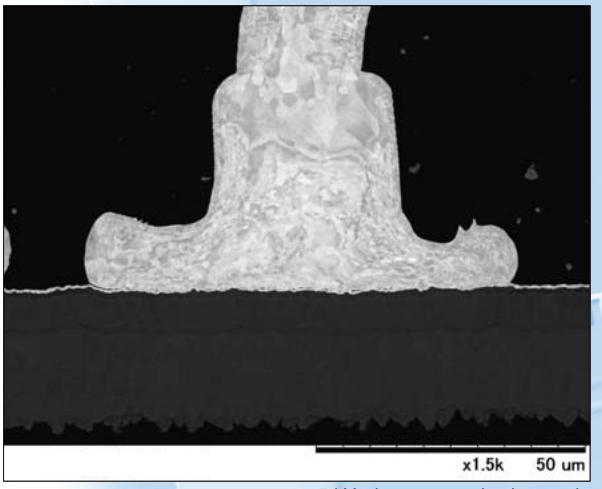
15 kV, charge-up reduction mode

Specimen: PC board



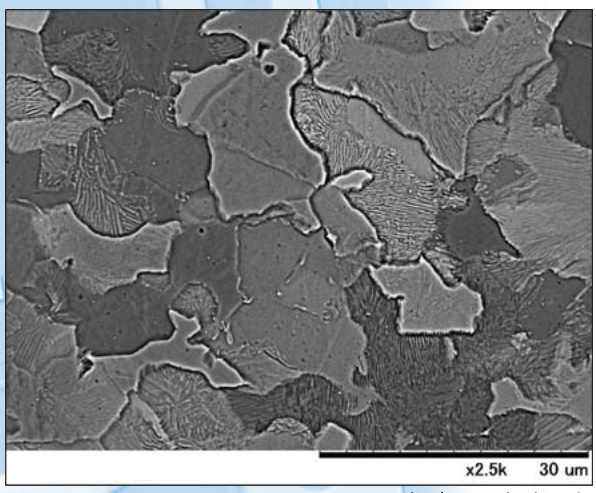
15 kV, charge-up reduction mode

Specimen: Cross section of electronic circuit board



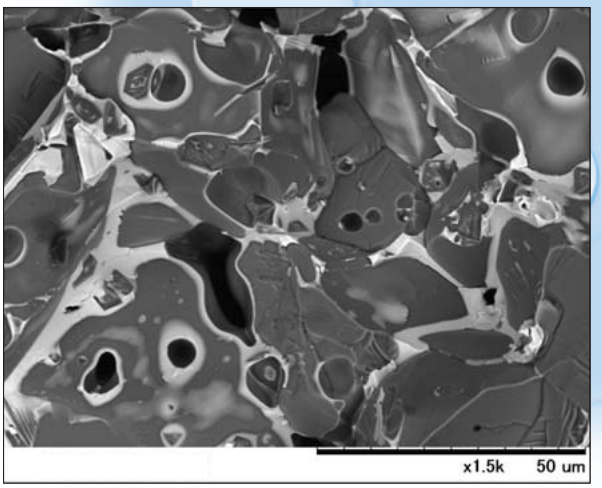
5 kV, charge-up reduction mode

Specimen: Au bonding wire



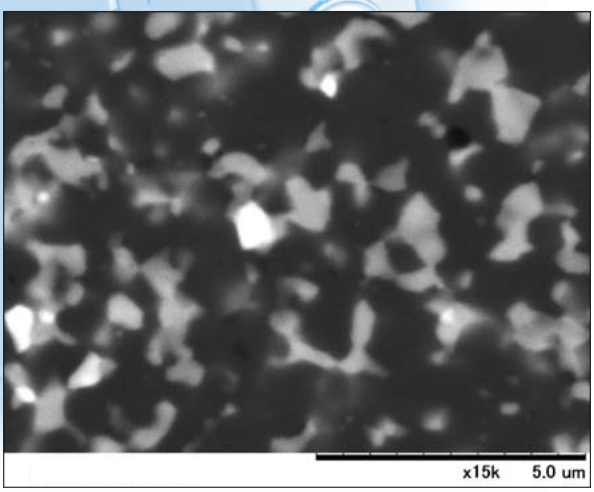
Analy, standard mode

Specimen: Metallographic structure



Analy, charge-up reduction mode

Specimen: Varistor

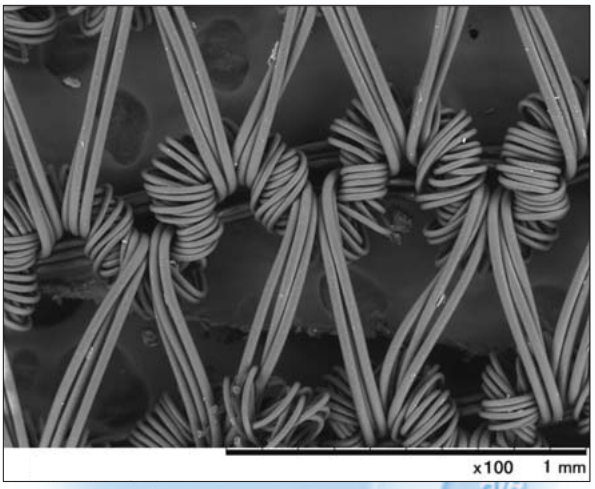


15 kV, charge-up reduction mode

Specimen: AlTiC circuit board

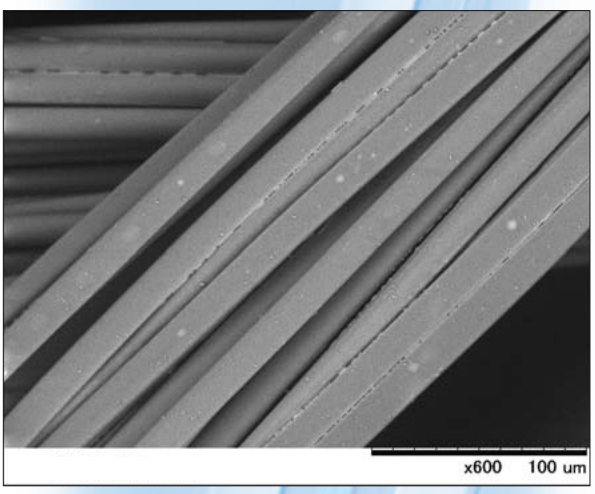
Application Gallery

■ Textiles



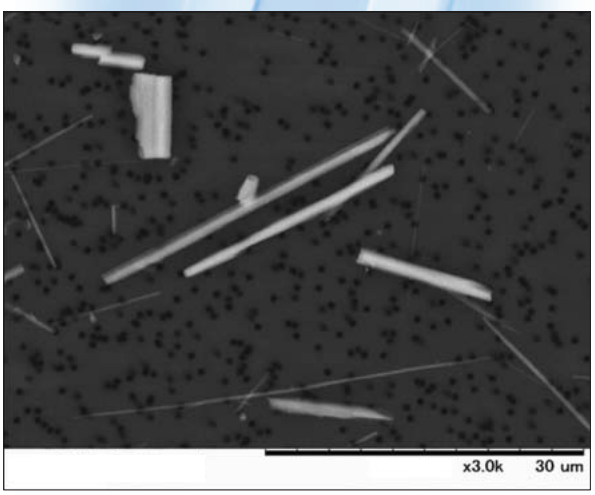
15 kV, charge-up reduction mode

Specimen: Nylon stocking



5 kV, charge-up reduction mode

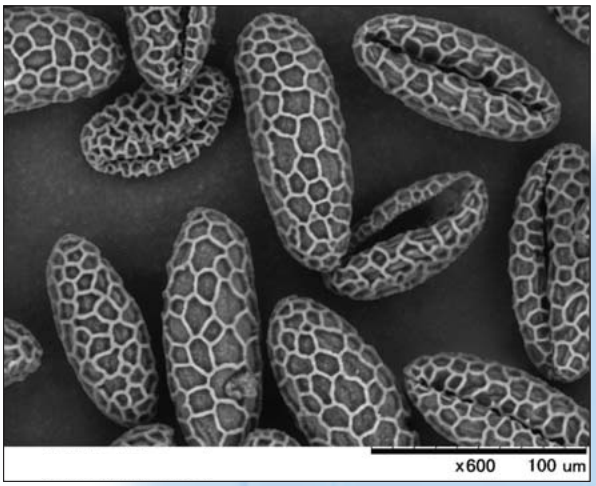
Specimen: Photocatalyst fiber



15 kV, standard mode

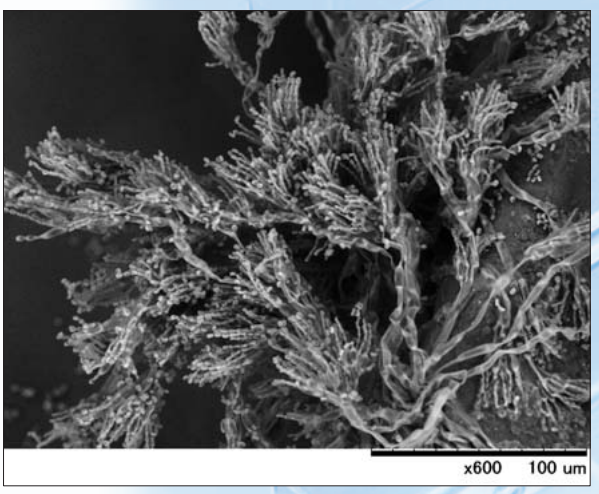
Specimen: Asbestos

■ Biological specimen



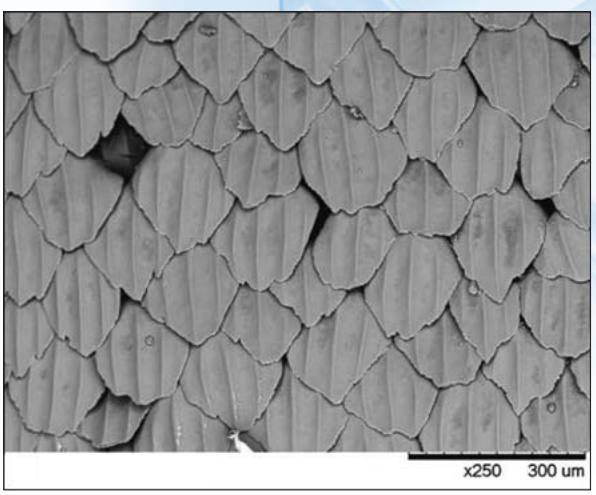
15 kV, charge-up reduction mode

Specimen: Lily pollen



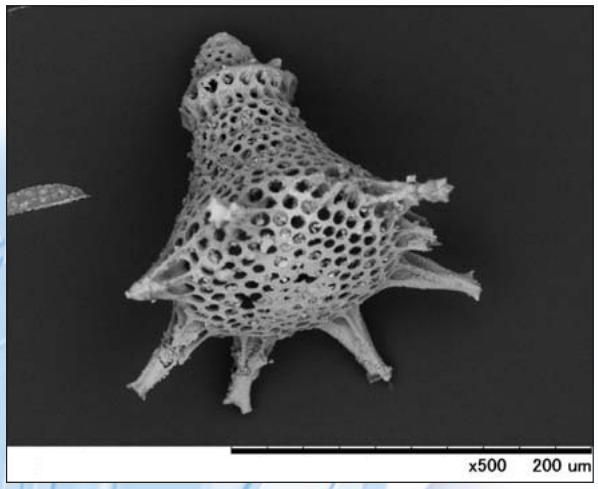
15 kV, charge-up reduction mode

Specimen: Mould spore



15 kV, standard mode

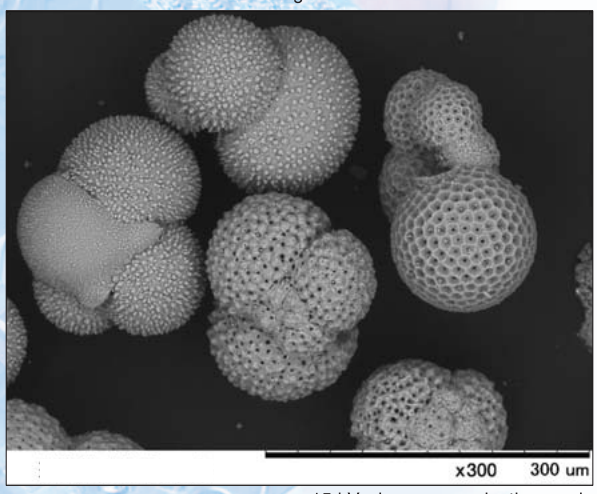
Specimen: Shark skin



5 kV, charge-up reduction mode

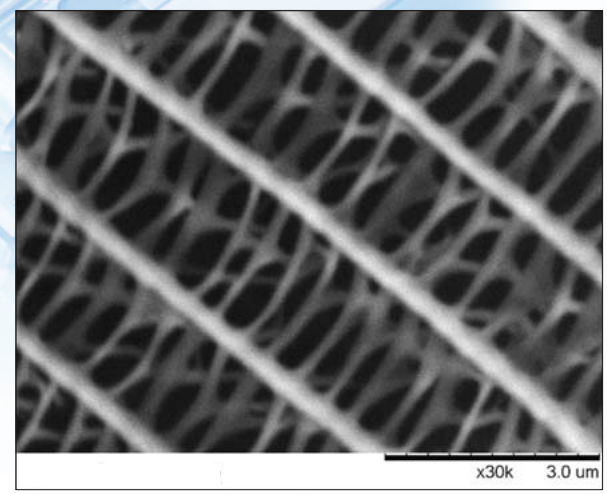
Specimen: Radiolarian fossil (Middle Jurassic radiolarian)*

Specimen courtesy of: Nagoya University Museum
Designated Prof. Mamoru Adachi



15 kV, charge-up reduction mode

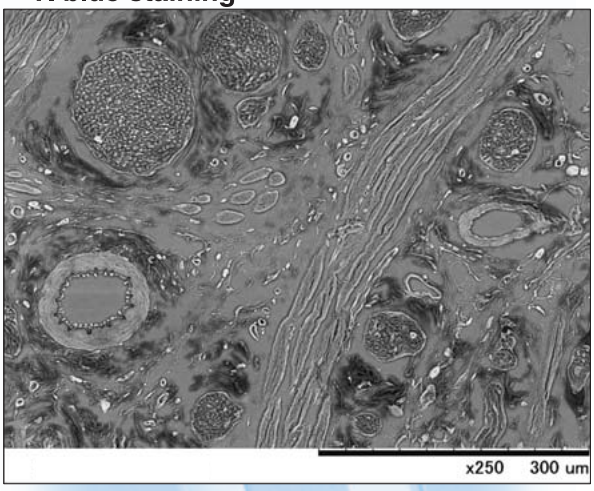
Specimen: Planktonic foraminifer



15 kV, charge-up reduction mode

Specimen: Butterfly wing

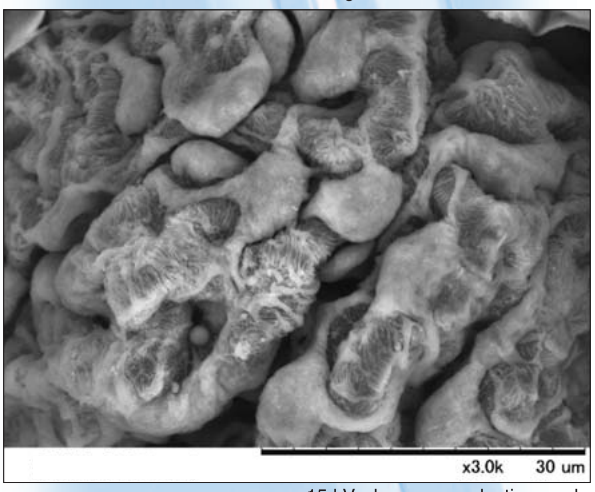
■ Observation of biological specimen by TI blue staining



Analy, charge-up reduction mode

Specimen: Tongue of rat (deparaffinated section)

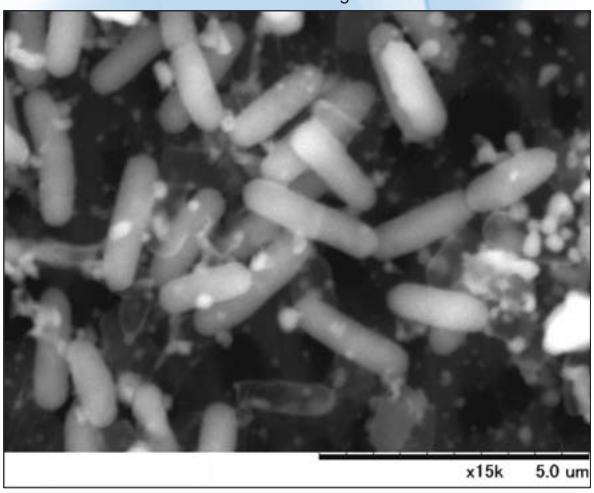
Specimen courtesy of: Tottori University, Faculty Medicine
Sumire Inaga



15 kV, charge-up reduction mode

Specimen: Renal glomerulus of rat

Specimen courtesy of: Tottori University, Faculty Medicine
Sumire Inaga



15 kV, charge-up reduction mode

Specimen: Fermented soybean bacteria

*Specimen: Middle Jurassic radiolarian fossils from the manganese-carbonate nodule collected in Unuma, Kakamigahara City, Gifu Prefecture
Nagoya University Museum (JMP380) (Shinjiro Mizutani, Prof. Emeritus of Nagoya University)

Elemental Analysis made easy (option)

EDX* for the TM3000 is available using 2 different systems.
Each system is equipped with the latest SDD (silicon drift detector). The detectors are compact and designed to be housed within the main TM3000 unit.
Liquid nitrogen is not required, as with all modern EDX systems.

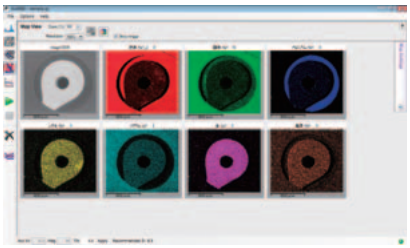
SwiftED3000 option

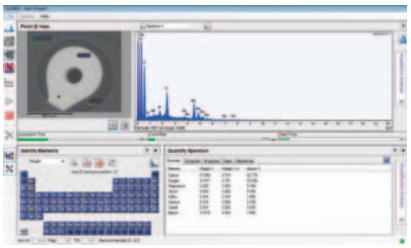
- Detectable elements: B_5 to U_{92}
- Swift multi-point analysis by POINT&ID

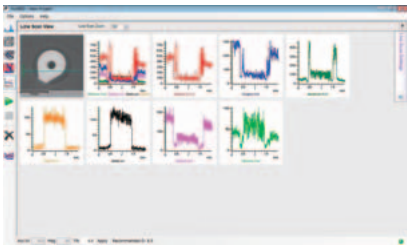
Typical configuration of TM3000 with PC.

*Detector built-in type
*Screen shows simulated image.

■ SwiftED3000 operation window







● Element mapping

The distribution for each element present can be displayed. In addition, 3 elements can be displayed simultaneously, in RGB, overlaid upon the BSE image.

● Point & ID

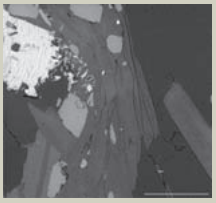
POINT&ID enables the user to specify multiple points or areas and acquire spectra sequentially.

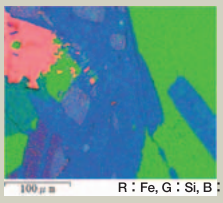
● Line scan

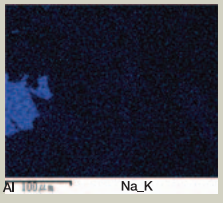
For a user-defined line, the intensity profile of each element selected can be displayed.

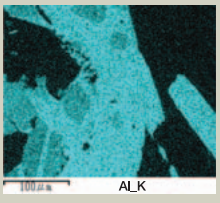
■ Example measurement with SwiftED3000

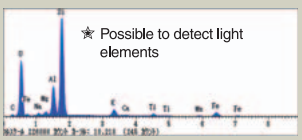
● Analysis of ground thin-section rock specimen (non-coated)



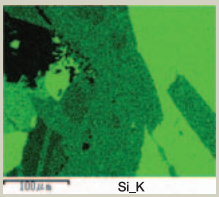


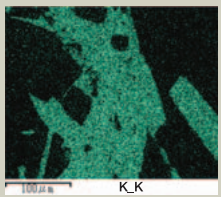


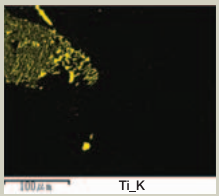


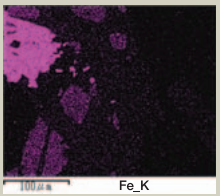


Specimen by courtesy of Prof. Mamoru Adachi, Nagoya University Museum









Continuing the “Simple Operation” design concept of the TM3000, all users can take full advantage of the powerful analytical capability including point analysis, area analysis and element mapping.

* EDX: Energy Dispersive X-ray Spectrometer

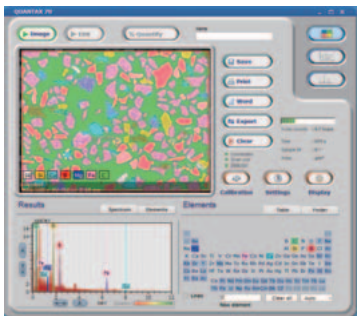
Quantax70 option

- Detectable elements: B_5 to Am_{95}
- Capable of full EDX analysis via spectrum map even after measurement

Typical configuration of TM3000 with PC.

*Detector built-in type
*Screen shows simulated image.

■ Quantax70 operation window



● Element mapping

The elemental distributions are displayed and overlaid on the BSE image. The intensity and colour of each element can be adjusted to maximize and highlight the data acquired.

● Point/Area analysis

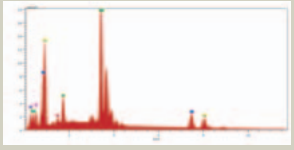
The spectrum at any point or area can be displayed by expanding or contracting a “selective area” target. Spectrums can be displayed after measurement by use of smart map.

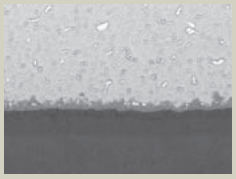
● Line scan

The intensity profile of each element is overlaid on a microscope image of the specific target area.

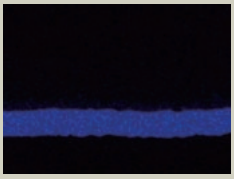
■ Example measurement with Quantax70

● Analysis of electronic component sample embedded in resin (non-coated)

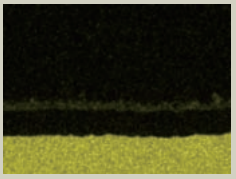




Miniscope image

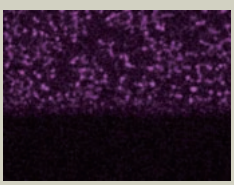


Ni_K

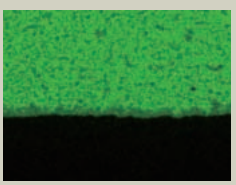


Cu_K

Synthesized map



Ag_L



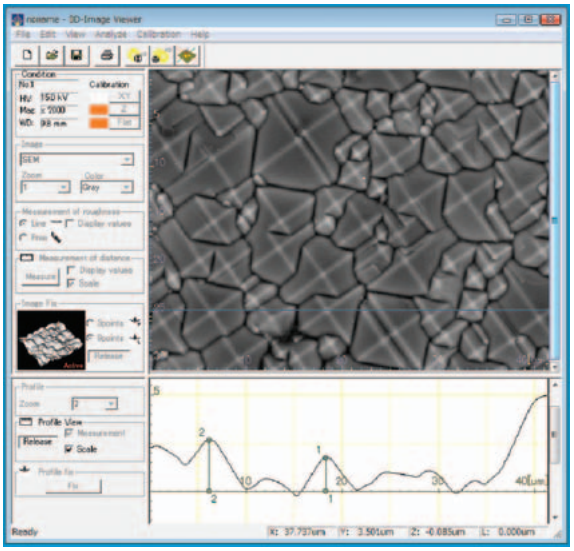
Sn_L

3-dimensional image display /measurement function

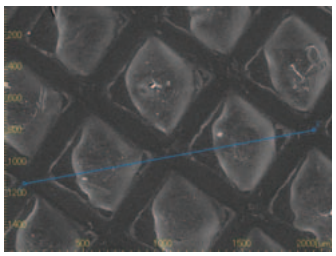
3D-VIEW

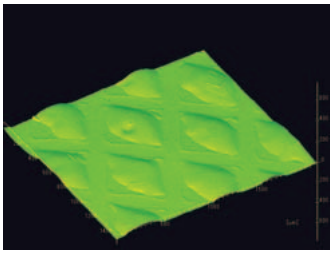
option

- A 3-dimensional model can be generated without sample tilting and alignment, using 4 directional surface profiles from the signals acquired with each segment of the 4-segment backscattered electron detector.
- Surface roughness can be measured easily based on the height measurement between 2 points, the surface area and cross-sectional profile.
- The 3-dimensional model under observation can be manipulated (rotated and zoomed), while rotational manipulation of the model can be recorded in a dynamic image file (AVI format).

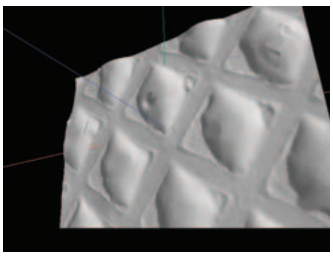


Main window of 3D-Image Viewer

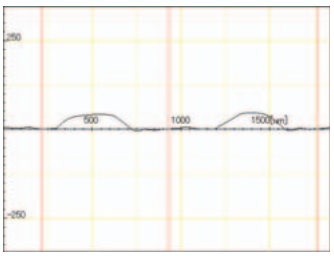




Bird's-eye view

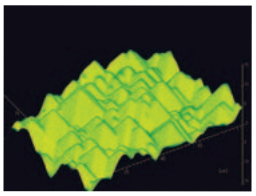


3-dimensional model display

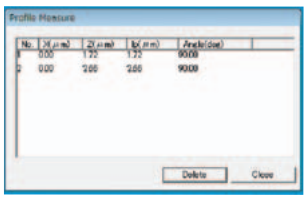


Profile measurement result window

Specimen: Food packaging material (Pt-coated)



Bird's-eye view



Profile measurement result window

Specimen: Solar cell

3D-VIEW main specifications

■ 3D-Image viewer function

Items	Description
Import function	Automatic select and read function of four elements image data (Equipped with automatic SEM condition acquisition function)
Measurement performance	Depth accuracy ± 20% (Reference) Measurement performance is different depending on calibration accuracy, the condition of the kind of the specimen, the observation mode, and the observation condition. Detectable angle range: ±50 (Reference) (Observation condition: Standard mode) Unavailable in the combination of "Charge-up reduction mode" and "5kV mode".
Measurement function	Section profile display / Calibration function (X/Y, Z and Flat) / Distance of X and Y, length and angle measurement between two points specified on the image / Surface area measurement / Distance of X and Y, length and angle measurement between two points specified on section profile / Surface roughness measurement on section profile / Depth direction zoom-in function in section profile display / Base line correction function (straight line and curved line) / Bird's-eye view display / Color contour line display
Three-dimensional display function	Rotation and zoom-in / Animation record function of observation screen (AVI file)
PC OS	Windows® VISTA Home Premium (SP1) (32-bit) / Windows® 7 Professional (32-bit)

■ 3D-Image capture function

Items	Description
Capture function	Automatic image data acquisition by four elements of quad BSE detector
Capture pixel count	640 × 480 pixels (Quick Save), 1,280 × 960 pixels (Save)
Brightness adjustment	Automatic

*A steep topographical surface that exceed detectable angle might not be displayed accurately.

*Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

SwiftED3000 specification

*Manufactured for Hitachi High-Technologies Corporation by Oxford Instruments Analytical Ltd.

■ Detector

Items	Description
Detector type	Silicon Drift Detector (SDD)
Detection area	30mm^2
Energy resolution	161eV (Cu-Kα) (equivalent to 137eV with Mn-Kα)
X-ray window	SATW (Super Atmosphere Thin Window)
Detection element	B_5 – U_{92}
Thermal cycle	Detector cool down on demand.
Cooling method	2-stage thermoelectric (peltier) cooling (without fan and LN_2 free)

■ X-stream, mics

Items	Description
Pulse processor	Digital
Multi-channel analyzer	2,048 channel (10eV/ch)

■ Software

Items	Description
Spectrum display	Expand and contract scale in vertical and horizontal, KLM marker display
Qualitative analysis	Auto ID and manual peak ID
Quantitative analysis	Standardless quantitative analysis, normalize to 100%
Image capture	1,024 × 768, 512 × 384, 256 × 192 pixel
Point & ID (Beam control)	Selectable points: 128 points Recrangle: Arbitrary size settable
Element mapping	Resolution: Select from 128, 256, 512 pixel Max. measureable elements: 32 Mix map: 3 elements
Line scan	Spectrum comparison: two spectra
Help function	On-line
Data management	Managed by project
Spectrum exporting	BMP, TIFF, JPEG, EMSA, Text
Data reporting	Print report template Export to Microsoft® Word

■ Dimensions and weight

Items	Description (Width × Depth × Height, Weight)
Detector unit	145 × 150 × 200mm, 2.7kg
Analyzer unit	290 × 265 × 332mm, 9.3kg

■ Installation condition

Items	Description
Power (SwiftED3000)	Single-phase AC100~240V (±10%) 50/60Hz 100VA, 3P cable

Quantax70 specification

*Manufactured for Hitachi High-Technologies Corporation by Bruker Nano GmbH

■ Detector

Items	Description
Detector type	Silicon drift detector (SDD)
Detection area	30mm^2
Energy resolution	154eV (CuKα) (equivalent to 137eV with Mn-Kα)
X-ray window	For light element detection
Detection element	B_5~Am_{95}
Thermal cycle	Detector cool down on demand.
Cooling method	2 stage Peltier cooling (No fan, No liquid nitrogen needed) Cooling temperature about –25°C Cooling is not needed when not in use. No detector warm-up needed during venting or sample changing. After power supply is turned on and cooling starts, it can be used in two minutes.

■ MIN SVE signal processing unit

Items	Description
Signal processor	Up to 60,000cps output count rate
Multi-channel analyzer	4,096 chennels (5eV/ch)

■ External scan box

Items	Description
Interface to TM3000 notebook	USB 2.0 or Ethernet
Interface to microscope	via DBC cable

■ Software

Items	Description
Spectrum display	Scale expansion in vertical and horizontal direction, Automatic scaling, KLM marker display
Qualitative analysis	Automatic ID and manual peak ID
Quantitative analysis	Standardless quantitative analysis, normalize to 100%
Image capture	1,024 × 768, 640 × 480, 320 × 240 pixel
Element mapping	1,024 × 768, 640 × 480, 320 × 240 pixel Displays as single element map Display of several maps as overlaid image Overlay of single and mixed element map with BSE image Color of each map can be changed
Line scan	Flexible line positioning in all directions Individual selection of line colors for each element Overlay of line scan profile with scan image Display of line scan spectrum
Spot/area analysis	Spot can be positioned anywhere on the image Single circle but can be moved and resized (10-768pixels). Analysis results of spot: Display of spectrum, results table and graphic display Automatic element ID of spot Automatic quantification of spot Manual selection/deselection of elements
Data reporting	Report template for printing Export of spectra to BMP, TIFF, JPEG, Excel 2007 and Text Export of spectra and results to Microsoft® Word 2007

■ Dimensions and weight

Items	Description (Width × Depth × Height, Weight)
Detector (housed within TM3000)	145 × 130 × 105mm, 1.5kg
MIN SVE signal processing unit	228 × 116 × 66mm, 1.0kg
External scan box	228 × 116 × 66mm, 1.0kg

■ Installation conditions

Items	Description	
Power (Quantax70)	MIN SVE signal processing unit	Single-phase AC100~240V (±10%) 50/60Hz 25VA, 3P cable
	External scan box	Single-phase AC100~240V (±10%) 50/60Hz 15VA, 3P cable

TM3000 specification

■ Specifications

Items	Description
Magnification	15 to 30,000× (digital zoom: 2×, 4×)
Observation condition	5kV/15kV/Analysis
Observation mode	Standard mode Charge-up reduction mode
Image mode	COMPO/Shadow 1/Shadow 2/TOPO
Sample stage traverse	X: ±17.5mm, Y: ±17.5mm
Maximum sample size	70mm in diameter
Maximum sample height	50mm
Electron gun	Pre-centered cartridge filament
Signal detection system	High-Sensitivity semiconductor BSE detector
Auto image adjustment function	Auto start, Auto focus, Auto brightness/contrast
Operation help functions	Raster rotation, Magnification preset (two steps) Image shift (±50μm@D*=4.5)
Frame memory	640 × 480 pixels, 1,280 × 960 pixels
Image data memory	HDD of PC and other removal media
Image format	BMP, TIFF, JPEG
Data display	Micron marker, micron value, date and time, image number and comments, Image mode, Observation condition, D* (Distance), Observation mode
Evacuation system (vacuum pump)	Turbomolecular pump: 30ℓ/s × 1 unit, Diaphragm pump: 1m³/h × 1 unit
Safety device	Over-current protection function, built-in ELCB

*D (Distance) is defined as the distance between lower surface of a high-sensitive semiconductor BSE detector and sample surface.

■ Required PC specifications

Items	Description
OS	Windows® 7
CPU	Intel® Core™ 2 Duo P8700 or compatible CPU
Memory size	2GB or larger
Display monitor	15.4 type, WXGA 1,280 × 800 pixels
Interface connector	USB 2.0

*An associated PC to be procured locally.
*Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.
*Intel is a registered trademark of Intel Corp. or its affiliated companies in the United States and/or other countries.
*Specifications of a PC are subject to change.

■ Dimensions and weight

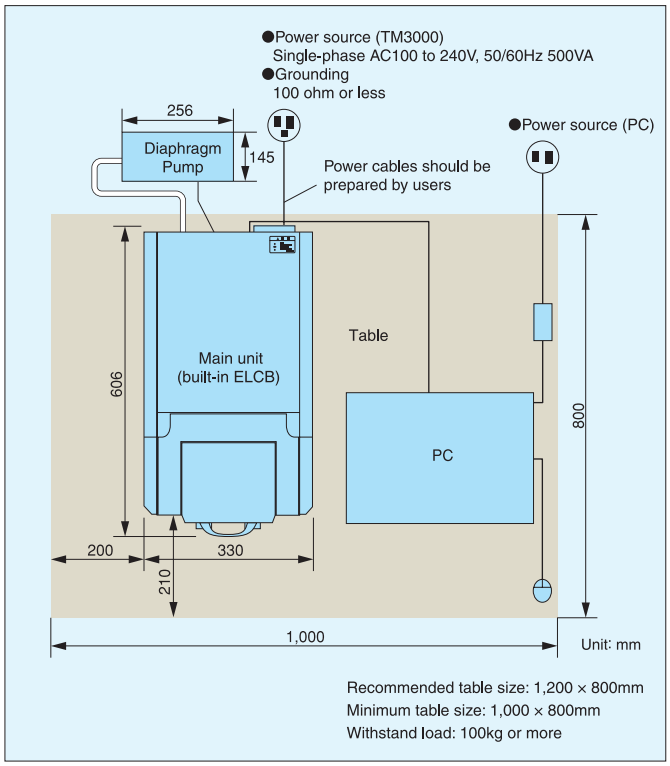
Items	Description (Width × Depth × Height, Weight)
Main unit	330 × 606 × 565mm, 63.0kg (manual stage) 330 × 630 × 565mm, 66.0kg (motor drive stage)
Diaphragm pump	145 × 256 × 217mm, 4.5kg

■ Installation condition

Items	Description
Room temperature	15 to 30˚C (Δt=±2.5˚C/h or less)
Humidity	70%RH or less
Power source (TM3000)	Single-phase AC100 to 240V (Minimum: 90 [V], Maximum: 250 [V])
Grounding	100 ohm or less

*Another power source for PC is required.

■ Minimum installation layout



*A table with casters is not suitable to put a main unit of TM3000 on.
*Recommended table size: 1,200 × 800mm, withstand load: 100kg or more.
*Periodical maintenance is required for this apparatus.
*Limited to indoor operation.

Notice: For correct operation, follow the instruction manual when using the instrument.

Specifications in this catalog are subject to change with or without notice, as Hitachi High-Technologies Corporation continues to develop the latest technologies and products for our customers.

Bringing the frontier to the forefront.

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