

Focused Ion and Electron Beam System  
**ETHOS NX5000 Series**

**HITACHI**  
Inspire the Next

Focused Ion and  
Electron Beam System

**ETHOS**  
NX5000  
Series



Science for  
a better tomorrow

Includes option

# Hitachi Ethos NX5000 Series



## Unsurpassed Performance with Ultimate Flexibility

The innovative FIB-SEM design platform of the Hitachi Ethos NX5000 Series combines a variety of analytical applications in one system.

The Hitachi Ethos FIB-SEM incorporates the latest-generation FE-SEM with superb beam brightness and stability. Ethos delivers high-resolution imaging at low voltages combined with ion optics for nanoscale precision processing.



	Cold FE electron source	Schottky FE electron source
Source size (nm)	5	15 - 30
Energy spread (eV)	0.2 - 0.3	0.6 - 0.8
Brightness (A/cm <sup>2</sup> sr)	10 <sup>8</sup>	10 <sup>7</sup>

Cold Field Emission (CFE) gun technology is electron dense with better brightness for improved imaging and analytical performance



## Key Features

1

### High-Performance FE-SEM Column with Dual Lens Mode

Ultra-high-resolution observation (HR mode: semi-in-lens)  
High-accuracy end-point detection in real time (FF mode: Field Free (time sharing mode))

2

### High-Throughput Material Processing

Ultra-fast processing with high ion-current density (Max beam current 100 nA)  
User-programmable script for automatic processing and observation

3

### Microsampling System

Fully integrated sample-orientation control for Anti-Curtaining Effects (ACE) technology  
TEM sample preparation for uniform lamellas at any orientation

4

### Triple Beam Capable, Delivering Advanced Quality Results

Low-acceleration noble-gas ion-beam material processing  
Innovative functions reduce Ga ion related and other milling artifacts

5

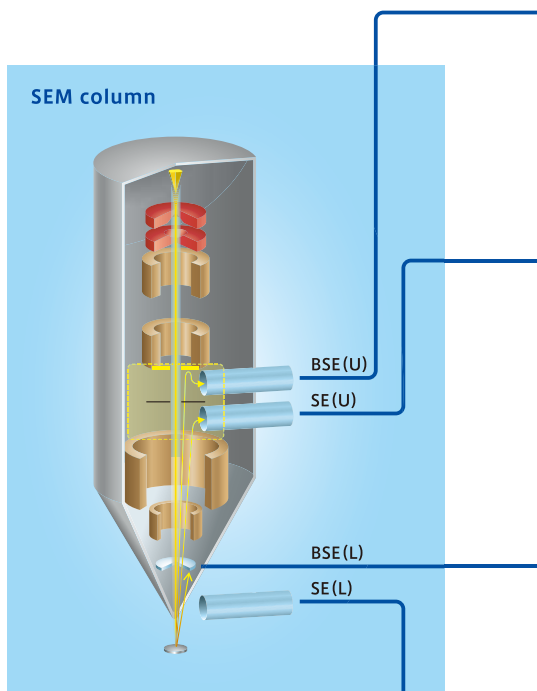
### Large Multi-Port Chamber and Stage for Various Applications

Capable to handle large sample sizes with exceptional stage stability  
Full-range enhanced long-distance tracking (155 x 155 mm)



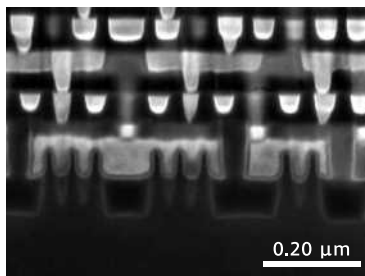
## Refined Electron Optics and Multi-Signal Detection

The Ethos SEM column is composed of a magnetic- and electrostatic-field compound objective lens system configured as two lens modes. High Resolution (HR) mode achieves sample observation at ultimate resolution by immersing the sample within the magnetic field of the lens system. Field Free (FF) mode offers real-time FIB processing for high-accuracy end-point milling. Hyper switching between FIB irradiation and SEM imaging as fast as 10 nsec offers real-time fabrication and observation views with clarity. Fast SEM and IM imaging enables users to quickly find the area of interest with ease.

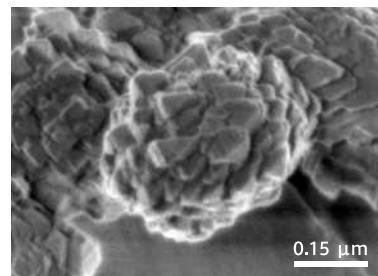


	Asbestos	Solder Junction Interface
<b>In-Column BSE detector</b> <b>BSE(U)</b> Loss-less compositional/material contrast imaging		
<b>In-Column SE detector</b> <b>SE(U)</b> Surface sensitive edge contrasted imaging		
<b>In-Column BSE detector</b> <b>BSE(L)</b> Material contrast and topographical imaging		
<b>Lower SE detector</b> <b>SE(L)</b> Surface sensitive edge contrast and topographical imaging		

## High-Resolution SEM Imaging



Sample: Semiconductor device  
14 nm Fin-FET  
Acceleration voltage, 3 kV



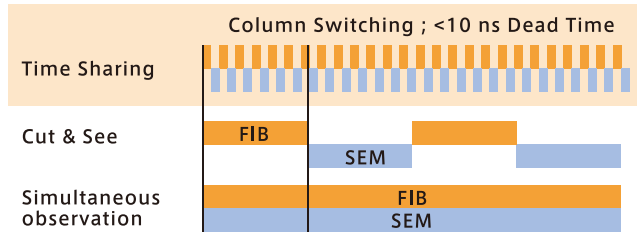
Sample: Zeolite (Beta)  
Acceleration voltage, 0.4 kV  
Sample courtesy of Advanced Industrial Science and Technology Mr. Yoshihiro Kamimura

# Hitachi Ethos NX5000 Series



## Time Sharing Mode

Time sharing mode is the ultimate tool to maximize SEM observation while ion milling simultaneously



- Time Sharing mode resolves high-quality SEM imaging with any detector and any milling condition for end-point detection in real time.
- Cut & See mode for ultra-high resolution imaging in HR mode.
- Simultaneous observation for traditional imaging



## High-Performance FIB Column

High-current-density FIB for high-speed and large-area processing.

Autopilot software supports a multitude of automated functions for imaging, TEM lamella preparation, cross-section generation, and more...

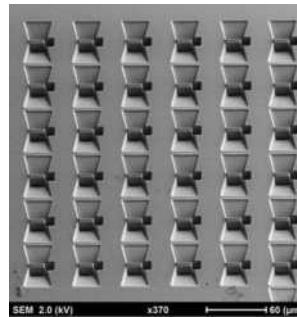


Image Description:  
Multiple sites processed for lift out by Auto-pilot Automation software

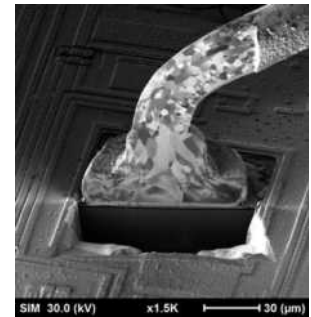
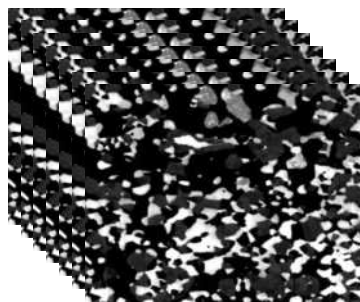


Image Description:  
High speed ion milling, SIM image highlighting grain contrast of bond wire



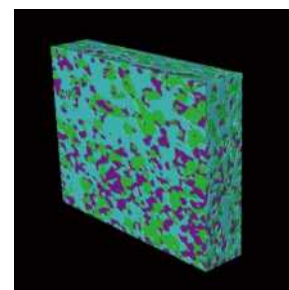
## 3D-reconstruction Processing by Cut & See



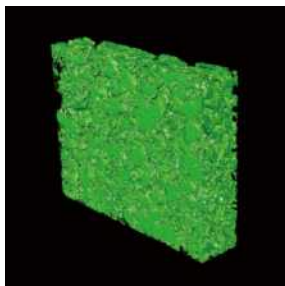
Sample; Ni-YSZ  
Sample courtesy of Prof. Naoki Shikazono, Institute of Industrial science, the university of Tokyo

FOV; 20 µm  
Slices; 200 pictures  
Slice pitch; 20 nm  
SEM observation at 1.5 kV

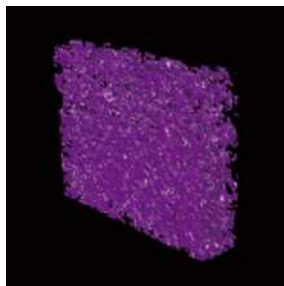
Supported by Image-Pro Premier 3D



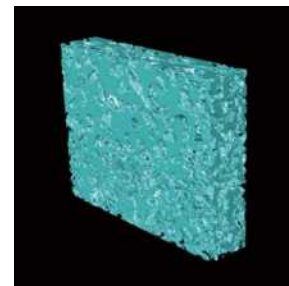
3D reconstruction of Ni-Zr-Void



3D reconstruction of Nickel



3D reconstruction of Zirconium



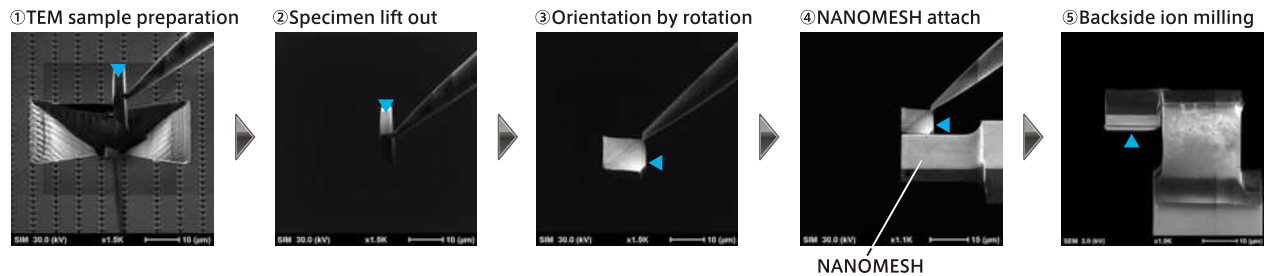
3D reconstruction of Void of filled resin

\*1: Dedicated software is required for 3D reconstruction imaging.

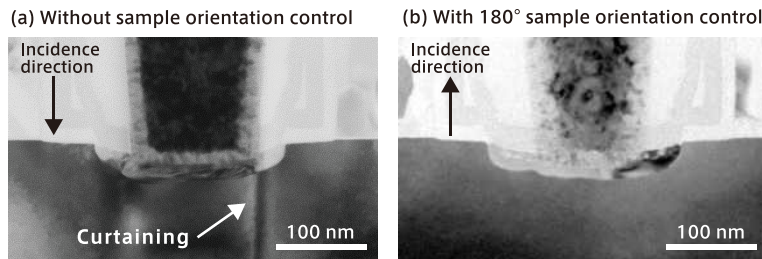


## ACE Technology Enables Ultra-High-Quality TEM Preparation

### Sample-orientation control as part of Anti-Curtaining Effect Technology



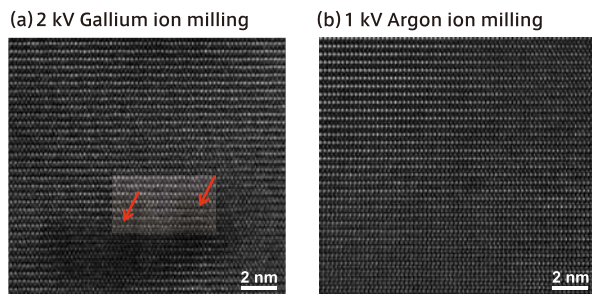
Orientation control mitigates curtaining and other artifacts by changing the impinging ion beam angle from 0°-360°.



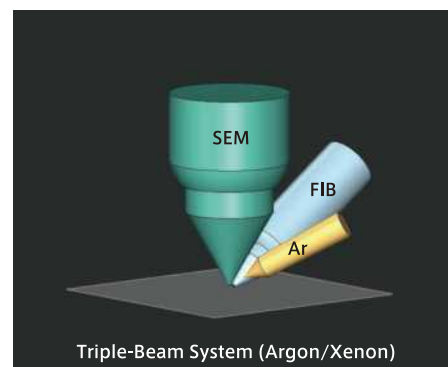
Bottom of contact plug observed by 300 kV FE-TEM

### High-quality TEM Specimen Preparation using Triple-Beam technology

Ethos offers powerful solutions integrated into a single platform including low-acceleration Ar/Xe ion-beam processing when configured as a Triple-Beam system.



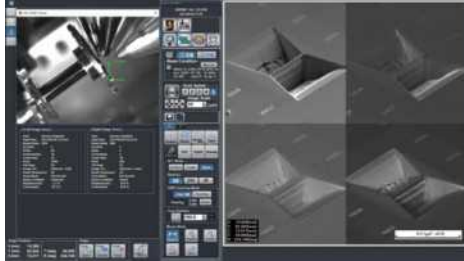
Al<sub>2</sub>O<sub>3</sub> single crystal in the <110> plane. Dark contrast (red arrow) areas indicates Gallium ion induced damage at 2 kV. The right image shows the same single crystal structure intact after applying 1 kV Argon ion milling revealing clear crystal lattice fringes.



Low-energy Ar/Xe broad ion milling mitigates amorphous material resulting from gallium ion milling

# Hitachi Ethos NX5000 Series

## Optimized GUI for Efficiency



### Enhanced signal selectivity with 4 detectors

- Four-channel simultaneous signal acquisition of In-Column detectors (SED x 1, BSE x 2) and In-Chamber SE detector
- Programmable menus to save and recall SEM and FIB beam parameters
- Selective and discreet imaging from various detectors enable specific user applications such as compositional or topographical imaging
- Condition saving and recalling are possible for each signal mode such as gain levels, contrast, and brightness in addition to other parameters

## Latest-Generation Interface for Custom Processing Modes and Recipes



### Graphically Driven Programming for Macro Visualization

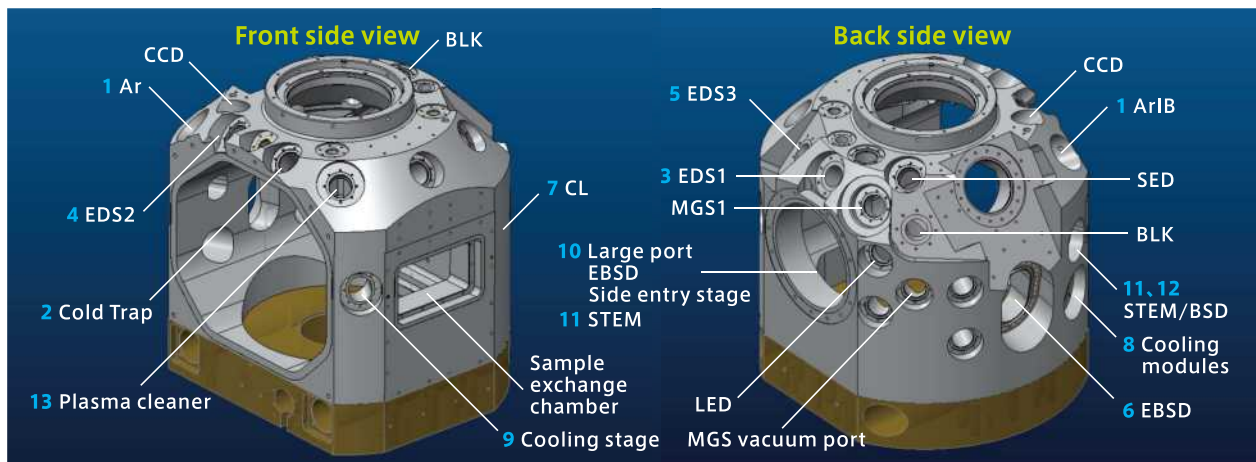
- Simple drag and drop interface to create complex processing/observation recipes with ease
- Fully programmable processing modes with nested templates
- Maximum efficiency for routine operation by utilizing registered recipes

### Unmatched Flexibility for Creating Your Recipe

- Multifaceted processing modes including slope and bitmap processing as well as preset patterns including rectangles, circles and trapezoids
- Predefined recipes for cross-section processing and TEM lamella preparation
- Vector scan software allows custom processing applications
- High-accuracy and automated processing with drift correction
- Recipes can be individual or group-based for multi-user lab environments.

## Sample Chamber and Stage for Various Applications

- Newly designed sample stage for high-resolution imaging
- A multitude of analytical configurations are possible with optimum detector positioning.



## Specification

FIB	
	NX5000
	NX5200
SIM Resolution (C.P)	4 nm @ 30 kV
	60 nm @ 2 kV (Edge resolution)
	50 nm @ 2 kV (Edge resolution)
Accelerating Voltage	0.5 kV – 30 kV
Max. Beam Current	100 nA
Ion Source	Ga Liquid Metal Ion Source

SEM	
SEM Resolution (C.P)	1.5nm@1kV, 0.7nm@15kV
Accelerating Voltage	0.1 kV – 30 kV
Max. Beam Current	10 nA
Electron Source	Cold cathode FE source

Detectors	
SEM In-Column	Secondary Electron Detector; SE(U) Back Scattered Electron Detector; BSE(U) Back Scattered Electron Detector; BSE(L)
Chamber Port	Secondary Electron Detector; SE(L)

Stage	
Stroke	X,Y: 155 mm, Z : 16.5 mm
5-Axis motorized	R: 360°, T: -10 to +59°

Sub-Chamber	
Configurable Subchamber for manual loading or an optional Auto-Loading type	

Options	
Auto-Loading Subchamber	Automatic sample exchange chamber
Ar Ion Beam System	Enables argon ion beam processing
Xe Ion Beam System	Enables xenon ion beam processing
Microsampling System MPS-V	Four-axis (XYZR) in-situ microsampling system
MGS III 2-Reservoir Type	Gas injection system for using two different types of deposition gas species (Carbon, tungsten, or platinum)
MGS III 3-Reservoir Type	Gas injection system for using three different types of deposition gas species (Carbon, tungsten, and platinum)
Multi-View TEM Sample Platform	Platform to hold four TEM grids vertically or horizontally for sample orientation control
Auto-Pilot Software	Auto-processing software for multiple locations, including drift correction function
Continuous TEM Sample Auto-Finishing Software (A-TEM II)	Automated TEM sample preparation for ex-situ lift out at multiple locations including Auto-Pilot software
Inspection System Linkage Software	Drives the stage according to the defect coordinate information from inspection system
Vector Scan Software	Enables variable pattern processing
Single Tilt System	Add a one-axis tilt mechanism to the sample holder
Double Tilt System	Add a two-axis tilt mechanism to the sample holder
Side Entry Stage System	Hitachi High-tech TEM/STEM holders can be shared
OM Link System	The entire image of the specimen holder can be photographed by optical microscope in the specimen chamber
Auto Microsampling System	automation function of TEM sample preparation



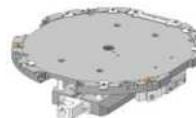
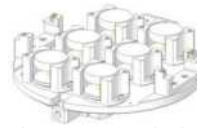




Options (3rd Party Vendor)	
EDS	Energy Dispersive Spectrometer
EBSD	Electron Backscatter Diffraction
Plasma Cleaner	Contamination control for specimen chamber
STEM detector	STEM image can be captured

## Sample Holders

- Quick scan holder registration for better navigation
- Holder compatibility with other analytical platforms available
- Drift reduction technology for holders available for demanding applications

Manual-loading Subchamber Upgradeable to an optional Auto-Loading Subchamber



Height adjustable holder*2	Height Adjustable Vertical Movement Sample Holder*2	150 mm Wafer Sample Holder*2	25 mm Sample holder (Different sample height at 6 position)
 Max sample size: 50 mm φ x 20 mm tall	 Max sample size: 25 mm xy x 5 mm tall		 25 mm diameter x 20 mm or less height and 6 sample position Easy to handling sample height adjust
t36 mm Sample Holder	SU Linkage Holder	Multi-View TEM Sample Platform	15 mm sample holder (Different sample height at 12 position)
 Max sample size: 40 mm xy x 36 mm tall			 15 mm diameter x 10 mm or less height and 12 sample position Easy to handling sample height adjust

\*2: Low Expansion type available

## System Requirements

Items	Description
Room Temperature	Set Value 22 °C ± 3 °C Tolerance 5V ± 1 °C Fluctuation 0.5 °C/h or less
Relative Humidity	35-60%, no condensation
Power	Single phase 200/208/220/230 VAC ± 10% 30 A (50/60 Hz)
Grounding	100 Ω or less
Cooling Water	Flow 0.6-0.7 L/min Pressure 50-100 kPa Temperature 15-20 °C * Ambient temperature difference is 7 °C or less. Temperature Fluctuation ± 0.5 °C or less/10 min
N <sub>2</sub> gas (gas purge)	Purity 99.95% or greater Pressure 0.5-0.7 Mpa
Air (pneumatic valve control)	0.5-0.7 MPa

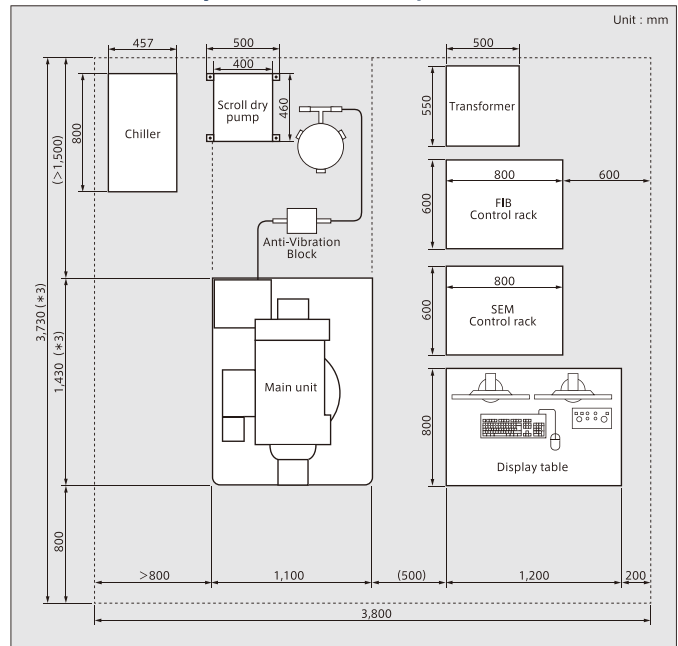
Unit	Size & Weight
Main	1,100 x 1,430 x 1,900 mm, 1,850 kg
Display Table	1,200 x 800 x 720 mm, 85 kg
FIB Control Rack	600 x 800 x 1,800 mm, 310 kg
SEM Control Rack	600 x 800 x 1,800 mm, 380 kg
Transformer	550 x 500 x 750 mm, 140 kg
Anti-Vibration Block	170 x 400 x 140 mm, 30 kg
Scroll dry pump (recommended model)	500 x 460 x 340 mm, 35 kg
Chiller model recommended	457 x 800 x 620 mm, 65 kg

The values listed in the table are rounded (approximate value).  
The values such as dimensions, weights differ depending on the product configuration (options and such).  
The values listed in the table are reference values.

Note: Approximate dimensions

\*3: Approximate dimensions when manual-loading subchamber is configured.  
Main unit size is 1,100 x 1,850 x 1,900 mm.  
Installation layout is 4,170 x 3,800 mm.

## Installation Layout (include an option)



The Science Ring demonstrates our desire to contribute to the betterment of society through Hitachi's innovative scientific instruments and expertise.

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

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