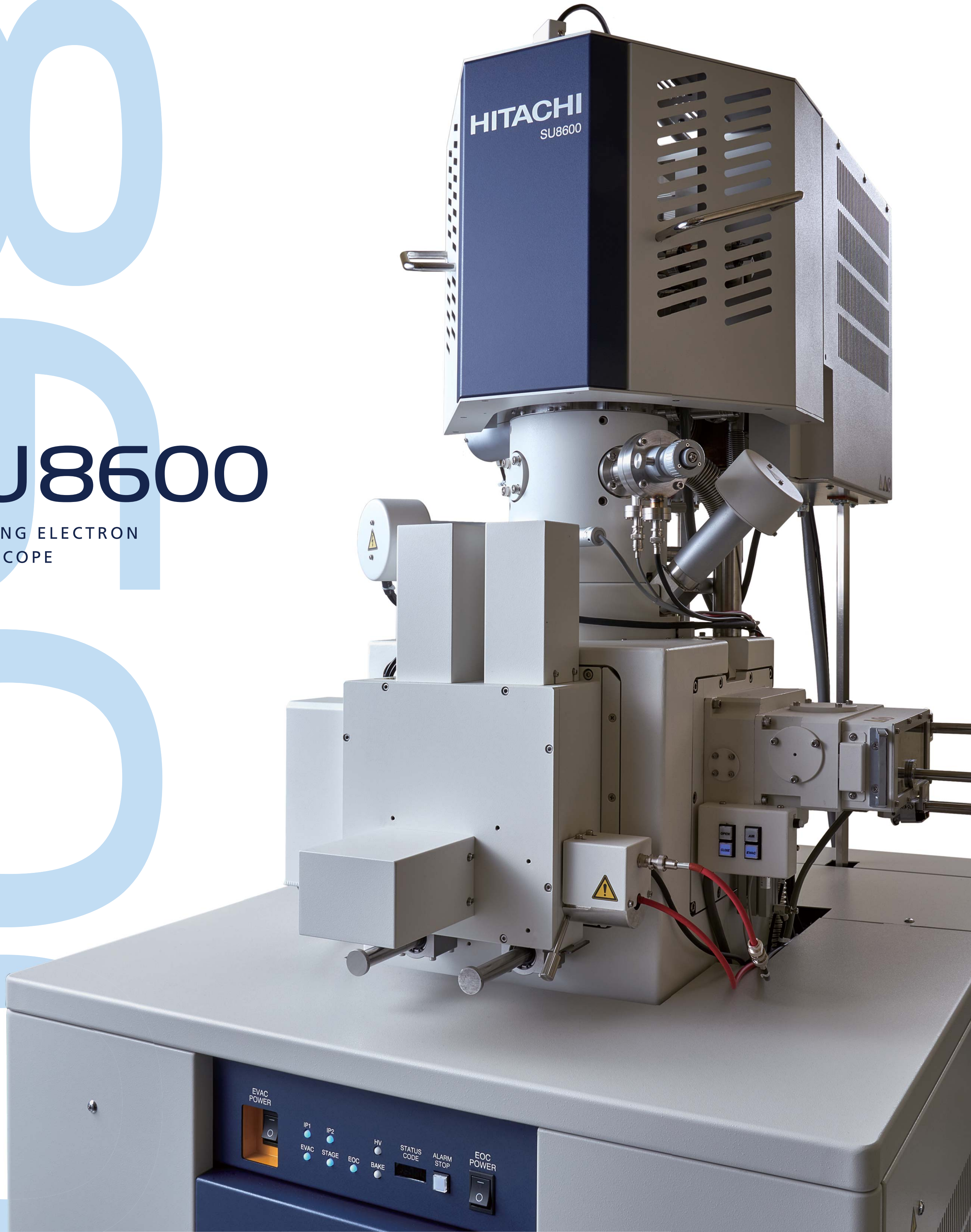
Hitachi Ultrahigh-resolution Field-emission
Scanning electron microscope

SU8600

HITACHI
Inspire the Next

SU8600

SCANNING ELECTRON
MICROSCOPE



SU8600 Modern Solutions for a Modern World

The SU8600 brings in a new era of Ultrahigh-resolution cold-field emission scanning electron microscopes to the long-standing Hitachi EM line-up. This revolutionary CFE-SEM platform incorporates multifaceted imaging, automation, increased system stability, efficient workflows for users of all experience levels, and more.

＊ The instrument picture includes options

Key feature of The SU8600

1 Enhanced User-Experience with Advanced Automation

- Automated alignments increase efficiency and throughput.
- Automated data acquisition recipes allow for greater precision as well as repeatability.
- High-precision piezo stage* improves navigational and recall accuracy for targeted regions of interest.

2 Ultrahigh-Resolution and Comprehensive Analysis

- Hitachi' s high-brightness cold field emission source provides ultrahigh-resolution images even at low acceleration voltages.
- A smart detection system combined with ExB allows for comprehensive imaging and analysis with ease.
- A multitude of new detectors and options are available to best suit the needs of any user.

3 New Display and Interface Features

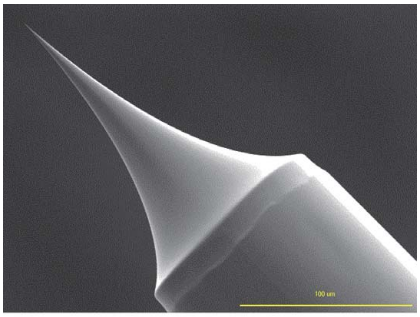
- Dual monitor configuration supports a flexible and highly efficient workspace.
- Display and save 6 signals simultaneously in order to acquire more information in less time.
- Acquire up to **40,960 x 30,720 pixels** of high-resolution information.*

(*) option

Electron Optics and Detectors

Core Technology (Cold FE Electron Source)

From the time that the cold field emission (CFE) electron source was realized in 1972, Hitachi High Tech has constantly improved this outstanding technology for high-resolution electron imaging. The latest developments in electron gun designs yield higher irradiation stability of the electron beam within the high-brightness region. The SU8600 enables high S/N imaging even at low accelerating voltages, and can also be used in long-term measurements and analyses under large current irradiation conditions rivaling other gun technologies available.



CFE tip

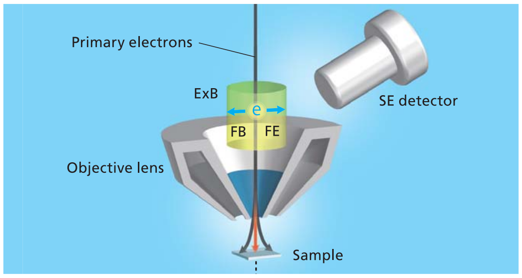
Comparison chart of electron sources for SEM

	Cold FE electron source	Schottky FE electron source
Source diameter (nm)	5	20
Energy spread (eV)	0.2～0.3	0.6 ～1.0
Brightness (A/cm²/sr)	10^8	10^7

Core Technology (ExB)

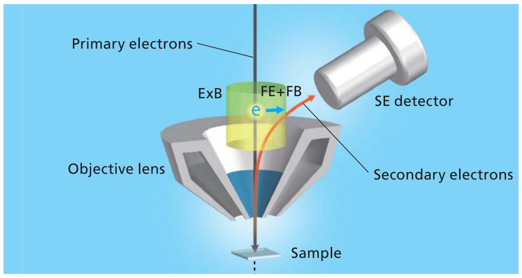
Efficient detection of secondary electrons (SE) without changing the trajectory of the primary electrons is possible by forming a mutually orthogonal electric field and magnetic field (ExB field) above the objective lens. This core technology makes it possible to obtain images with excellent S/N and contrast, even at the smallest probe current conditions often used for high-resolution imaging.

Influence of electric and magnetic fields on primary electrons



Primary electron beams pass through the ExB region without axial deviation because the actions of the electric field (E) and the magnetic field (B) are mutually cancelling.

Influence of magnetic field on secondary electrons

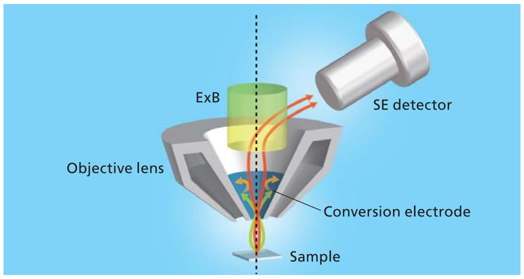


Efficient detection of SE is possible because the electric field and magnetic field act in the same direction for SEs traveling in the opposite direction to the primary electrons, forcefully directing the trajectory of the SE signal toward the SE detector.

Core Technology (SuperExB)

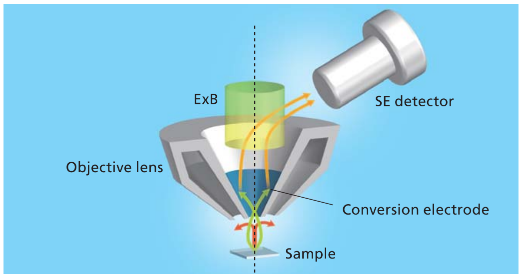
The advancement in design to enact SuperExB signal mixing function is one of the signature technologies of Hitachi High- Tech. The electrons (secondary electrons, SEs, or backscattered electrons, BSEs) that arrive at the SE detector are precisely controlled by changing the voltage of the signal conversion electrode in the objective lens. Simultaneous acquisition of mixed SE/BSE images can be acquired with refined selectivity.

SE mode



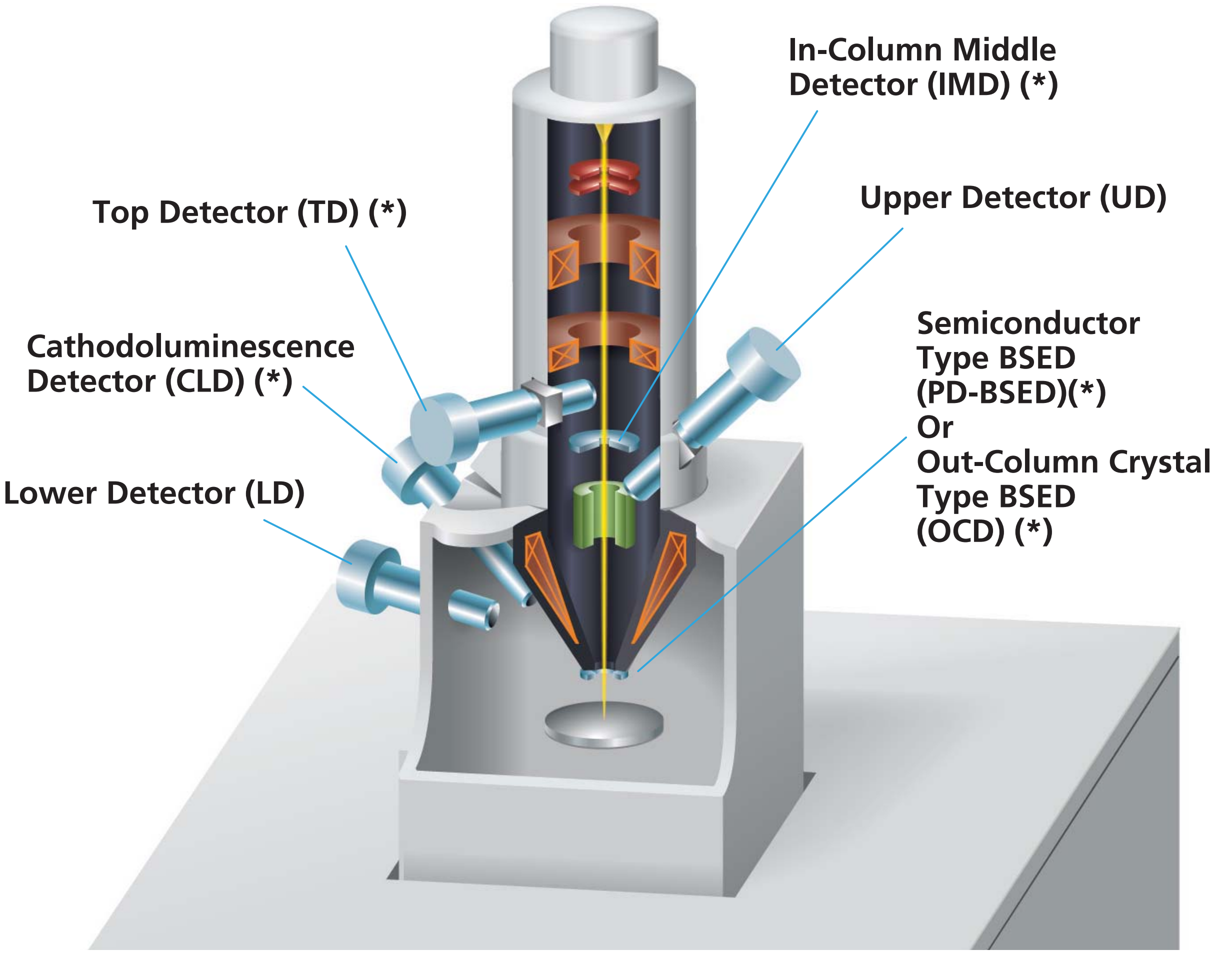
BSEs are trapped by the signal conversion electrode, and only the SEs emitted by the sample are detected.

LA-BSE mode



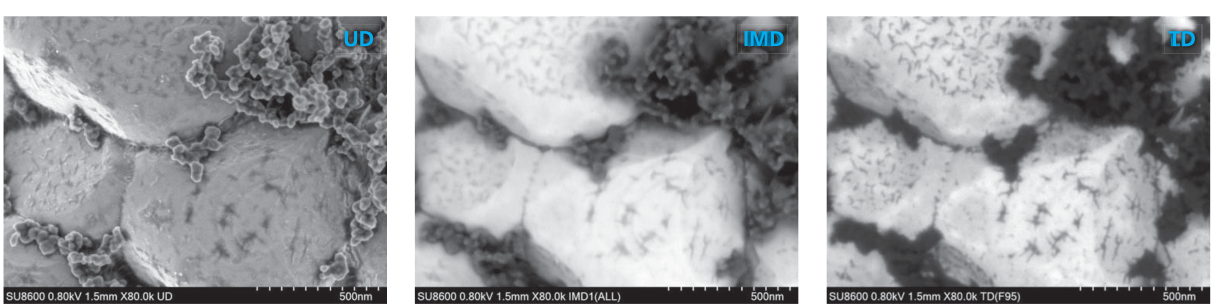
The detection rate of SEs emitted from the sample is controlled by the voltage of the signal conversion electrode. BSEs collide onto the conversion electrode, and thus resulting SEs are detected.

· High brightness CFE with improved stability for superb imaging.
· New optional detectors (IMD, CLD, PD-BSED, OCD) for enhancing your informational experience.



(*) option

More Signals, More Information



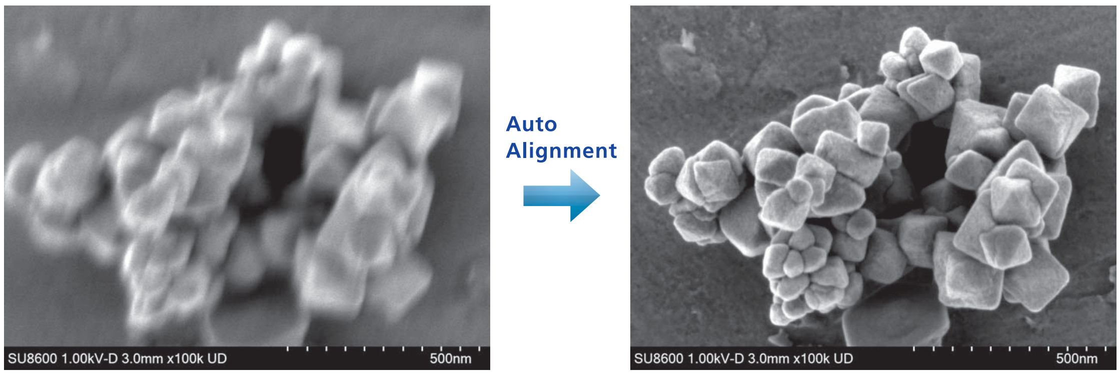
UD image shows fine structure of carbon on metal oxide particles (left)
IMD image suggests thin and fine light element materials distribute on metal oxide particles (center)
TD image enhances material contrast that suggest another thin layer on metal oxide particles (right)
All the images above were acquired simultaneously with 0.8 kV of accelerating voltage.

Specimen : Lithium-Ion Battery electrode material

Specimen courtesy of Mr.Hajime Okui,
DAINEN MATERIAL Co., Ltd.

Automated Optics Alignment

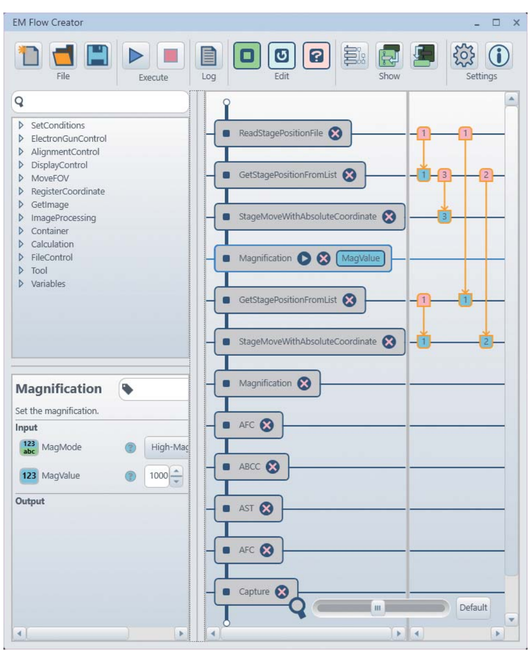
SEM operation requires optimization of various parameters when conditions, specimen, or analyses change.
The SU8600 features an automated alignment function to assist in this procedure. From beam alignment to stigmator alignment, each alignment optimization can be done automatically.



before alignment **after alignment**

EM Flow Creator (*)

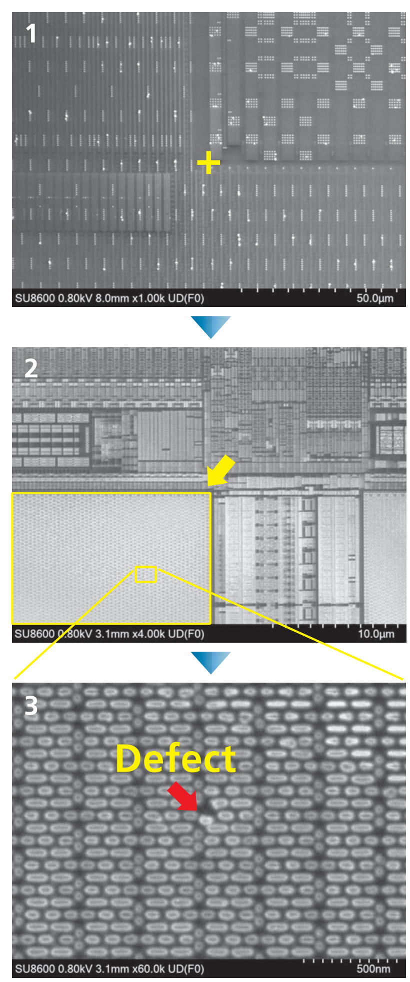
"EM Flow Creator" allows users to configure repeatable SEM operation sequences. Various SEM functions can be assembled in EM Flow Creator's window by drag-and-drop method then saved as a recipe for later use.
Once a recipe is configured, automated data collection under the set conditions can be performed with high accuracy and repeatability.



GUI of EM Flow Creator

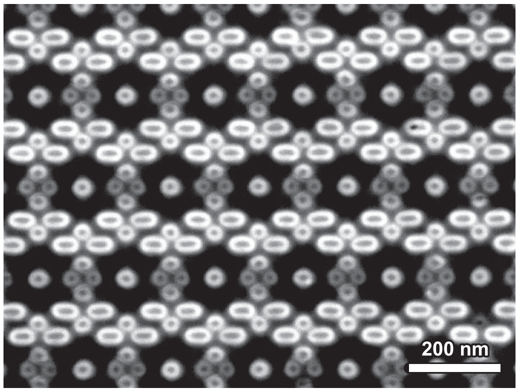
Example of workflow by "EM Flow Creator"
Approaching semiconductor device's defect.
1. Set up SEM condition
2. Navigate arbitrary point (+) to corner of SRAM mat, coordinate given as a csv file. (1→2)
3. Navigate from corner to defect (2→3)

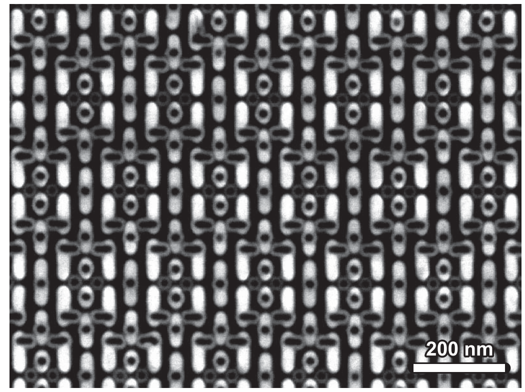
EM Flow Creator can read out and move to the coordinate *.csv recorded.
Piezo stage option required for precise navigation as shown.



(*) option

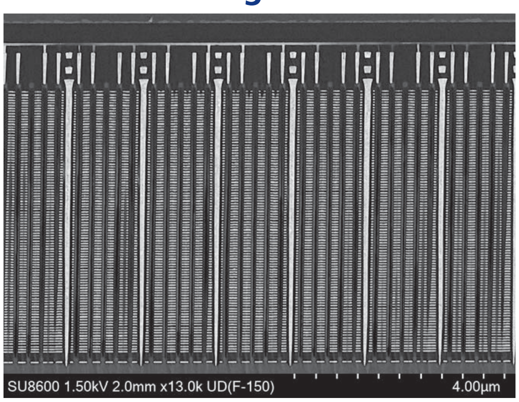
Voltage Contrast Images of 5 nm process SRAM

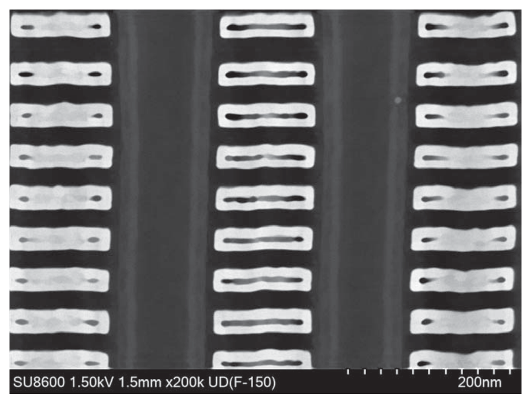




Above Left: W contact Layer, acquired at 0.5 kV (UD), Above Right: Co-W contact layer, acquired at 0.3 kV (TD) with deceleration condition. Various conditions such as landing energy, detector signal, etc. can be leveraged to effectively acquire targeted information from specific specimens.

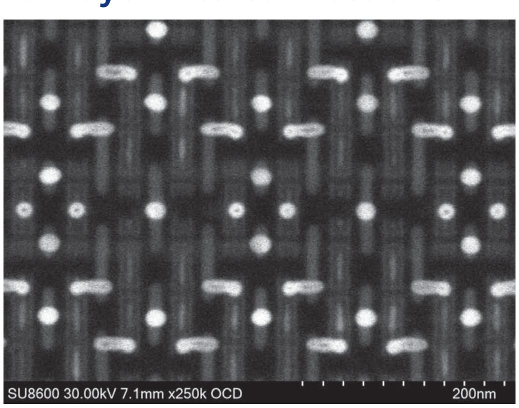
Cross Section Images of 3D NAND

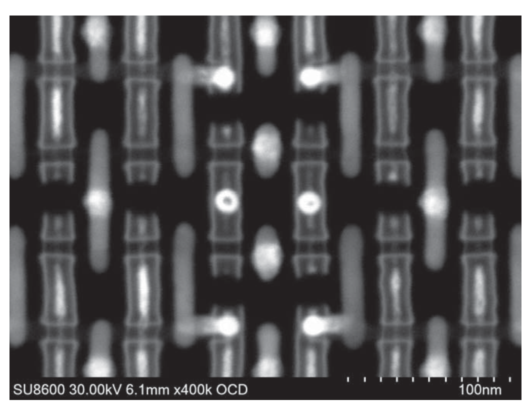




Left: Overview of cross-section image of 3D NAND.
Right: Magnified image of ROI on left.
Oxide layer and Nitride layer of capacitor are easily distinguishable in right image due to BSE detection capability.

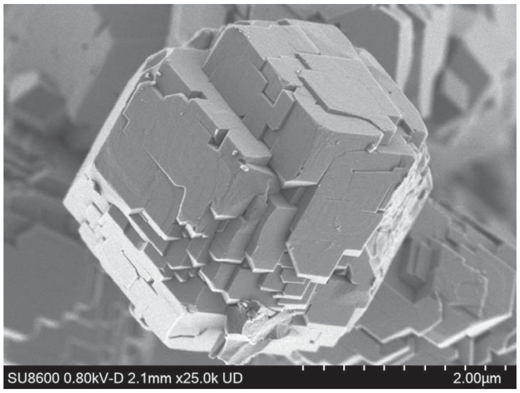
Lower Layer Interconnect of 5 nm process SRAM

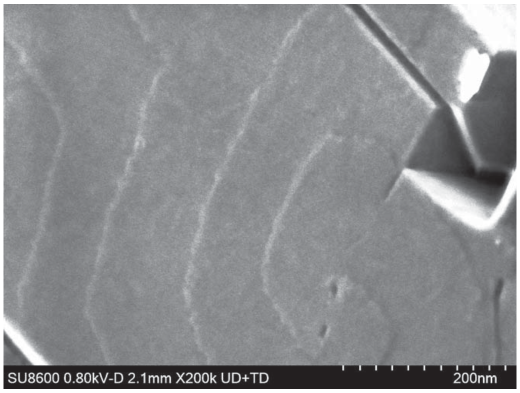




Left: Lower layer interconnect and Fin FET are visible.
By using new Out-Column Crystal Type BSED (OCD), image acquisition time was less than **ONE SECOND, yet** structure is clearly visible. Right: Higher magnification image of ROI, demonstrating an outstanding signal to noise ration.

Fine Surface Structure of RHO-type Zeolite

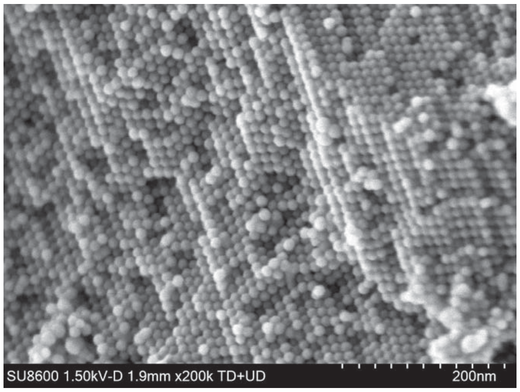


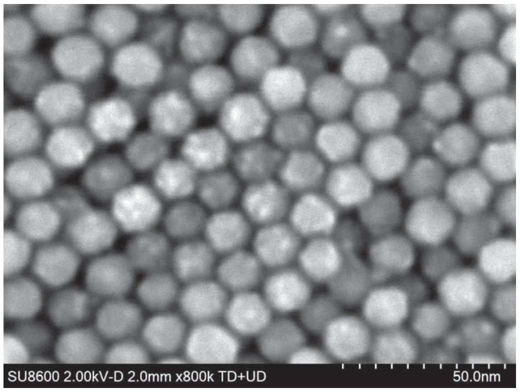


Left: RHO-type Zeolite particle at low-kV. In order to reveal fine steps structure on surface, the image was acquired at 0.8 kV of landing voltage. This allows the very fine structure of surface steps to be clearly visible (image on right).

Specimen courtesy of Dr. Yoshihiro Kamimura,
National Institute of Advanced Industrial Science and Technology (AIST), Japan

Self - Assembling Magnetic Iron Oxide Nanoparticles

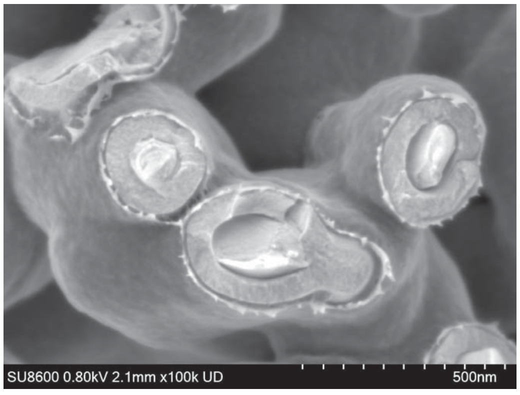


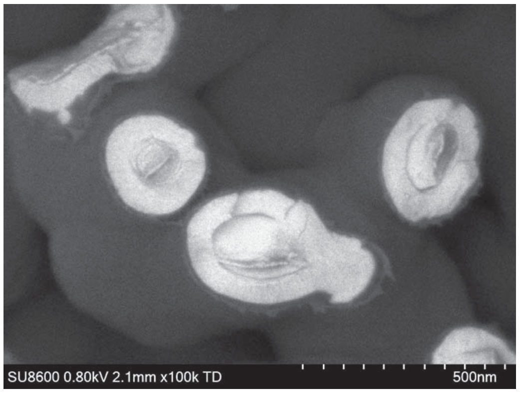


Left: Nanoparticles arranged in self-assembling regular sequence.
Fine structure of particles, Approx. 12 nm diameter, are visible in right image at 800 kX of magnification.

specimen courtesy of Electrical Computer Engineering department, National University of Singapore

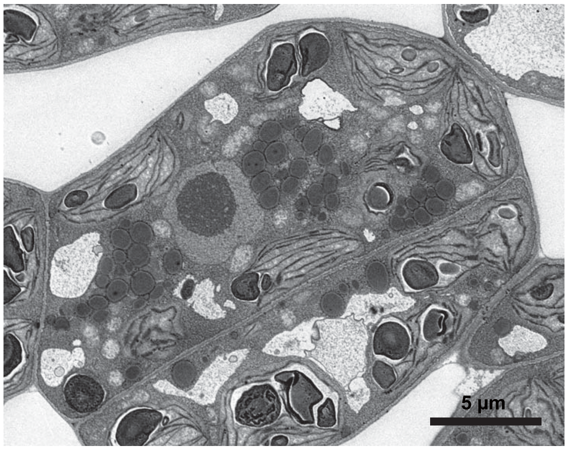
Surface Detail & Internal Composition of Capacitor Material

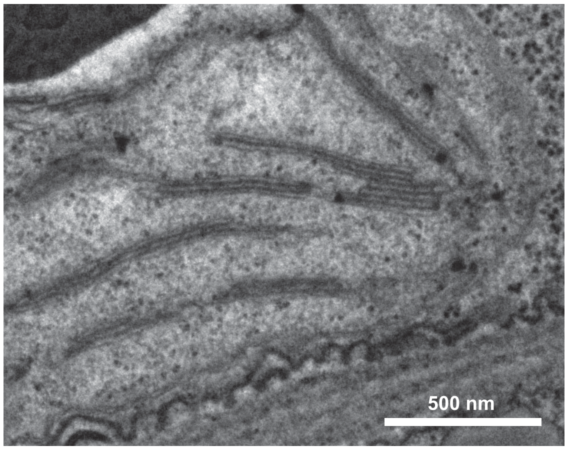




Surface morphology and compositional information of coated Tantalum which are used for capacitors. Simultaneous multi-signal acquisition increases sample information while reducing overall time input.

Ultrastructure of Arabidopsis

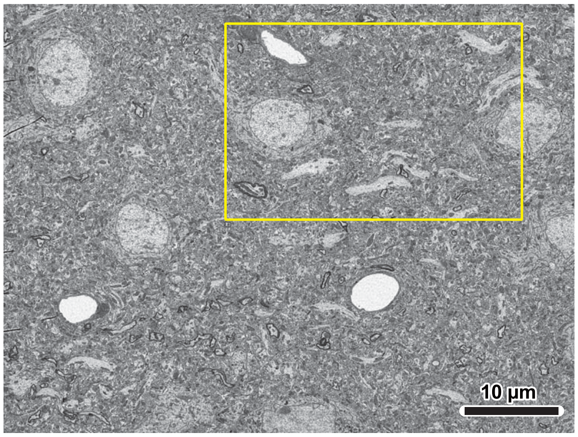




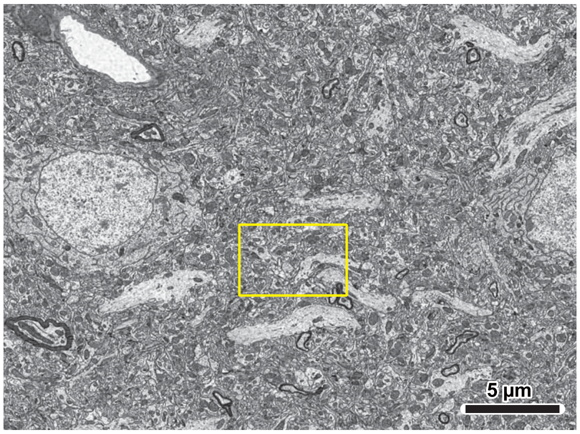
Backscattered electron images above from ultrathin section of Arabidopsis thaliana. Images were acquired at 2 kV of acceleration voltage to demonstrate TEM-like quality. For Energy Filtered BSE detection, ultrastructure such as thylakoid membrane are clearly visible in right image.

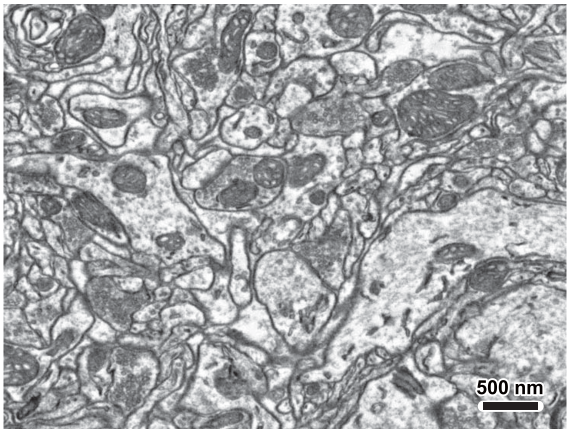
Specimen courtesy of Dr. Kiminori Toyooka, RIKEN CSRS

Large FOV + High Pixel Resolution of Rat Cerebral Cortex



Three backscattered electron images from ultrathin section of rat cerebral cortex demonstrate SU8600 image acquisition capability.
Top-left image was acquired with >60 µm of FOV. The yellow rectangle field in the image is also shown in bottom-left image with an increase of digital magnification. Right-bottom image is further digitally magnified and cropped from bottom-left image.
Even though digitally enhanced the original image more than **12 times**, and high-quality is maintained.
High pixel resolution image up to 40,960 x 30,720 pixel available (*) on SU8600



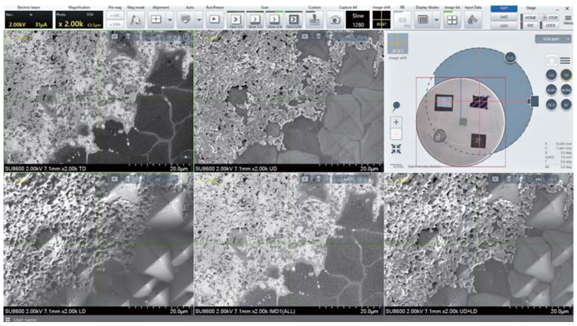


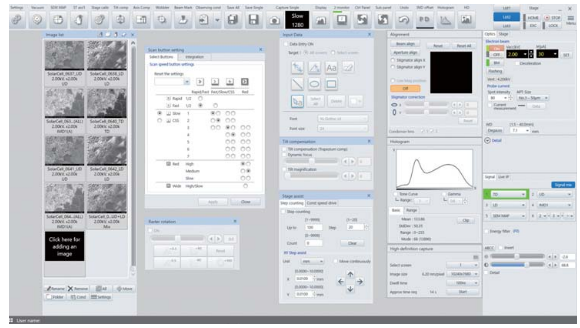
Specimen courtesy of Dr. Yoshiyuki Kubota, Section of Electron Microscopy, National Institute for Physiological Sciences

(*) option

Flexible Interface and Chamber SU8600

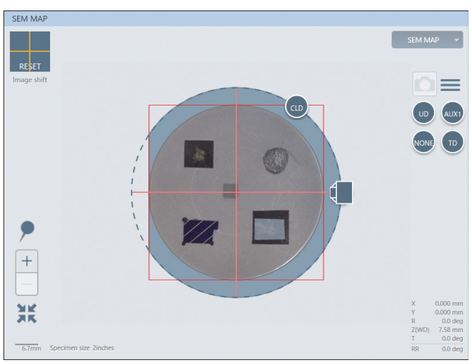
Dual monitors with 6-signal simultaneous display





1, 2, 4 or 6 signals, including the chamber scope(*) or SEM MAP, can be displayed simultaneously on a single monitor. By adding a second screen, the dual-monitor configuration supports enhanced productivity plus expanded workspace and allows the operation panel to be customized with submenus positioned anywhere on either screen.

Camera Navigation*

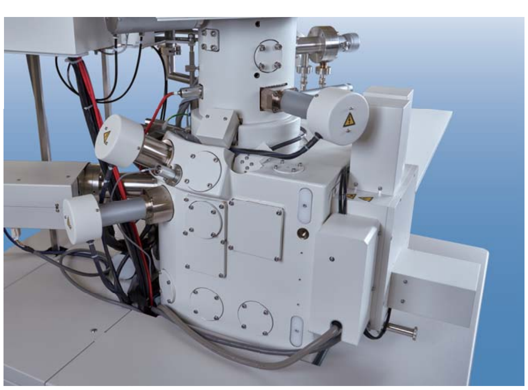


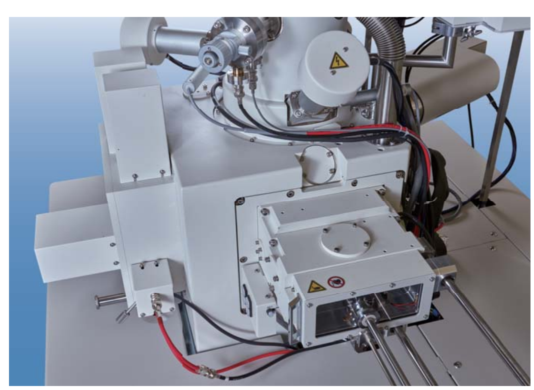
The built-in optical camera captures the specimen holder overview which is automatically transferred to the SEM MAP screen for a graphical navigation interface to assist with quick access ROI navigation.

Chamber Scope*

GUI integrated chamber scope provides safe operation by showing the specimen position in real-time. This display is monochrome/color convertible and can be displayed in its own individual window.

Chamber and Port Layout





The specimen exchange chamber accepts large specimens up to Φ150mm diameter.
Multiple EDS ports in the improved chamber design offer versatile analytical platform.
(The instrument pictures includes options)

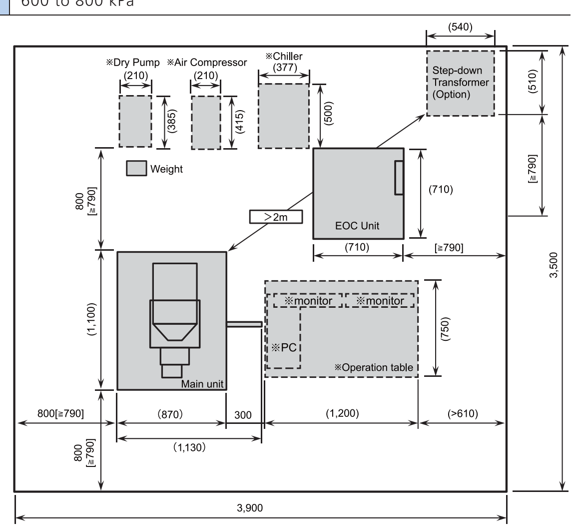
(*) option

Specifications

Model No.			SU8600
Product Name			SU8600 G
Electron Optics	Secondary Electron Image resolution		0.6 nm@15 kV
			0.7 nm@1 kV(*1)
	Magnification		20 to 2,000,000 x
	Electron Gun		Cold cathode field emission gun with anode heating system
	Accelerating Voltage		0.5 to 30 kV
	Landing Voltage(*1)		0.01 to 20 kV
Specimen Stage	Stage Control		5-axis Motor Drive
	Movable Range	X	0 to 110 mm
		Y	0 to 110 mm
		Z	1.5 to 40 mm
		T	-5 to 70°
		R	360°
Specimen Chamber	Specimen Size		Max. φ150 mm
Detectors	Standard Detectors		Upper Detector (UD) with ExB filter: SE/BSE signal mixing function
			Lower Detector (LD)
	Option Detectors(*2)		Top Detector (TD)
			In-Column Middle Detector (IMD)
			Out-Column Crystal Type BSED (OCD)
			Semiconductor Type BSED (PD-BSED)
			Cathodoluminescence Detector (CLD)
			STEM Detector
	Optional Accessories(*3)		Energy Dispersive X-ray Spectrometer (EDS)
			Electron Backscattered Diffraction Detector (EBSD)
Image Display Mode	Large Screen Display Mode		1,280×960 pixels
	Single Image Display Mode		800×600 pixels
	Dual Image Display Mode		800×600 pixels and 1,280×960 pixels with dual monitors
	Quad Image Display Mode		640×480 pixels
	Six Image Display Mode w/dual monitors		640×480 pixels with dual monitors
	Pixel Size		640×480 / 1,280×960 / 2,560×1,920 / 5,120×3,840 / 10,240×7,680 / 20,480×15,360(*2) and 40,960×30,720(*2)
Dimension and Weight (*4)	Main Unit		1,130(W)×1,100(D)×1,750(H) mm, Approx. 660 kg
	EO Control Unit		710(W)×710(D)×1,210(H) mm, Approx. 260 kg
	Weight		200(W)×160(D)×140(H) mm, Approx. 25 kg
Utility Requirements	Temperature		15 to 25 ℃
	Humidity		60 %(RH) of less (non-condensing)
	Power(main unit)		4 kVA(crimp contact for M6)AC100 V±10 %, or AC200-240 V ±10 % with autotransformer
	Grounding		100 Ω or less
	Cooling Water(Chiller)		Dedicated Cooling Water Circulation system(*5)
	Vacuum Pump		Dry Pump(*5)
	Air Comperrsor(*6)		600 to 800 kPa

(*1) with deceleration mode
(*2) Option
(*3) Mountable Detectores
(*4) Weight of standard unit; does not include options.
(*5) Customer-supplied item
(*6) In case of connection from installation site facilities.

Suggested Layout



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