JEM-9320FIB

Focused Ion Beam System for Specimen Preparation

JEOL

Serving Advanced Technology

JEM-9320FIB

Focused Ion Beam System for Specimen Preparation

Nanoscale observation and analysis are increasingly important in the nanotechnology era. Based on electron- and ion-optics technologies developed by JEOL for many years, the JEM-9320FIB system can prepare cross sections from local areas of STEM/TEM specimens for semiconductor failure analysis and achieves precise, fast milling for SEM cross sectional specimens.

Preparation of SEM cross sectional specimens

- For SEM common specimen stub
  (When a bulk specimen stage is installed)
  After cross sectional milling, it is possible to transfer a specimen, which is mounted on a specimen stab, from the JEM-9320FIB to a JEOL SEM, EPMA or Auger instrument for observation and analysis.

Simple thin-film preparation for STEM and TEM

- For TEM common tip-on holder
  (When a side-entry goniometer stage is installed)
  Observation using a JEOL TEM and re-processing using this system can be easily repeated.

High-speed, high-precision milling, high-resolution observation

- High-speed milling with a large ion-beam current (30 kV, 30 nA or greater) reduces the rough-milling time to 1/8 (compared to JEOL conventional models).
- High-speed processing with a large ion-beam current (30 kV, 30 nA or greater) reduces the rough-processing time to 1/8 (compared to JEOL conventional models).
- Improvement of the ion optical system enables one to observe a high-resolution SIM image (6 nm, 30 kV).
- Stable beam scan allows high-precision processing.
- The optional Automatic Processing Software has greatly increased the processing efficiency.

Eco-friendly, space-saving, energy-saving

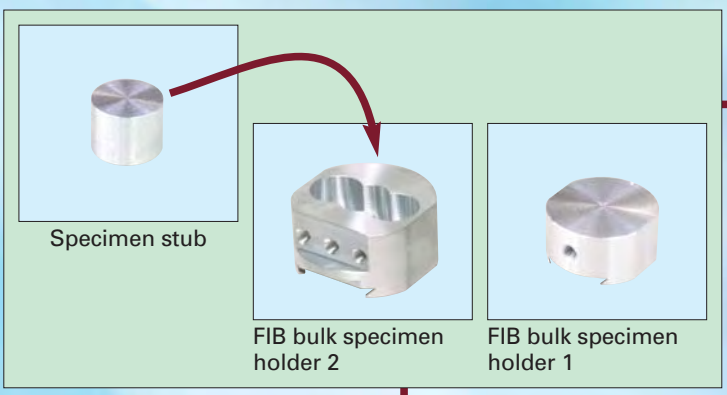
- The JEM-9320FIB can be installed even in a narrow space because of its small footprint.
- The beam saver mode suppresses unnecessary consumption of the Ga ion source.

** SIM image (Scanning Ion Microscope Image)*

Simple, Fast, Preci for Specimen Prep

SEM stage/SEM common specimen stub

It is possible to use a JEOL SEM, EPMA or Auger instrument with a common specimen stub. A milled specimen (mounted on the specimen stub) by FIB can be transferred to an instrument with the specimen stub attached, for observation and analysis. Since the same specimen stub can be used, the specimen can be easily positioned for an additional processing point.

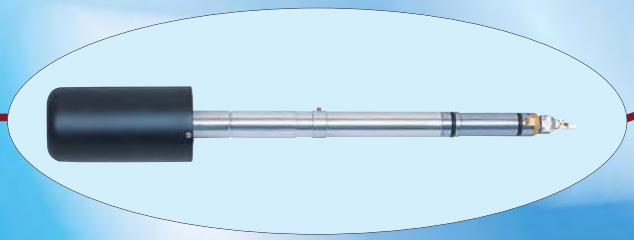


(Optional attachments are included in the photograph of the appearance of the JEM-9320FIB.)

TEM stage/TEM common tip-on holder

The JEM-9320FIB employs a side-entry goniometer stage commonly used with a JEOL TEM. Since a tip-on holder and a shuttle retainer can be shared with a JEOL TEM, FIB milling and TEM observation can be easily repeated.

** For the compatibility with a TEM, please consult us.*



FIB tip-on holder with a shuttle retainer attached to the tip

se. FIB System Optimum aration

FE-SEM specimen holder adapter

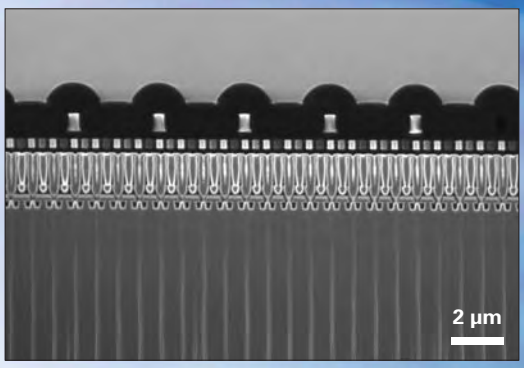
JSM-7401F
Emission Scanning Electron Microscope

JEM-2500SE
Nano Analysis Electron Microscope

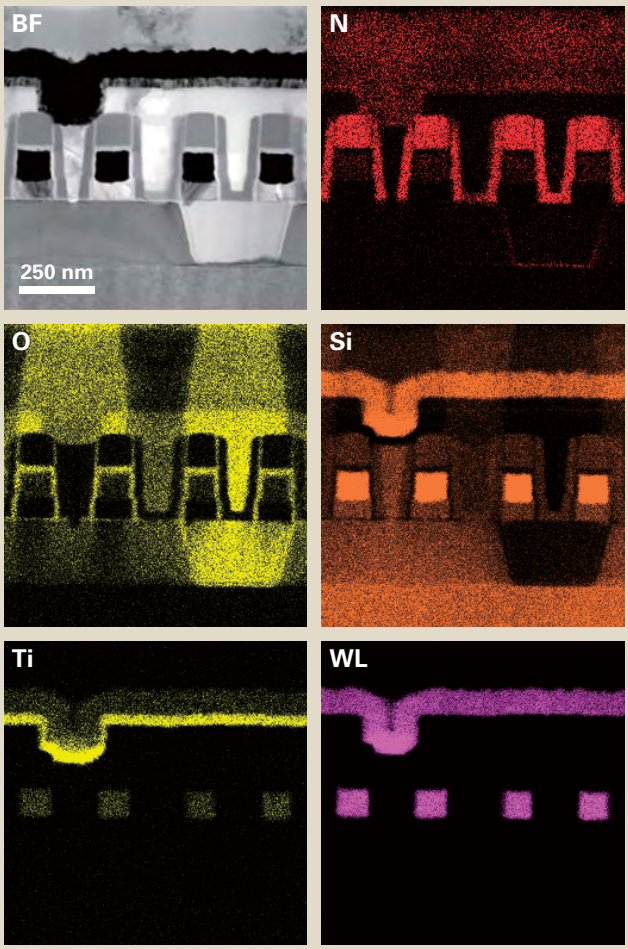
JEM-2100F
Field Emission Electron Microscope

SIM image [Specimen: 512 DRAM]

SEM image [Specimen: 512 DRAM]



STEM image/EDS maps [Specimen: 512 DRAM]

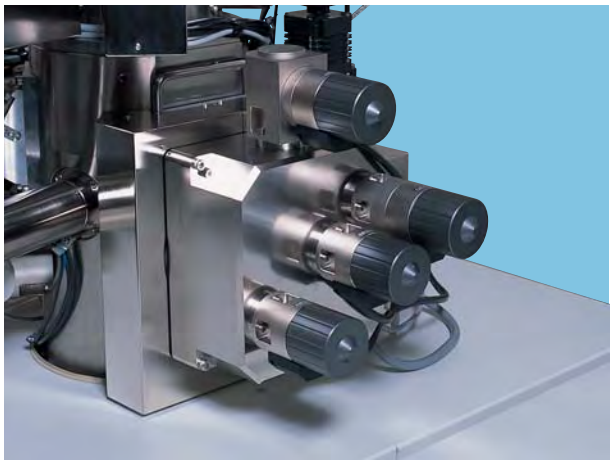


Twin Stage Optimum for SEM/TEM Specimen Preparation

The JEM-9320FIB can simultaneously install the bulk specimen motor stage optimum for SEM/TEM specimen preparation from a bulk specimen, and the side-entry goniometer stage optimum for TEM specimen preparation (either one is a standard configuration). A better one is selectable depending on specimen size.

Bulk specimen stage

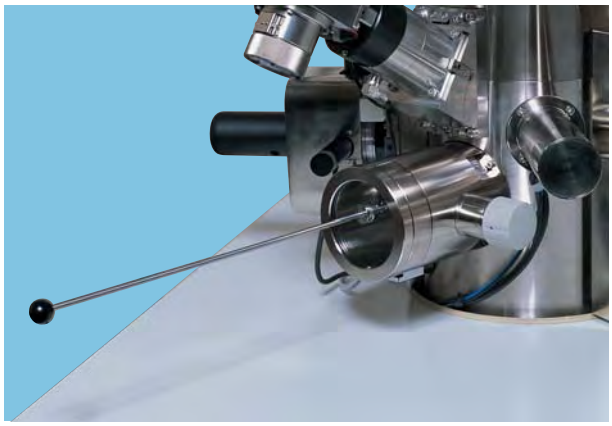
The entire surface of a specimen with 20 mm × 20 mm can be observed.



Bulk specimen motor stage

Airlock system for simple specimen exchange (optional)

A specimen holder can be installed on the specimen stage through an airlock chamber in a short time.



Airlock system

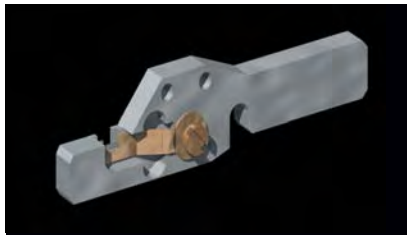
TEM specimen stage

It is possible to prepare a thin film from a specimen polished by dicing in prior treatment.

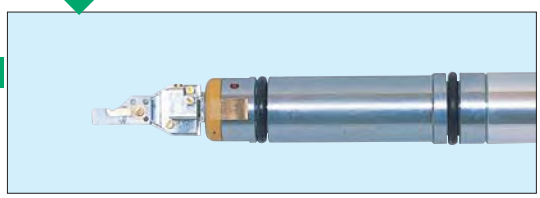
Side-entry goniometer stage for TEM specimens

Tip-on holder for simple handling of specimens (optional)

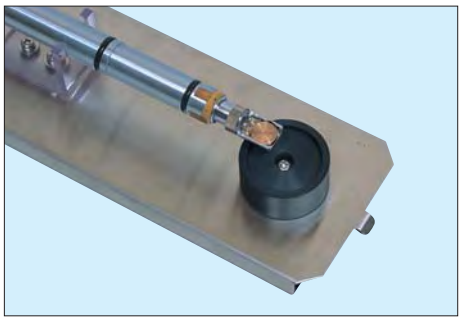
The shuttle retainer can be installed on the tip of the tip-on holder. Since the retainer can be replaced with the specimen mounted on it, even a small specimen 3 mm in width can be easily handled.



Shuttle retainer



Shuttle retainer installed on the tip of the FIB tip-on holder



FIB bulk specimen holder (optional)

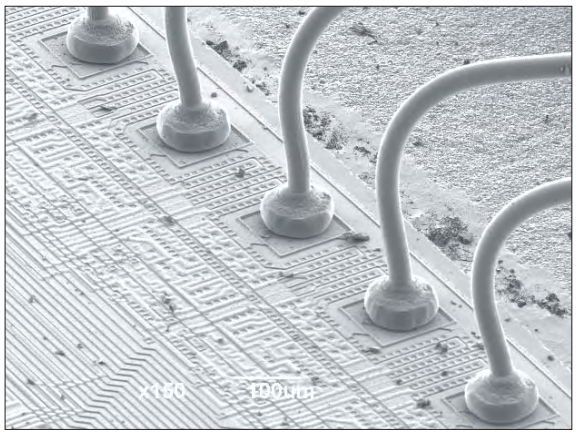
This holder can retain a bulk specimen up to 8 mm in diameter and 1 mm thick. It is useful for cutting a thin section from a fragment of a semiconductor wafer for FIB milling.

High Operability and Extensive Capabilities

Wide view, snap shot

The wide view mode facilitates the search of target-milling positions by means of an ultra-low magnification (×50). In particular, this capability is useful when you want to find target milling-positions on a large specimen and multiple specimens. The snap shot can capture a real-time image on the monitor screen. By clicking on an arbitrary position on a snap shot, this specified position appears at the center of the real-time screen. Combined use with the wide view mode opens the application for navigation.

Clicking the snap shot screen displays a high-magnification image. A sophisticated eucentric capability maintains the target specimen position on the monitor screen even the specimen is rotated or tilted. Sequentially varied magnifications are displayed from ×150.

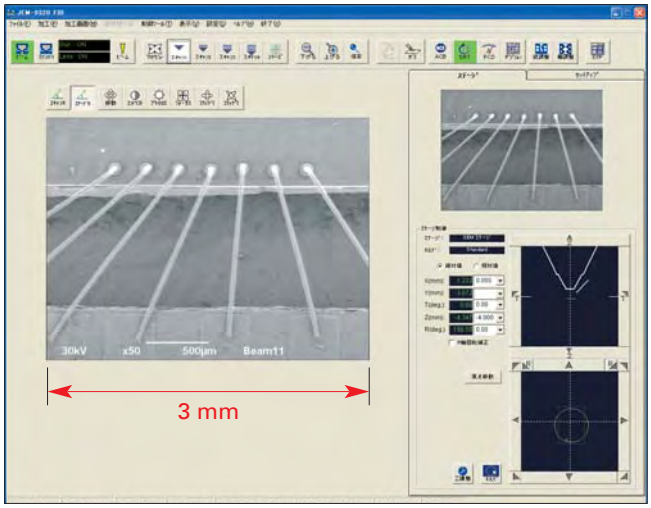


SIM image at a magnification of ×150

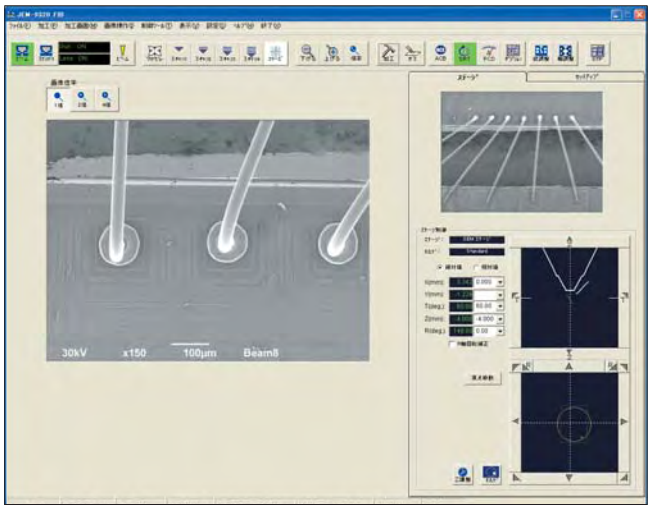
Thumbnail position-memory

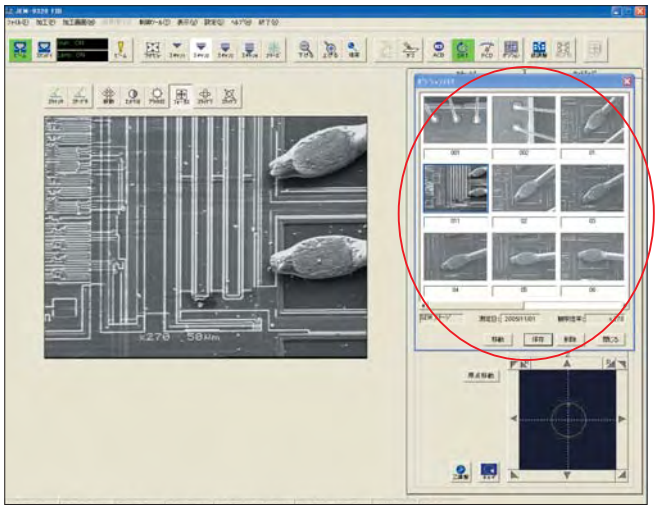
This capability makes it possible to memorize the presently displayed image and to display it in the thumbnail view, which includes the positional information. Clicking an image in the thumbnail view moves the specimen stage and reproduces the target object at the center of the screen.
It is easy to reproduce the target specimen position when multiple specimens are alternately observed or additional milling is applied to the specimen after SEM observation. In addition, this advantage is useful when the specimen is removed from the specimen stage due to an interruption work and returned to the stage for the observation.

Wide view mode (×50)/Wide field image (3 mm in width)



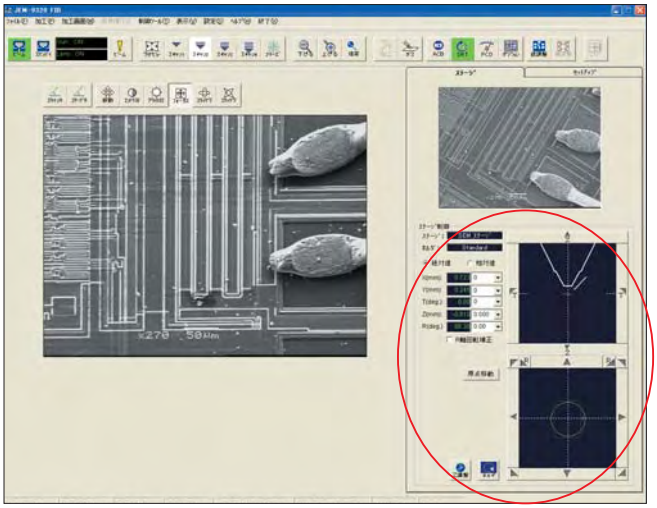
Facilitated rotation and tilting by eucentric capability





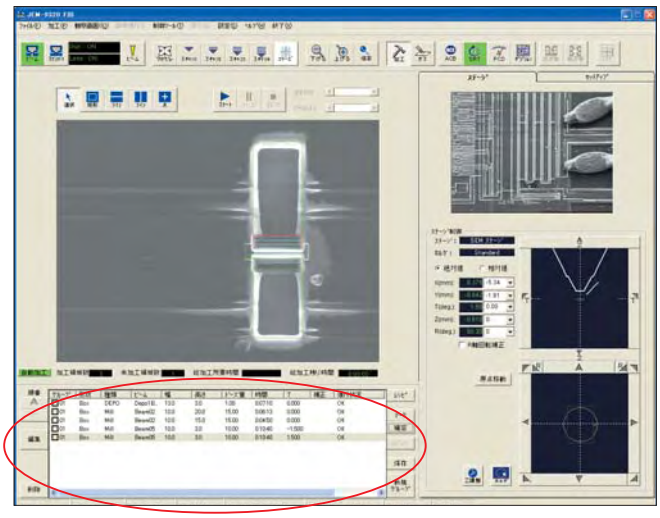
Specimen position display and specimen rotation capability

The specimen position on the stage is graphically displayed. Clicking on the graphic display moves the sage to the target position and its image appears. This capability is useful for searching the target position.
With a one-touch operation on the displayed image, the specimen can be rotated to an arbitrary angle. It is easy to adjust the orientation of the specimen for processing.



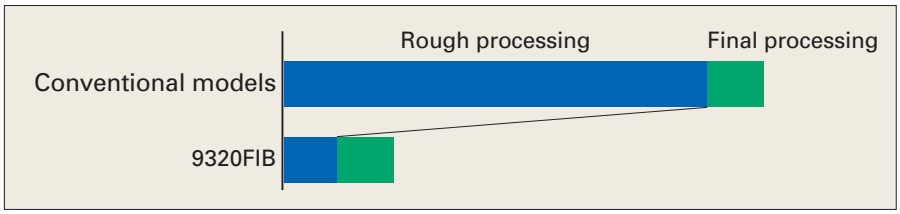
Automatic Processing Software
(optional)

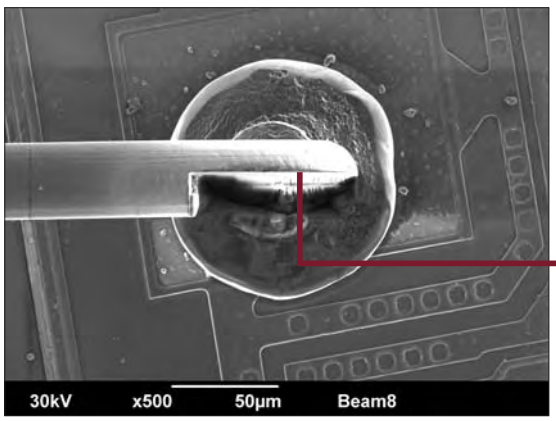
This software records the processing procedure (recipe) for metal deposition, rough processing and final processing in advance. In addition, the positions to be processed can be recorded up to 250 points for continuous automatic processing. This capability is utilized for all-night automatic processing and operators' final processing in the next morning, thus increasing efficiency.



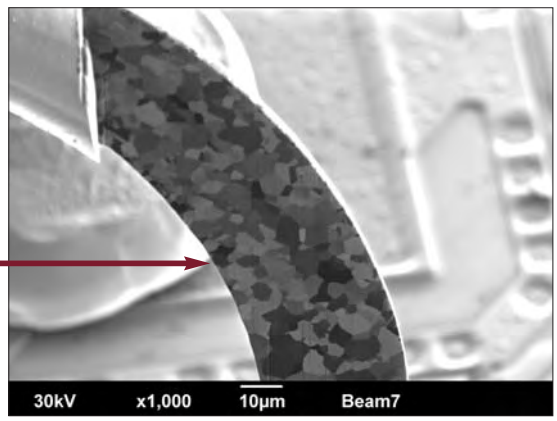
Large-current processing

Large-current processing (30 nA or more) has greatly shortened the processing time. The rough-processing time has been reduced to 1/8 (compared to JEOL conventional models). This capability is particularly useful for processing on large areas.





Cross-section SIM observation
Specimen: bonded wire.

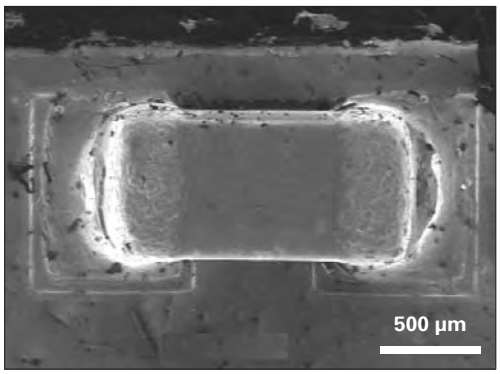


Large-area processing in the large-current mode (rough processing: 40 nA).

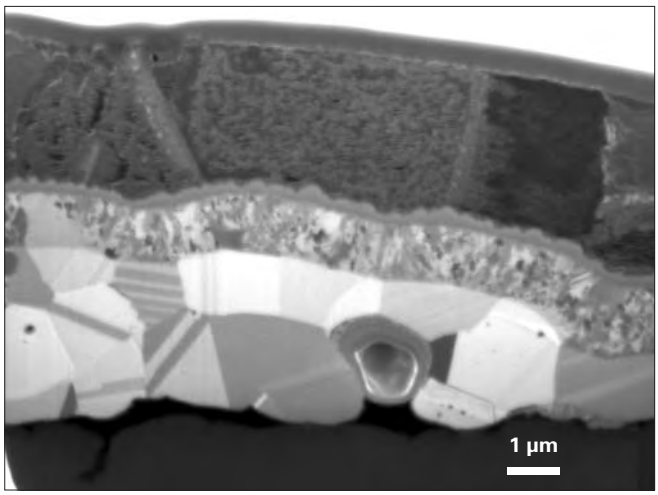
Applications of JEM-9320FIB To Processing and Observation

Cross-section processing/SIM image observation

The JEM-9320FIB is an effective tool for not only processing but also observation. In particular, SIM images offer better channeling contrast than SEM images, which are formed by differences in crystalline orientations. This advantage is very suited to metallic textures and plated films.



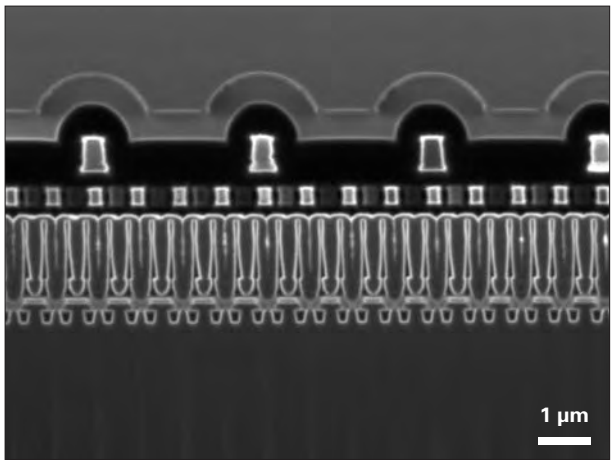
SIM image of a chip capacitor on a printed circuit board



SIM image of a cross section of a chip capacitor milled by an ion beam. Channeling contrast clearly shows the difference in layer structures.

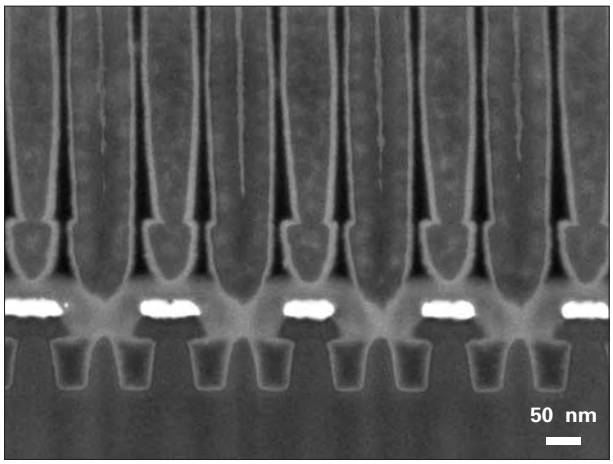
Specimen preparation for SEM

A cross section milled by FIB can be subject to high-resolution SEM observation and elemental analysis using an energy dispersive X-ray spectrometer.



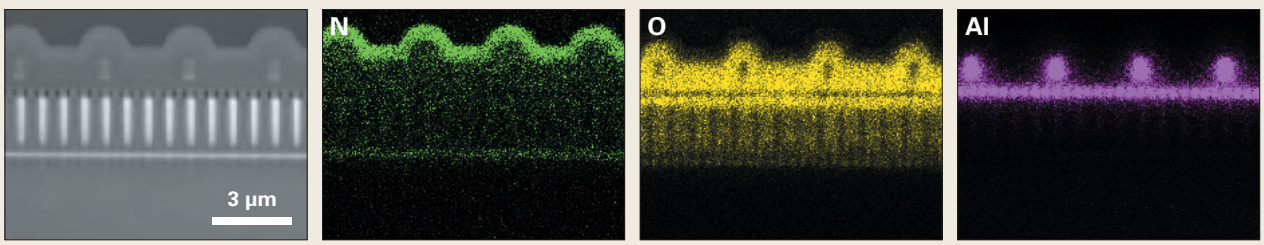
SIM image

Specimen: 512M DRAM



SEM (secondary electron) image

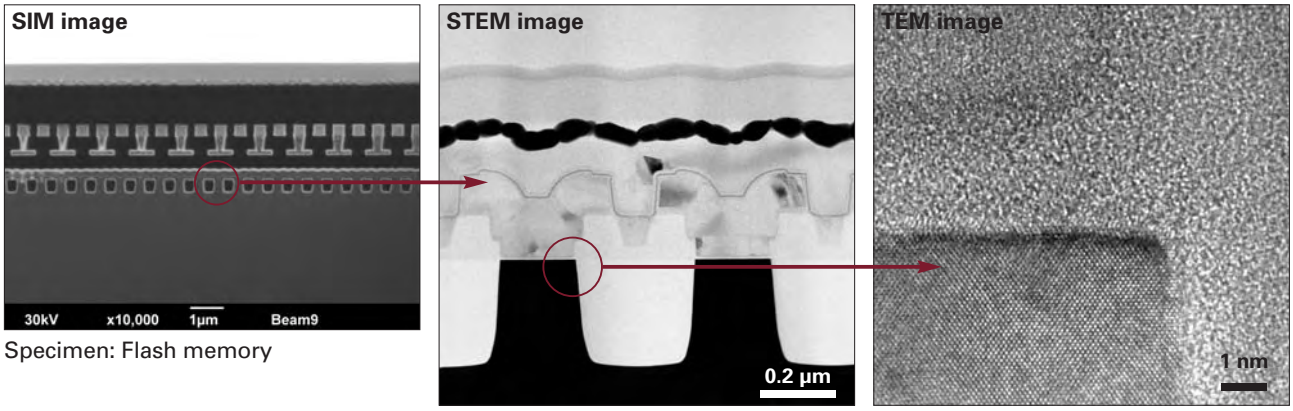
Elemental mapping images obtained by EDS



Composition images formed by backscattered electrons

Thin-film specimen preparation

The JEM-9320FIB can prepare thin films from local microscopic areas with high accuracy. This tool is essential for evaluation and defect analysis of nano-materials such as semiconductor devices.

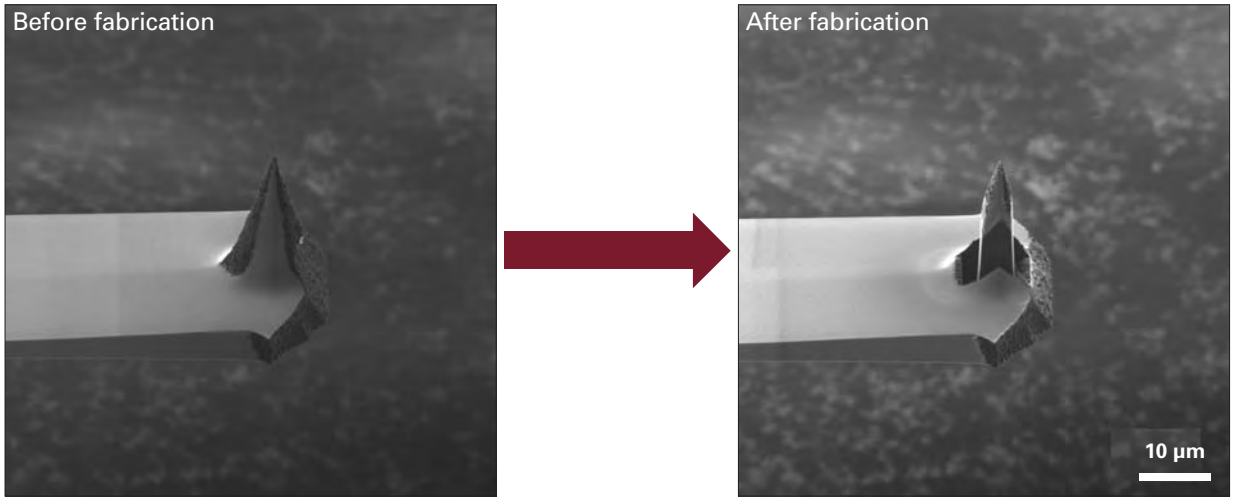


Specimen: Flash memory

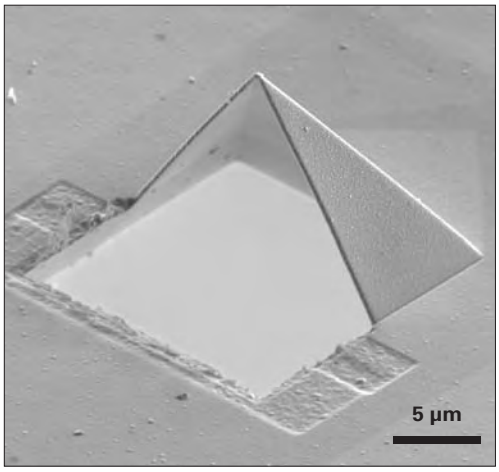
Fine fabrication

The JEM-9320FIB can fabricate the tip of a cantilever as well as prepare thin films.

Tip of a cantilever for an AFM fabricated by an ion beam



Cantilever for α -SNOM subject to cross-section fabrication

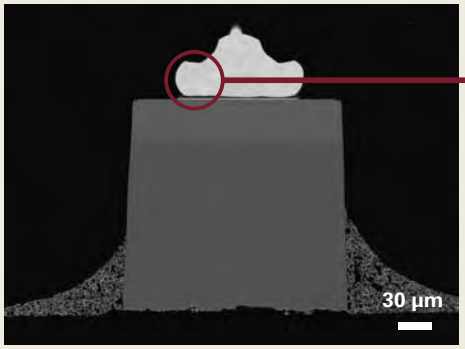


Thinning by additional processing

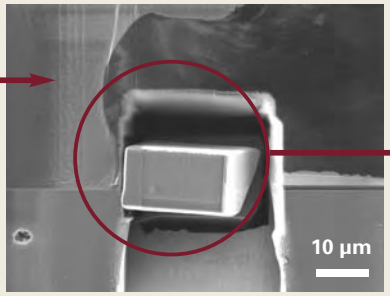
Additional processing is effective for preparation of a thin film when the area of observation is specified. In this technique, first, an ion beam cuts a specimen into a block 10 to 15 µm in size, including the area of observation. Then, this block is picked up with a glass probe, fixed on a specimen mount such as a half-sliced grid, and attached to a shuttle retainer. This shuttle retainer is installed in the FIB system and the specimen is thinned for TEM/STEM observation. Since TEM observation and FIB processing can be repeated, the target position is precisely thinned.

Light-emitting diode (LED) milled with a Cross Section Polisher for cross-section preparation

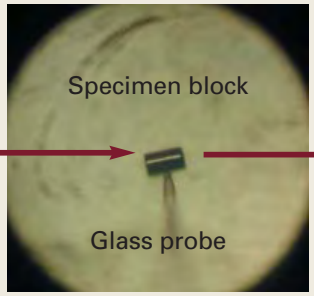
A LED was subject to cross-section preparation with a Cross Section Polisher for SEM observation. After this, the LED was cut into a block by FIB, fixed on a specimen mount, and thinned by FIB for high-resolution STEM observation.



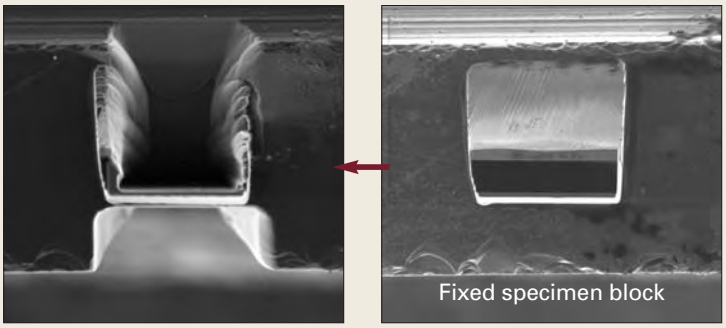
Composition image formed by backscattered electrons taken with an FE-SEM



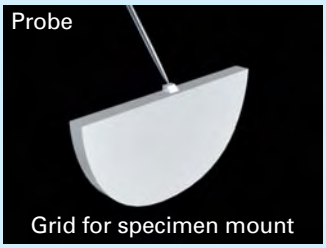
Specimen block cut by an ion beam (interface of gold bonding and LED shown in SIM image)

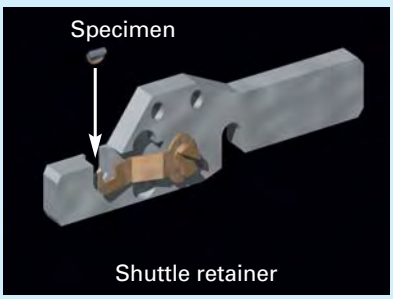


STEM image of a picked-up thin film

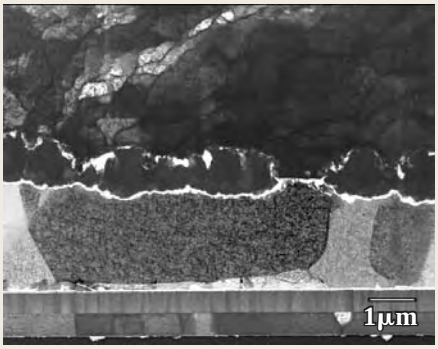


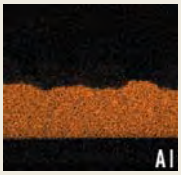
Thinning by FIB (SIM image)

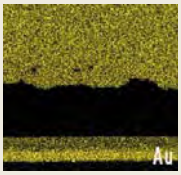




It is easy to repeat thinning until an optimum specimen thickness is obtained.







STEM image of an interface and elemental mapping images obtained by EDS

Optional Attachments for Supporting Specimen Preparation

Specimen pickup system

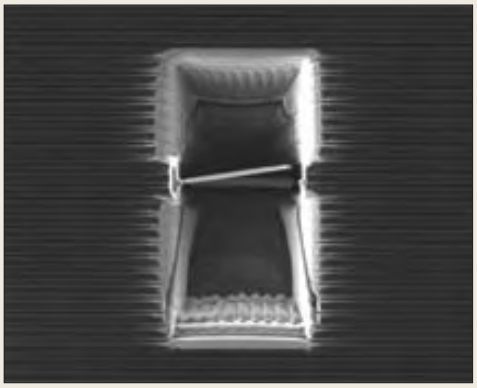
This system picks up a TEM specimen in the air, which is milled by the JEM-9320FIB, and transfers it to a grid for observation. The system is comprised of a micropipette preparation device, a glass probe preparation device and an optical microscope with a manipulator.

Micropipette preparation device

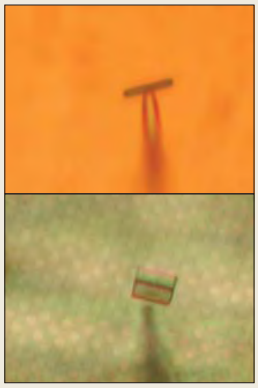
Glass probe preparation device

Optical microscope with manipulator (CCD camera is separately provided)

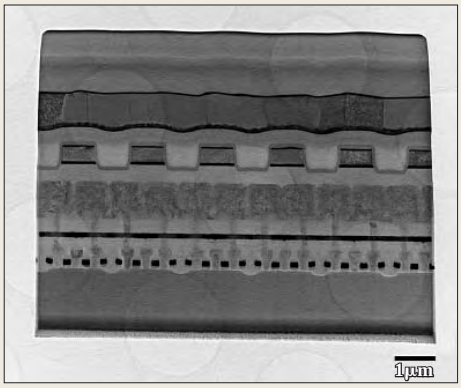
Examples of applications (thin-film pickup)



Thin film cut and separated



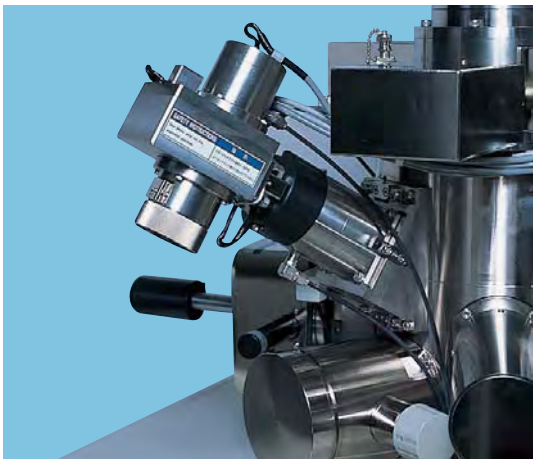
Thin film picked up by a glass probe



STEM image of a picked-up thin film

Metal deposition unit

By installing the metal deposition unit, it is possible to deposit a carbon film on a desired position for protecting this position. The cartridge for a gas source is replaceable from the outside of a vacuum.



Metal deposition unit

Specifications and Optional Attachments

Principal specifications

Ion source	Ga liquid metal ion source
Accelerating voltage	5 to 30 kV (in 5 kV steps)
Magnification	×50 (for searching field) ×150 to ×300,000
Image resolution	6 nm (at 30 kV)
Maximum beam current	30 nA (at 30 kV)
Ion beam shapes during milling	Rectangle, line and spot
Specimen stage	Side-entry goniometer stage for TEM specimens
Vacuum pumps	SIP/TMP/RP

Optional attachments

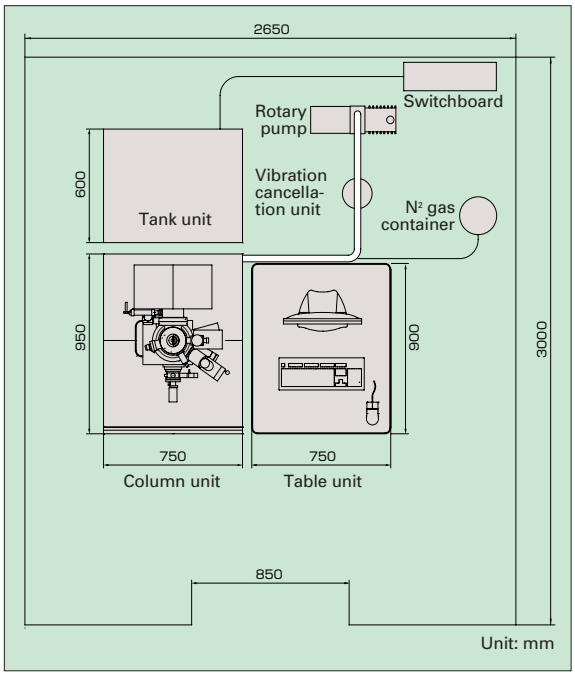
● Side Entry Goniometer Stage for TEM Specimens	EM-0261FSEG
● FIB Tip-on Holder	EM-02210
● FIB Bulk-Specimen Holder	EM-02220
● Bulk-Specimen Motor Stage	EM-02550FBSS
● FIB Bulk-Specimen Holder 1	EM-02560FBSH1
● FIB Bulk-Specimen Holder 2	EM-02570FBSH2
● FE-SEM Specimen Holder Adapter	EM-02580FSHA
● Airlock System	EM-02590FALS
● Probe Current Detector	EM-02620FPCD
● Metal Deposition Unit	EM-02630FMDU
● Automatic Processing Software	EM-02520APS
● Specimen Pickup System	EM-02230
● Shuttle Retainer	EM-02280
● Lamp Holder	EM-02990
● Operation Keyboard	EM-02640FOKB

Installation Requirements

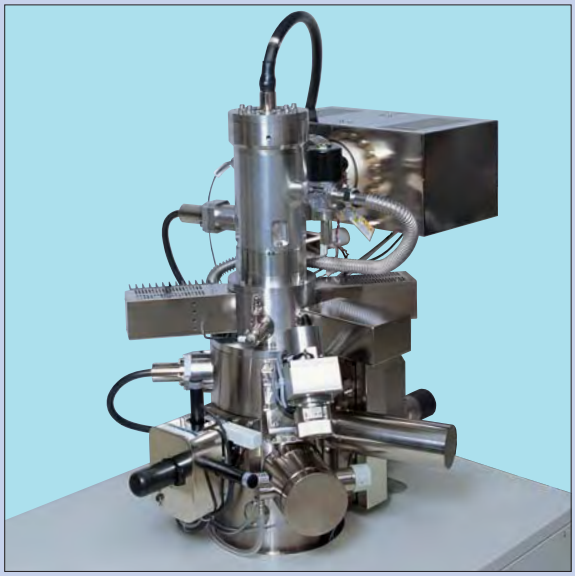
Power	Single phase 100 V ±10%, 50/60 Hz, 3 kVA
Grounding terminal	One, 100 Ω or less
Dry nitrogen gas	0.4 to 0.7 MPa
Exhaust duct	Exhaust pipe of 25 mm I. D.
Room temperature	18 to 25°C
Humidity	60% or less
Stray magnetic field	5 µT or less
Floor vibration	0.5 µm (p-p) or less
Noise	65 dB or less in the range up to 300 Hz

*Dry nitrogen gas and a connecting tube should be provided by customer.

Installation Room Example



*Specifications subject to change without notice.



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