JEOL

Scientific / Metrology Instruments
CROSS SECTION POLISHER™

Solutions for Innovation

IB-19530CP

CROSS SECTION POLISHER™

Multipurpose stage

JEOL Ltd.

CROSS SECTION POLISHER™ (CP)

IB-19530CP

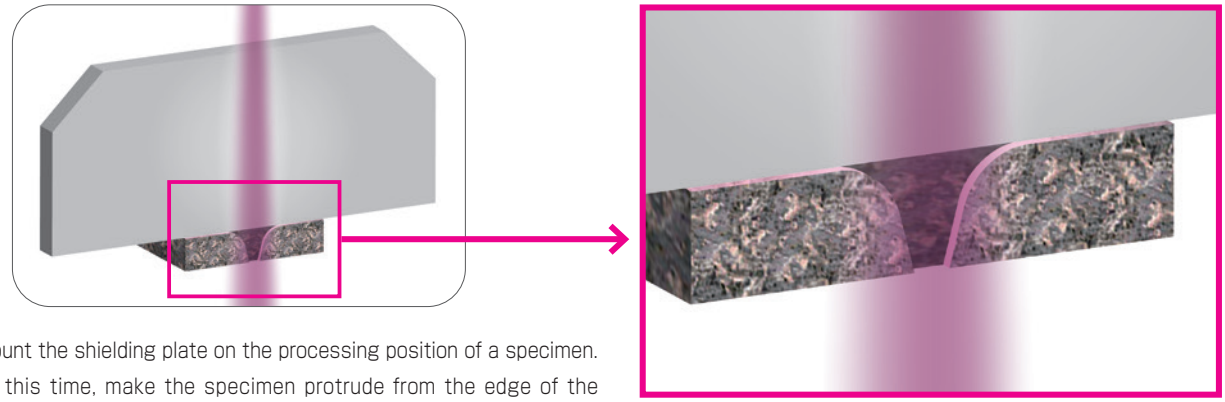
Multipurpose stage

Auto milling program

Precise positioning adjustment system

Principle of cross-section preparation by CP

In the CP, a shielding plate is mounted on the upper portion of the specimen, and then the portion protruding from the shielding plate is irradiated with a Broad argon (Ar) Ion Beam (BIB). This procedure enables a cross section to be prepared along the edge of the shielding plate. Compared with general mechanical polishing, the CP easily creates a highly uniform cross section with no strain caused by milling. Thus, cross-section preparation can be made for various specimens, such as composite materials and laminated materials. Patent: No. EP 1517355 B1, US 7722818 B2, JP 4557130 Patent related to rocking function



Mount the shielding plate on the processing position of a specimen. At this time, make the specimen protrude from the edge of the plate so that the protrusion is confined within 100 μm.
When this protruded specimen is irradiated by BIB, the protruded portion is etched and a cross section is created.

1 Multi-purpose stage

Cross-section milling

*Long life shielding plate achieves 3 times higher durability (approx. 8 h)**

**In the case of 8 kV accelerating voltage and ion source with 500 µm/h milling speed*

Planar surface milling Option

A larger specimen (40 mm diameter) can be milled. The specimen tilt angle is adjustable from 0° to 90°.

Cross-section rotated milling Option

The use of the dedicated shielding material (cylindrical sample stage) allows ion-beam irradiation onto the specimen from any direction (360°). This feature reduces streak-like milling marks during cross-section preparation.

Ion beam sputter coating Option

High-quality carbon coating is enabled by ion beam sputtering.

2 Auto milling program

Auto milling start mode

Immediately after reaching the preset chamber pressure, milling starts automatically.

Intermittent milling mode

Setting the times for repeatedly turning the ion beam ON and OFF suppresses temperature rise of the specimen. Thus, thermal damage to the specimen is reduced.

Fine milling mode

After milling at high accelerating voltage, the milling mode is automatically switched to milling at low accelerating voltage for enabling high-quality cross-section preparation in a short time.
In particular, this mode is effective for specimen preparation to analyze crystal structures.

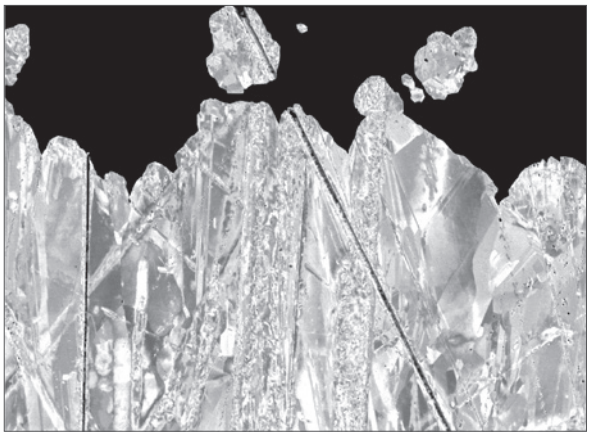
3 Precise positioning adjustment system

(1) The standard cross-section milling holder has the processing position adjustment capability, thus making it possible to adjust the position from the outside of the CP. Combined use with a dedicated precise positioning microscope (option) facilitates adjustment of the processing position at a high magnification.

(2) The use of an optional holder, compatible with a scanning electron microscope (SEM), enables additional processing after the milled specimen is observed with the SEM.

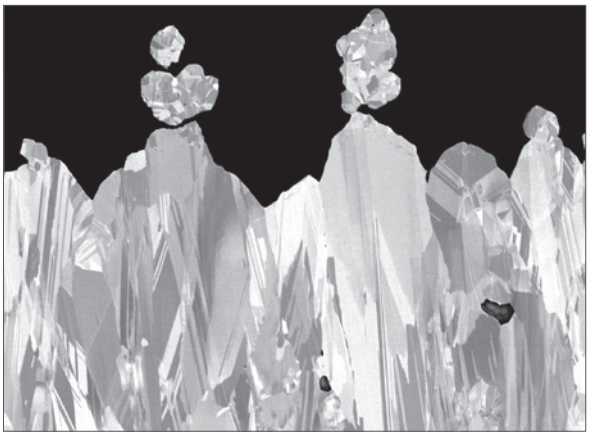
Comparison of mechanical polishing and CP milling

Specimen : Copper



Cross section prepared by mechanical polishing

Skilled techniques are required to prepare a cross section of soft metals (copper, gold, etc.) by mechanical polishing. The above backscattered electron image shows copper plating prepared by mechanical polishing. In this image, many scratches due to mechanical polishing are seen. Also, the channeling contrast is unclear due to strains resulting from polishing.



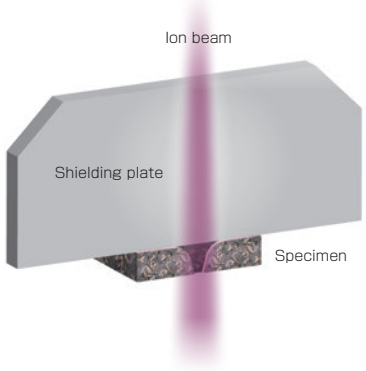
Cross section prepared by CP

Preparing a cross section with an argon ion beam enables creation of a uniform cross section with no crystalline strain. The channeling contrast, which is dependent on the difference of crystal orientation, can clearly be observed.

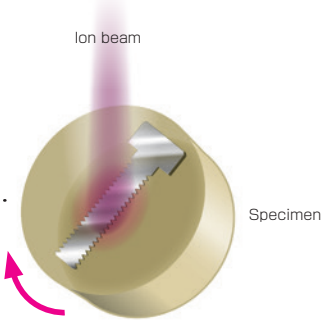
Multi-purpose stage

A new CP, IB-19530CP, adopts a multi-purpose stage, thus expanding its applications to cross-section milling, planar surface milling, cross-section rotated milling, carbon coating, etc.

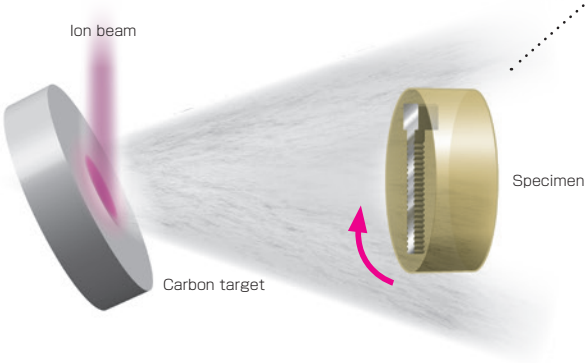
Cross-section milling



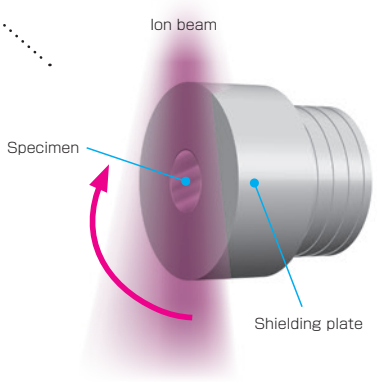
Planar surface milling Option



Carbon coating Option



Cross-section rotated milling Option

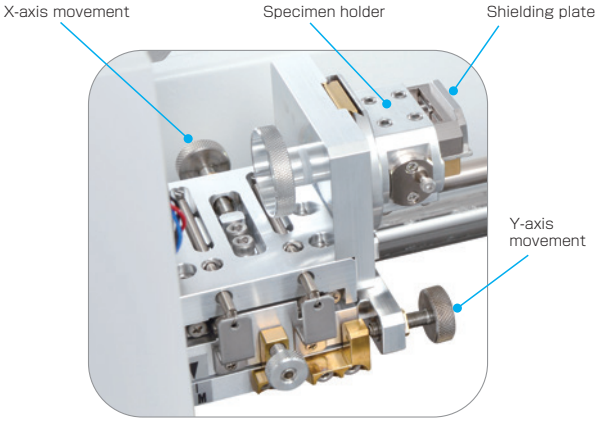


Specimen stage

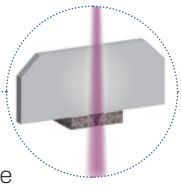
The standard specimen stage allows for the use of a wealth of functions, from cross-section milling to planar surface milling, and carbon coating.

Standard specimen stage

- In addition to cross-section milling, planar surface milling, cross-section rotated milling and carbon coating can be made.
- The cross-section milling holder can be used with the optional precise positioning microscope, thus enabling highly precise adjustment of the processing position at a high magnification.



Cross-section milling

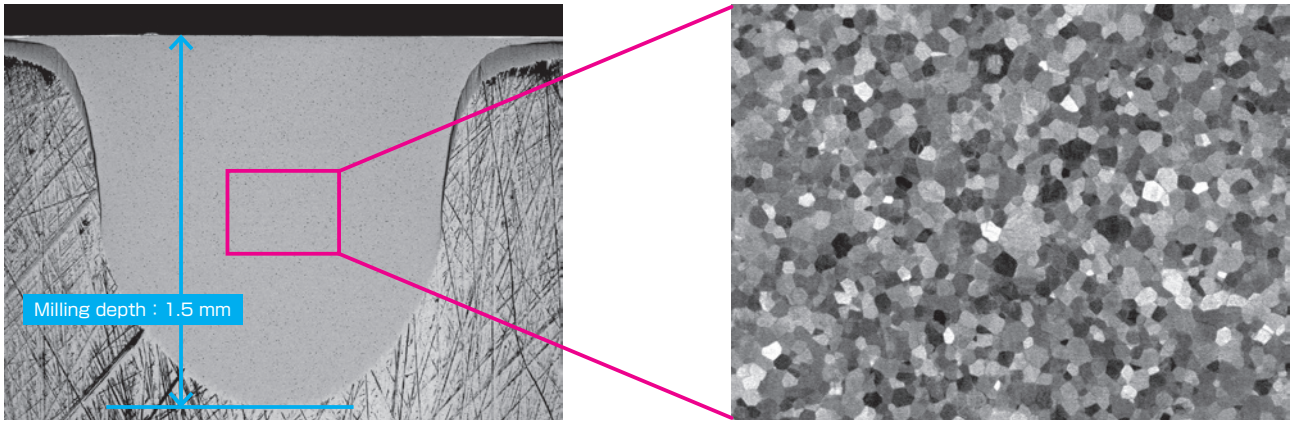


Mount the edge of the shielding plate on the processing position, and then irradiate an Ar ion beam onto the target position. The portion protruding from the specimen is etched by the Ar ion beam for enabling the creation of a uniform cross section along the shielding plate edge. Long life shielding plate achieves 3 times higher durability (approx. 8 h)*. This high-durability shielding plate is effective to process materials with low milling rate.
The use of the optional large area milling holder (IB-11730LMH) also allows for milling a large specimen (maximum size: 25 (W) × 15 (L) × 10 mm (T)) and for milling over a wide area.

*In the case of 8 kV accelerating voltage and ion source with 500 μm/h milling speed

A specimen with low milling rate

Specimen : Zirconia

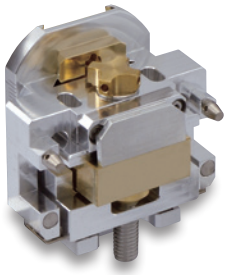


Accelerating voltage : 8 kV, Milling time : 8 h

Large-area milling

Large area milling holder (IB-11730LMH) *Option*

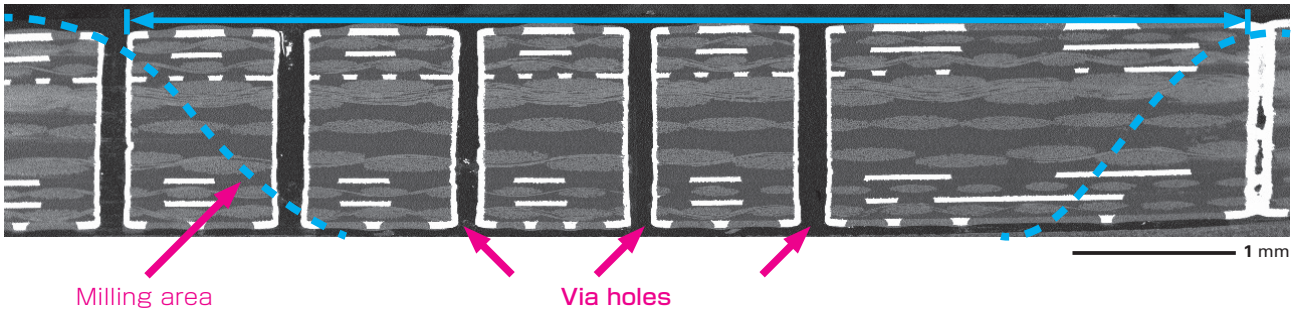
Swing the specimen largely to irradiate an ion beam over a large area, for enabling a large-area cross section preparation. This holder is effective to mill a wide area or to process multiple objects.
In addition, the IB-11730LMH allows for milling a large specimen (maximum size: 25 (W) × 15 (L) × 10 mm (T)). When using this holder with the Cooling CROSS SECTION POLISHER™ (IB-19520CCP), the functions of large-area milling and large-specimen milling can be combined with the cooling function of the IB-19520CCP.



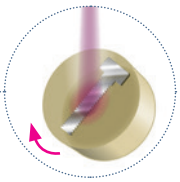
Large area milling holder (IB-11730LMH)
Maximum specimen size: 25 (W) × 15 (L) × 10 mm (T)

Milling width : 8.6 mm

Specimen: Printed board



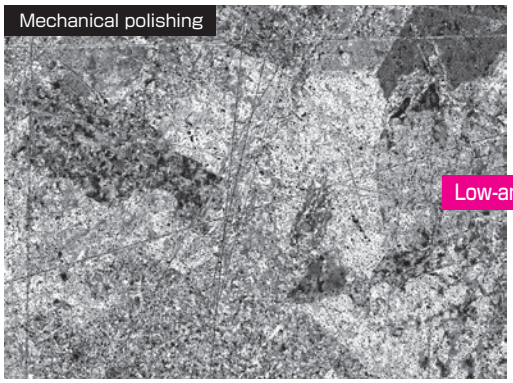
Planar surface milling



Large Specimen Rotation Holder (IB-11550LSRH) *Option*

The use of the optional Large Specimen Rotation Holder (IB-11550LSRH) enables planar surface milling over a large area for specimens subjected to mechanical polishing (beam irradiation angle is 0° to 90°). Beam irradiation at a low angle, with respect to the specimen surface, makes effective removal of scars caused by mechanical polishing, or of crystalline strains on the surface. This leads to enhancement of the channeling contrast. On the other hand, the irradiation at a high angle, with respect to the specimen surface, enables acquisition of the topographic information resulting from the difference of milling rate caused by the existence of crystalline grain boundaries or their internal crystalline structures. The following example shows three backscattered electron images of a mechanically-polished copper plate, which is subsequently subjected to planar surface milling by changing the irradiation angle of the Ar ion beam. The top two images show the result of low-angle milling (specimen tilt: 85°, ion beam irradiation angle: 5°, accelerating voltage: 4 kV, milling time: 10 min). The bottom right image shows the result of high-angle milling (specimen tilt: 60°, ion beam irradiation angle: 30°, accelerating voltage: 4 kV, milling time: 3 min).

Specimen : Copper plate



3 µm

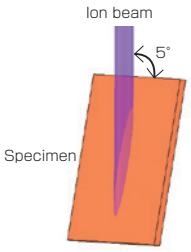
Backscattered electron image of a mechanically-polished copper plate. Many scars due to polishing are seen to make grain boundaries unclear.

SEM image common data
Backscattered electron images, Accelerating voltage : 5 kV

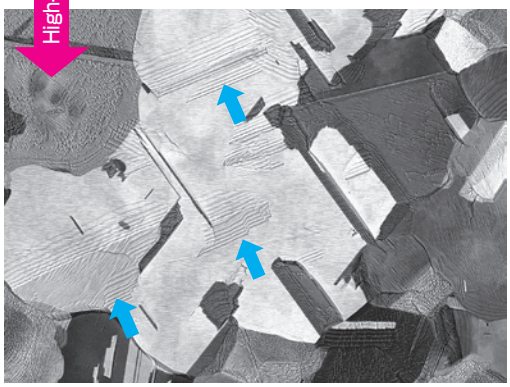
Low-angle milling

3 µm

Backscattered electron image of the copper plate milled at a low angle. Scars due to polishing disappear and the channeling contrast is enhanced.

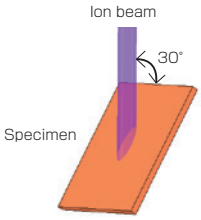


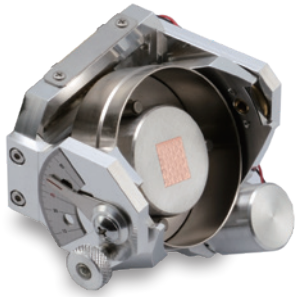
High-angle milling



3 µm

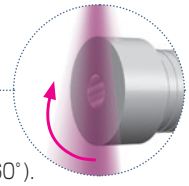
Backscattered electron image of the copper plate milled at a high angle. Applying additional high-angle planar surface milling provides the topographic information dependent on crystal orientation (many surface irregularities) indicated by blue arrows.





Large Specimen Rotation Holder (IB-11550LSRH)
Maximum specimen size : 40 mm dia. × 15 mm thick
Specimen tilt : 0° to 90°

Cross-section rotated milling

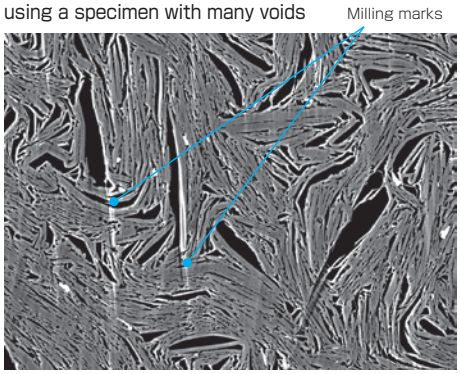


Cross Section Preparation Kit (IB-12540CKIT) *Option*

*This kit is attached to the Large Specimen Rotation Holder (IB-11550LSRH).

The use of a cylindrical shielding material enables cross-section preparation by irradiating the specimen from any direction (360°). Even for a specimen with many voids, this milling technique reduces milling marks for enabling creation of a uniform cross section.

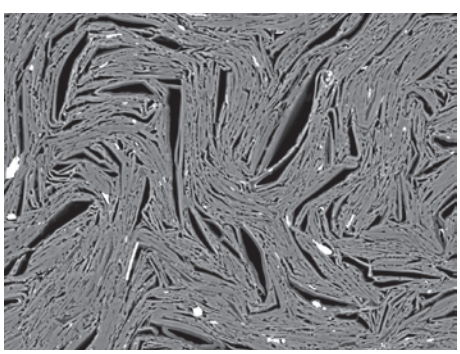
Comparison of milling performance using a specimen with many voids



5 µm

Cross section prepared with the shielding plate

Specimen : Mechanical pencil core



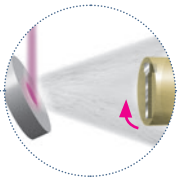
5 µm

Cross section prepared with the kit

Cross Section Preparation Kit (IB-12540CKIT)

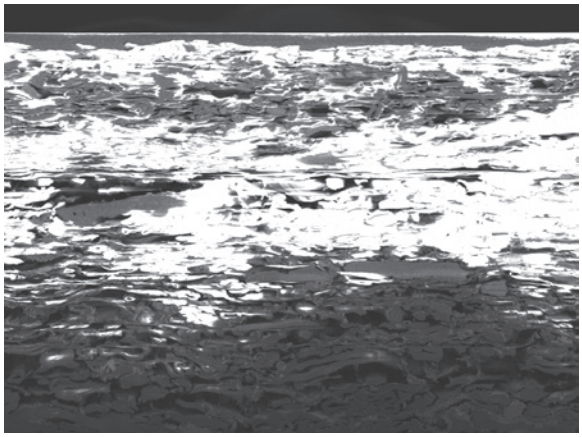
Carbon coating

Option

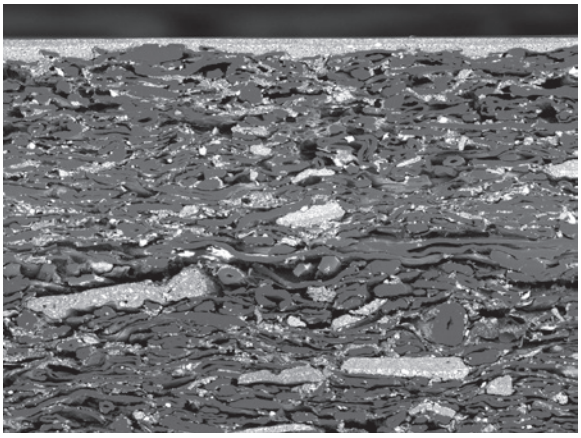


The use of ion beam sputtering enables carbon coating. A carbon-coated film with this capability has high density, granularity and uniformity. Thus, this carbon coating suppresses charging and is effective for elemental analysis and EBSD mapping of insulating materials.
This capability allows the coating of all of the specimens, to which cross-section milling, planar surface milling or cross-section rotated milling, were applied by CP. In addition, specimens prepared by other techniques can be carbon-coated.

Specimen : Cross section of a printed part on a paper

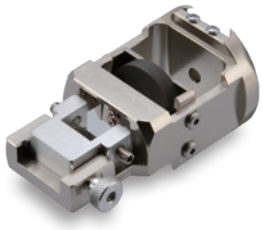


Without coating — 50 µm

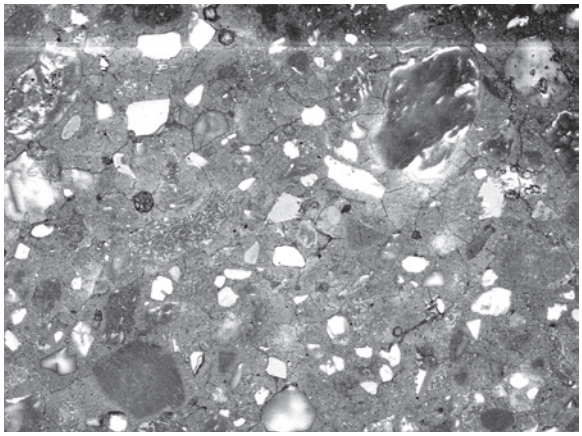


With coating — 50 µm

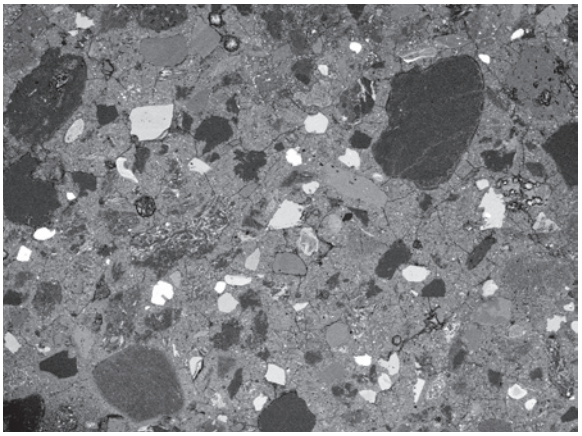
Carbon coating holder (IB-12510CCH)



Specimen : Concrete



Without coating Backscattered electron image — 500 µm



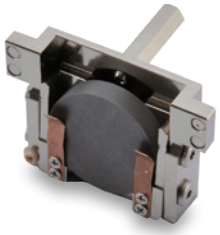
With coating Backscattered electron image — 500 µm

The left SEM image is taken without coating. Abnormal contrast, due to charging, is seen.
The right SEM image is taken with coating. Carbon coating eliminates the influence of charging.

Carbon coating adapter (IB-12530CCA)

※ This adapter is attached to the Large Specimen Rotation Holder (IB-11550LSRH).

Large specimens (max. 40 mm dia. × max. 15 mm thick) can be coated while rotating it.



Auto milling program

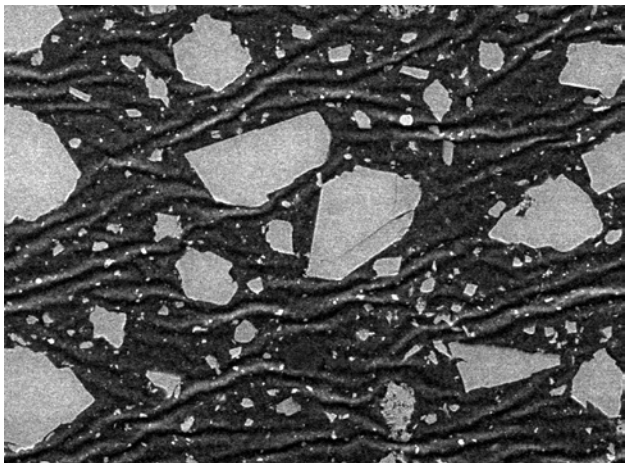
Auto milling start mode

This mode automatically starts milling. Immediately after reaching the preset chamber pressure, milling (ion-beam irradiation) starts automatically.

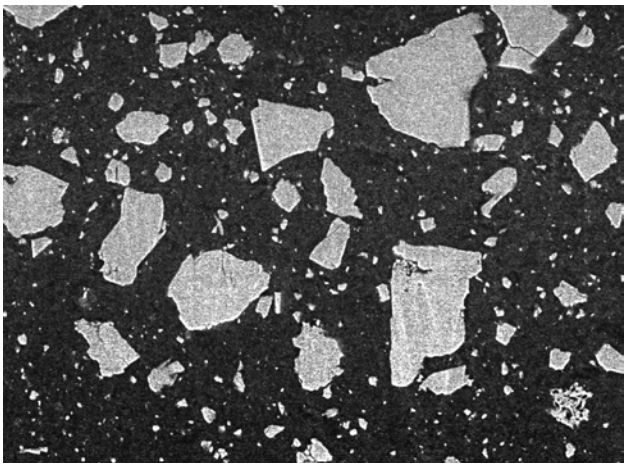
Intermittent milling mode

The intermittent milling mode can set the times for repeatedly turning the ion beam ON & OFF and control the beam dose per unit of time for suppressing temperature rise of the specimen. Thus, this mode is effective for milling low-melting-point metals, rubbers and polymers. In the following two images, a differently-milled rubber specimen is shown. The left image shows a specimen without intermittent milling, exhibiting deformation of the rubber part resulting from heat due to continuous ion-beam irradiation. On the other hand, the right image shows a specimen with intermittent milling, leading to a reduced deformation by thermal damage.

Specimen : Chloroprene rubber



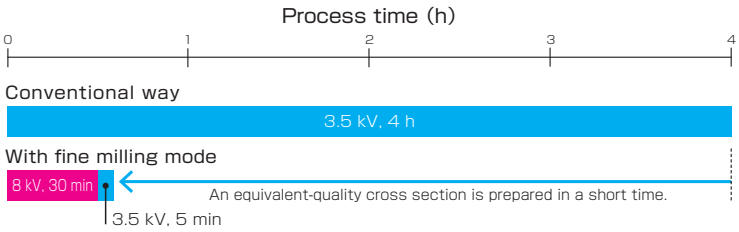
Without intermittent milling — 5 µm



With intermittent milling — 5 µm
(ion-beam irradiation ON : 8 s / OFF : 30 s)

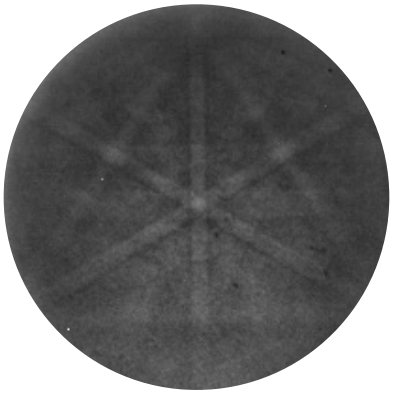
Fine milling mode

This mode automatically switches the accelerating voltage from high to low at the end of high-voltage ion milling so that finishing can be made. Owing to this mode, a high-quality (uniform) cross section is prepared in a short time, which is equivalent to the conventional milling at low accelerating voltage.

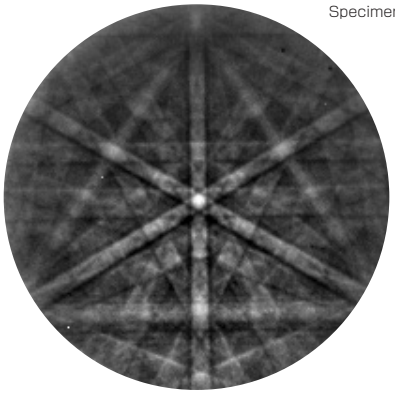


The figures below are EBSD patterns of a cross section of a milled silicon wafer.
In the milling only at high accelerating voltage, non-crystalline layers on the milled cross section become thick, thus making the EBSD pattern unclear. But the use of the finishing mode enables thin non-crystalline layers to be prepared in a short time, thus providing the clear EBSD pattern.

Specimen : Silicon wafer



Without finishing milling voltage : 8 kV

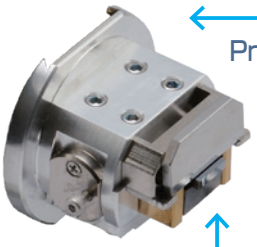


With finishing milling voltage : 8 kV + 3.5 kV

Precise positioning adjustment system

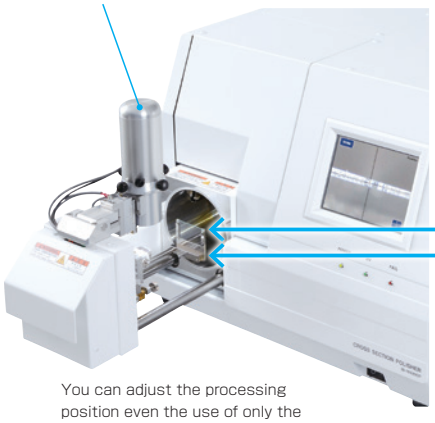
A variety of holders and optional attachments are available for precise adjustment of the processing position.

Standard specimen holder
IB-11560MBSH

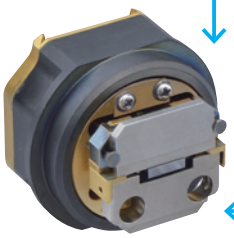


Precise positioning adjustment

Positioning Camera



You can adjust the processing position even the use of only the standard Positioning Camera.



FE-SEM compatible holder Option
IB-11610NMSHA

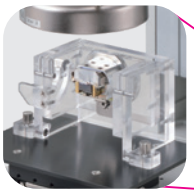
SEM observation

Mount base specimen holder (standard)

A new standard mount base specimen holder can use not only the standard Positioning Camera, but also a dedicated precise positioning microscope (option) by removing the holder from the CP. This capability enables more precise adjustment of the processing position at higher magnification.

Precise positioning microscope

- Cross-section observation
- Processing position adjustment



Precise positioning microscope
(P/N : 783118511)
Max. magnification : × 150,
Positioning accuracy : Approx. 10 µm
Option

Precise positioning microscope TYPE2
(P/N : 783120664)
Max. magnification : × 500,
Positioning accuracy : Approx. 3 µm
Option

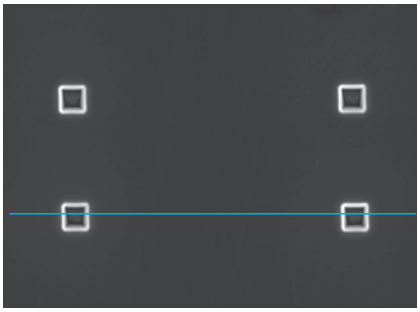
FE-SEM compatible holder Option

By using a holder (option) compatible with a scanning electron microscope (SEM), it is possible to observe an SEM image and mill the specimen alternately.

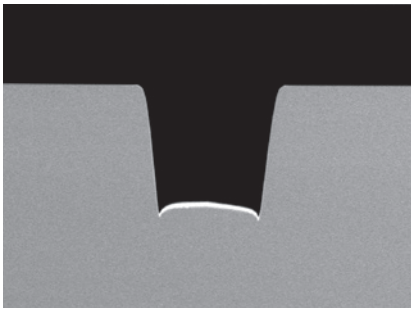
The use of the precise positioning microscope enables more accurate adjustment of the processing position. It is possible to mill a cross section for a very small structure (10 µm or less), including fine foreign materials, pin-holes and via.

Specimen : FIB-milled silicon wafer

Milled face



Surface — 10 µm

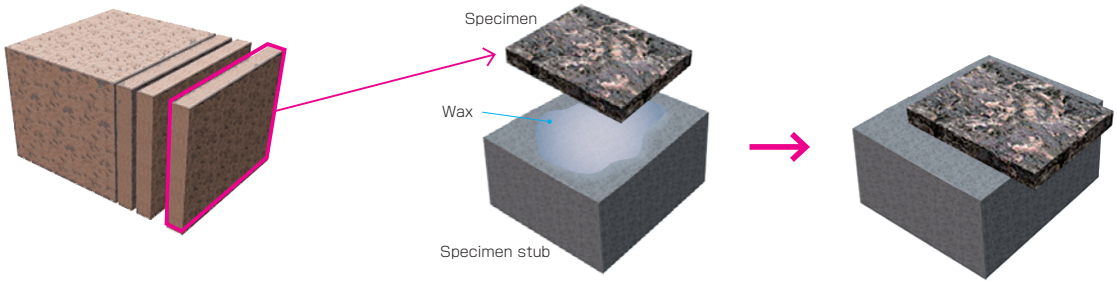


Cross section — 10 µm

Standard work process

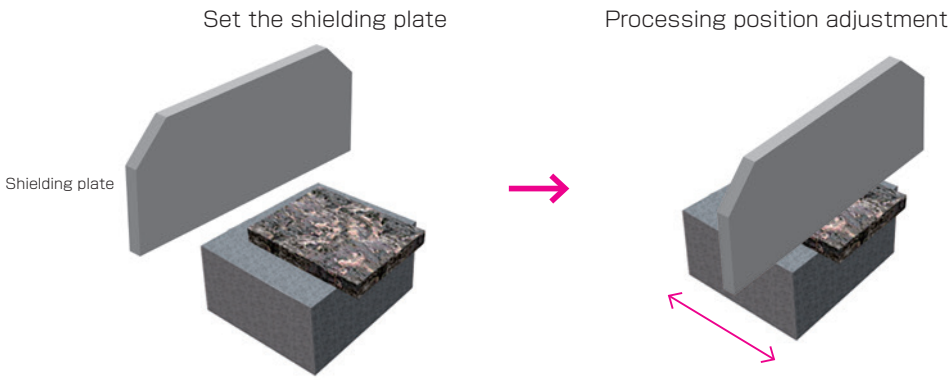
1 Cutting material

Cut a material with a diamond cutter or similar tool to make a piece that can fit onto the specimen stub.



Attach the specimen to the specimen stub using wax.

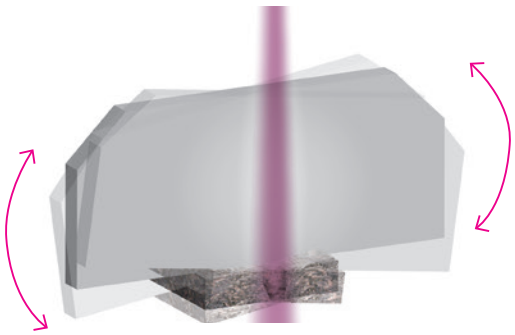
2 Mounting and processing position adjustment of the specimen



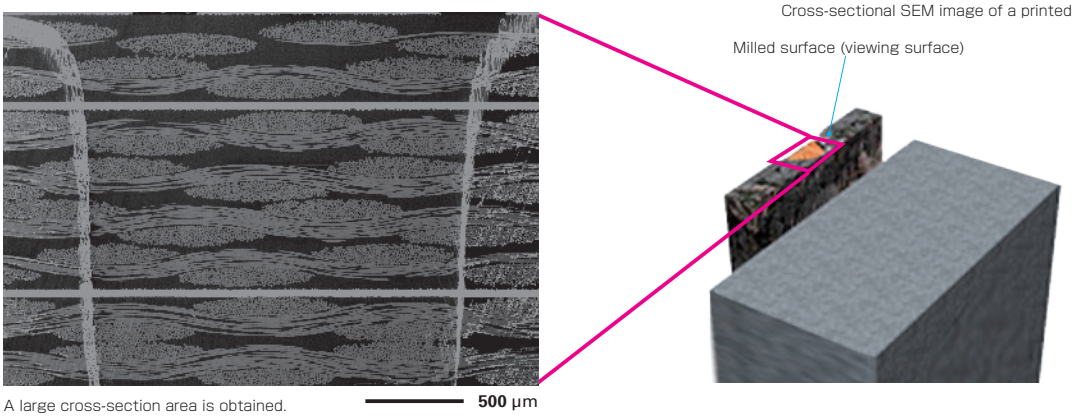
3 Cross-section milling by ion beam irradiation

Ions are irradiated while the specimen is rocked, providing a high-quality (uniform) cross section.

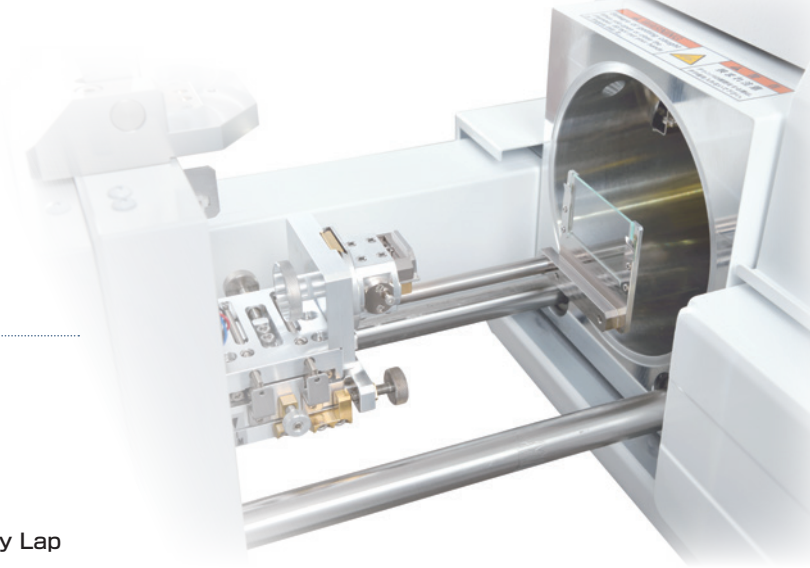
※ Patent: No. EP 1517355 B1, US 7722818 B2, JP 4557130 Patent related to rocking function

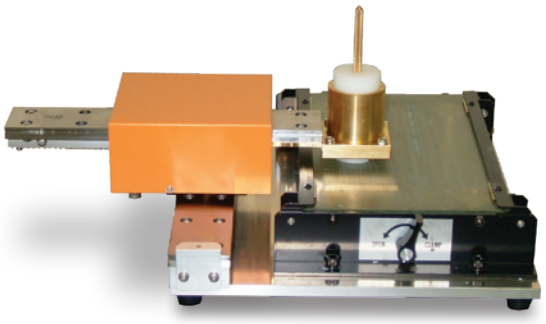


4 SEM observation



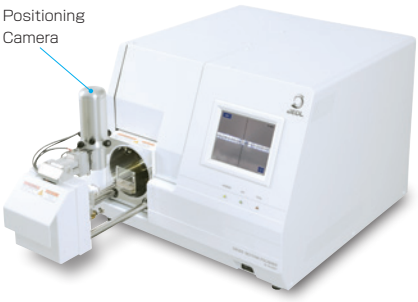
A large cross-section area is obtained.

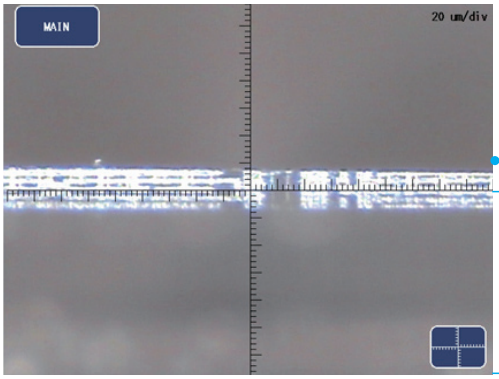




Handy Lap

After cutting the material with a diamond cutter, the use of the handy lap makes it smoothly trim the edge as needed (mechanical polishing) for adjusting the specimen size.



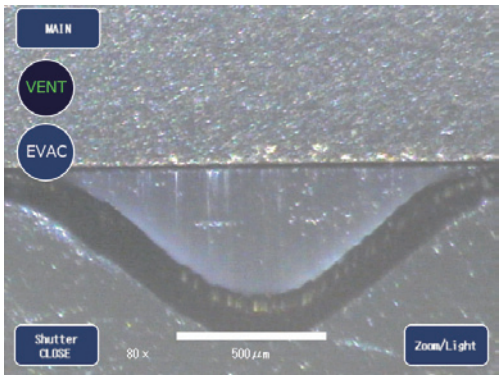


Enlarged image of the specimen edge taken with the camera

The position of the shielding plate can be adjusted from the monitor screen of the camera.

Monitor screen for operation

Set the ion source voltage and etching time from the touch panel screen. Touching the Start icon automatically starts the etching after the completion of vacuum evacuation.



Monitor screen for milling and observation

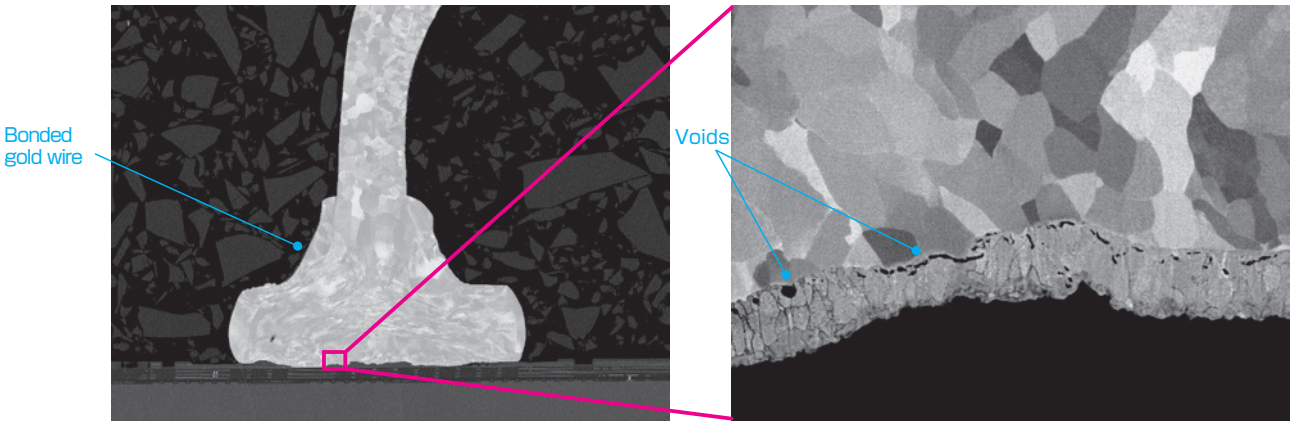
When the optional IB-14510MCAM Milling Monitoring Camera is installed, the milling process can be monitored in real-time.

Applications (soft materials)

Soft materials (copper, aluminum, gold, solder, polymers, etc.) can also be easily processed. In conventional mechanical polishing, it was difficult to prepare those soft materials.

Cross section of bonded gold wire

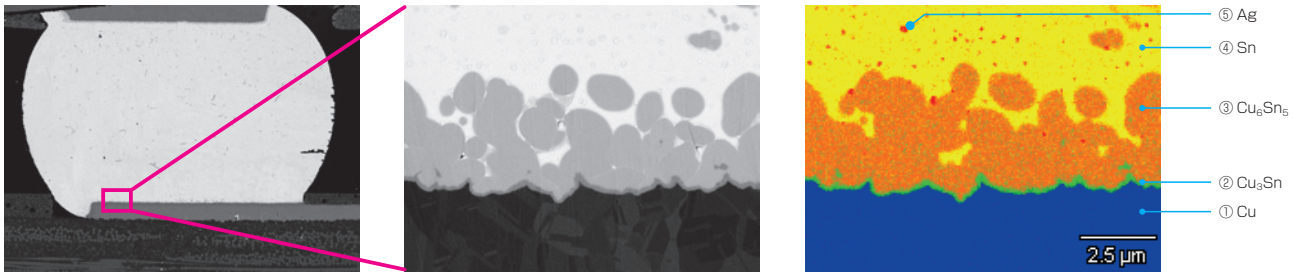
The channeling contrast, dependent on the difference in crystalline orientation of gold (Au), can clearly be observed in the images below. The images thus demonstrate ideal milling with no strains. In addition, physical stress is not applied during milling, thus visualizing the specimen-originated defects (voids) generated on the bonded interface.



Backscattered electron images

Lead-free solder

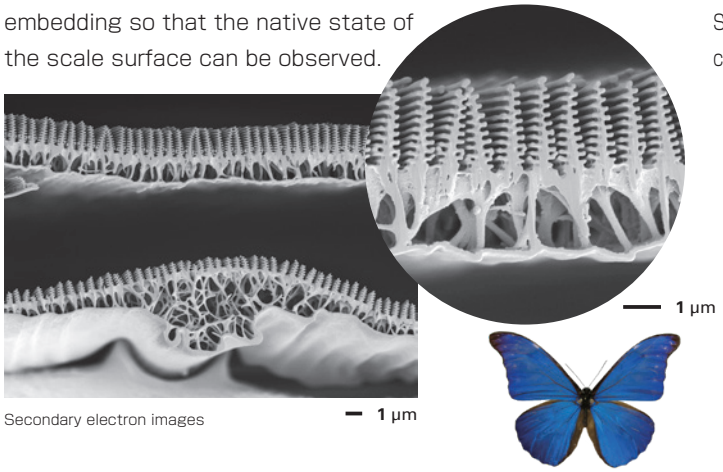
The lower left figure is a cross-sectional SEM (backscattered electron) image of a bump (lead-free solder) prepared by CP. The lower middle figure and lower right figure respectively show the backscattered electron image of the bonded interface and the EDS phase analysis result (map) of the same area. These results demonstrate that alloy layers of copper and tin can clearly be observed and analyzed.



Backscattered electron images

Scales of butterfly

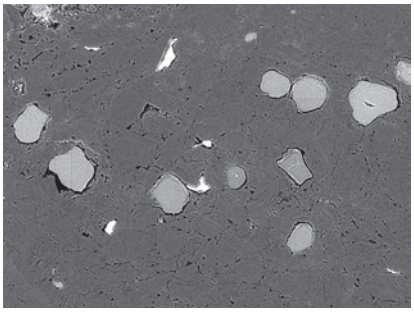
Cross section of scales from the wing of a Morpho butterfly. Milling was performed without resin embedding so that the native state of the scale surface can be observed.



Secondary electron images

Tablet (medicine)

The following SEM image is a backscattered electron image of a tablet subjected to planar surface milling using the optional Large Specimen Rotation Holder. Since milling can be made in a dry condition, a water-soluble specimen like tablet can easily be milled.



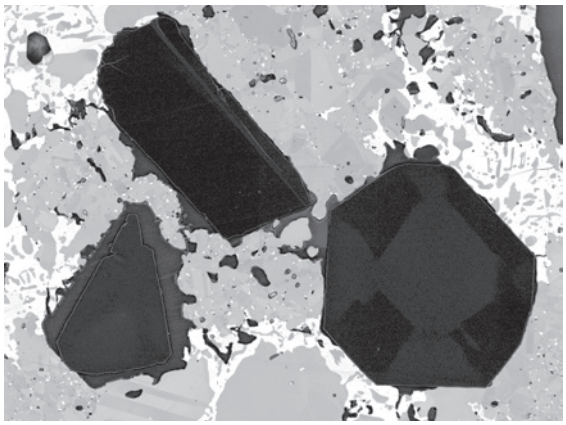
Backscattered electron image

Applications (hard materials, composite materials, powders)

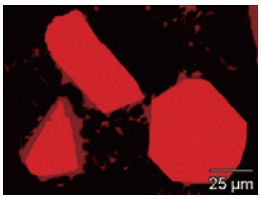
Hard materials (ceramics, glass, etc.), or composite materials containing the hard and soft materials, can be processed.

Diamond blade

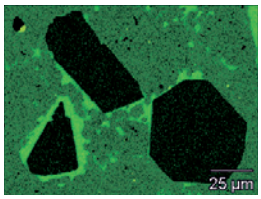
The following figures are a backscattered electron image of a diamond plate and the corresponding EDS maps of the imaged area. A uniform cross section can be created for the diamond abrasive grains that are embedded in soft metal.



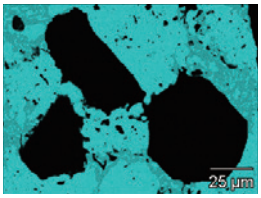
Backscattered electron image
(contrast adjusted by image processing software)
25 µm



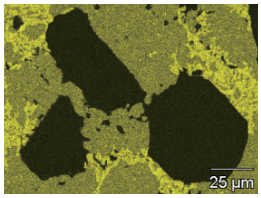
Elemental map : C



Elemental map : O



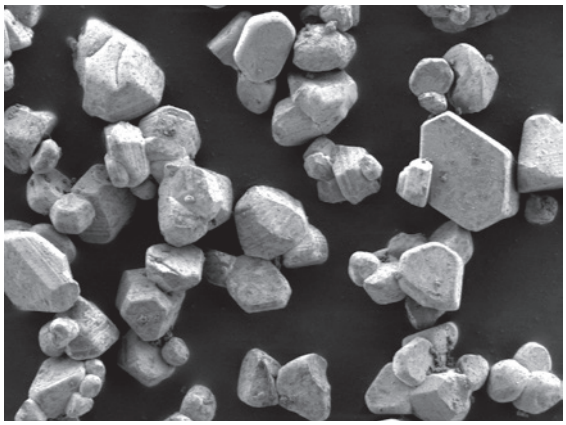
Elemental map : Cu



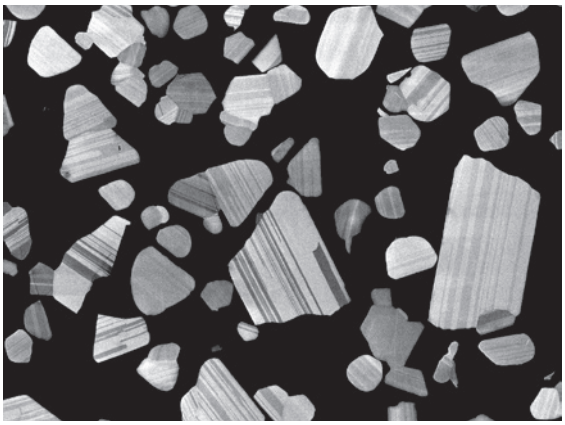
Elemental map : Sn

Fluorescent material

The following two images are an SEM (secondary electron) image of the surface of a powder-like fluorescent material and an SEM (backscattered electron) image of the cross section of the same specimen milled by CP. The use of CP allows preparation of a cross section from the powder specimen.



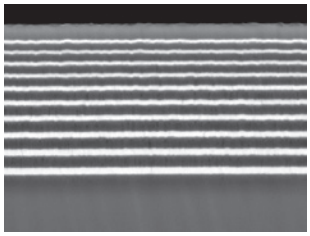
Surface morphology (secondary electron image)
10 µm



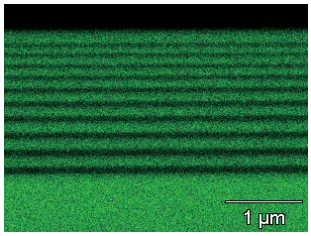
Cross section (backscattered electron image) :
Resin-embedded specimen
10 µm

Dichroic mirror

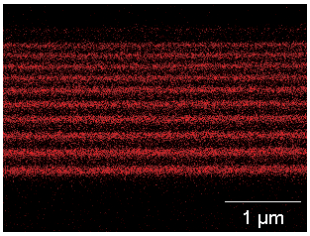
The following figures are a cross-sectional SEM (backscattered electron) image of a dichroic mirror and the corresponding EDS maps of the imaged area. Fine structures (multi layers), which selectively reflect the light with specific wavelength, can be observed and analyzed.



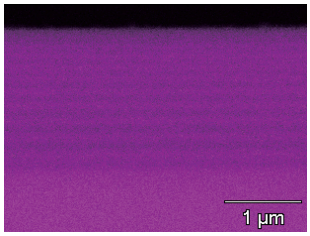
Backscattered electron image
1 µm



Elemental map : Si



Elemental map : Ti

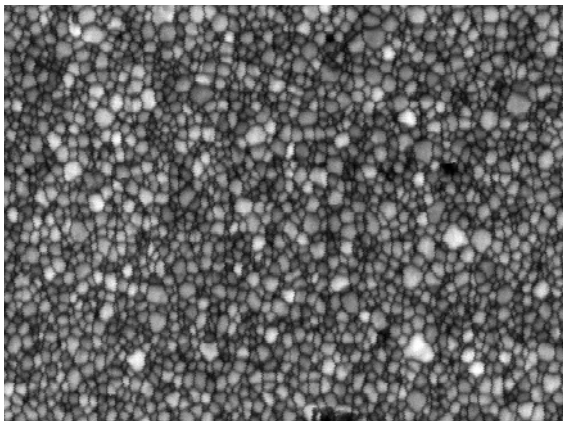


Elemental map : O

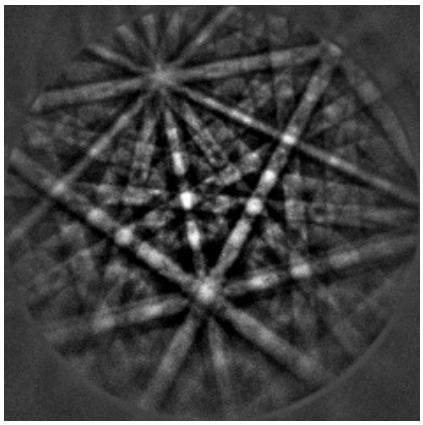
Applications (hard materials, composite materials, powders)

Crystal orientation analysis of a ceramic knife made of zirconia

CP easily allows cross-section preparation for a hard material like this knife.
The following figures show EBSD analysis results of the ceramic knife subjected to cross-sectional milling. A sharp EBSD pattern (upper right figure) and a crystal orientation map (lower left figure) are acquired. An IQ map (upper left figure) also provides high-quality crystalline information.

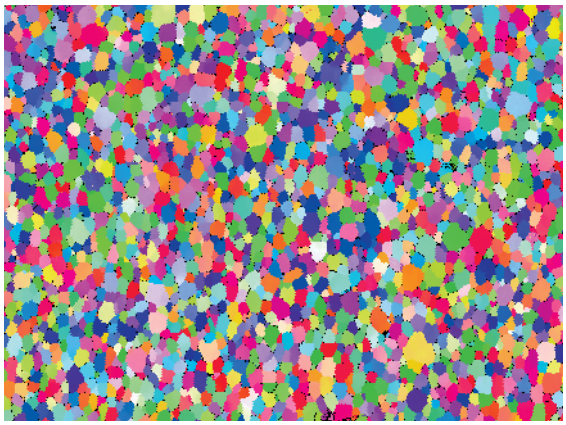


IQ map



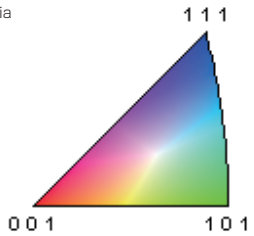
An EBSD pattern acquired from zirconia

Phase : Zirconia
Size : X 18.4 µm, Y 12.2 µm
Step : 0.04 µm



IPF map surface orientation

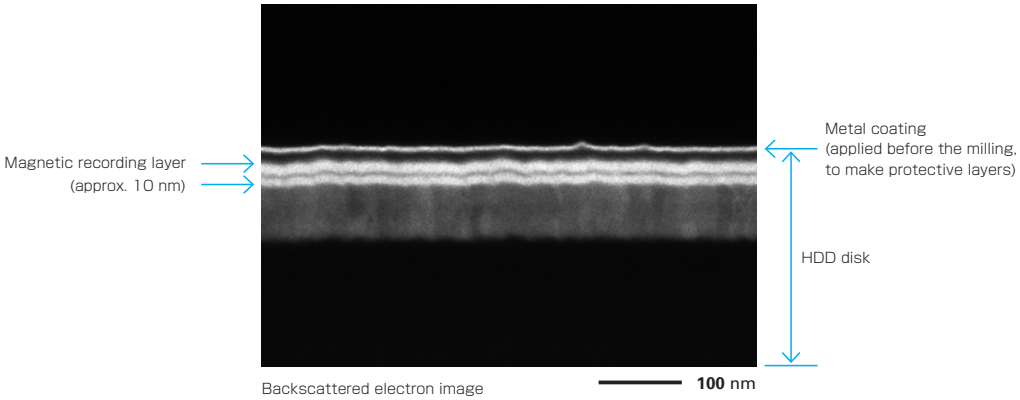
Zirconia



FE-SEM : JSM-7200F, EBSD : EDAX/TSL,
CCD camera : DVC5, Software : OIM 7.2

Hard disk

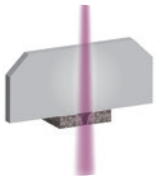
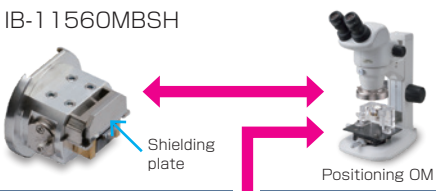
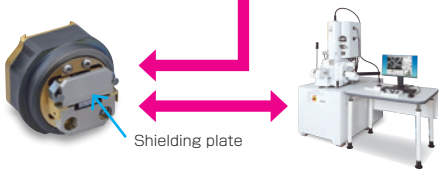
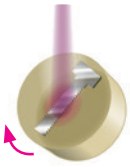
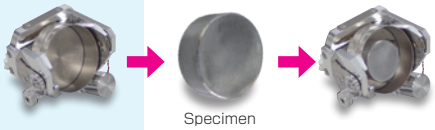
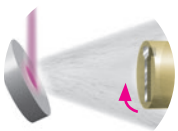
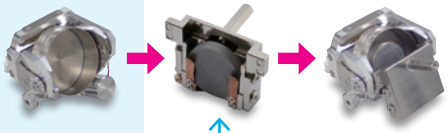
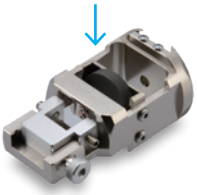
The following image shows a cross section prepared from magnetic recording layers on the top surface of a hard disk. To protect the surface of this magnetic disk, metal coating is applied before the milling. Two magnetic recording layers, with a very small thickness of approximately 10 nm, can be clearly observed.



Backscattered electron image

Specimen holders

The following table shows functions and features of the main specimen holders. A variety of optional holders, are available for different purposes.

Function	Model and Feature		Max. specimen size
Cross-section milling 	Model : IB-11560MBSH (Standard holder) Name : Mount base specimen holder · Precise adjustment of the processing position is enabled using a precise positioning microscope.	IB-11560MBSH 	W : 11 mm L : 10 mm T : 2 mm
	Model : IB-11610NMSHA (FE-SEM compatible holder) Name : Specimen holder · The specimen can be observed without changing the holder. A nonmagnetic shielding plate is used. · Precise adjustment of the processing position is enabled using a precise positioning microscope.	 IB-11610NMSHA	W : 11 mm L : 8 mm T : 3 mm
	Model : IB-11730LMH Name : Large area milling holder · Large-area cross section preparation is enabled. (large-area milling) · Large-specimen milling is possible. · The use with the Cooling CROSS SECTION POLISHER™ (IB-19520CCP) allows for large-specimen milling and large-area milling while cooling the specimen.	 IB-11730LMH	W : 25 mm L : 15 mm T : 10 mm
Planar surface milling Option 	Model : IB-11550LSRH Name : Large specimen rotation holder · Planar surface milling can be made while rotating the specimen. Changing the tilt angle provides surface irregularities due to removal of polish scars or preferential etching effects. Irradiation angle : 0 to 90°	IB-11550LSRH (Common) 	Dia. : 40 mm T : 15 mm
Cross-section rotated milling Option 	Model : IB-12540CKIT Name : Cross section preparation kit · This kit is attached to IB-11550LSRH. The use of a cylindrical shielding material enables cross-section preparation by irradiating the specimen from any direction (360°). · Milling marks, generated in a specimen with many voids or a composite material, can be reduced.	IB-12540CKIT 	① Dia. : 1 mm L : 1 mm ② Dia. : 0.5 mm L : 1 mm
Carbon coating Option 	Model : IB-12530CCA (for planar surface- or cross-section rotated milling) Name : Carbon coating adapter · This adapter is attached to IB-11550LSRH. A specimen, subjected to planar surface milling or cross-section rotated milling, can be coated while rotating it. (Specimens for planar surface milling or cross-section rotated milling are coated)	IB-12530CCA 	Dia. : 40 mm T : 15 mm
	Model : IB-12510CCH (for cross-section milling) Name : Carbon coating holder · This holder accommodates a CP specimen stub or IB-11610NMSHA for coating a specimen. · The holder also accommodates an SEM specimen holder for coating the SEM specimen. (Specimens for cross-section milling are coated)	Carbon target  IB-12510CCH	

Specifications

Ion accelerating voltage	2 to 8 keV
Ion beam diameter	500 µm or more (full width at half maximum)
Milling speed	500 µm/h or more (Average over 2 h, Accelerating voltage 8 keV, Si equivalent, Edge distance 100 µm)
Specimen swing function	Automatic swing of specimen during milling by ± 30° (patent No. 4557130)
Auto milling start mode	When reaching the preset pressure, milling starts automatically.
Intermittent milling mode	Ion beam irradiation time and stop time are settable (ON : 1 to 999 s, OFF : 1 to 999 s)
Fine milling mode	Milling conditions automatically switched
Maximum specimen size (Cross-section milling)	11 mm (W) × 10 mm (L) × 2 mm (T) (with standard holder) 25 mm (W) × 15 mm (L) × 10 mm (T) (Option: Large area milling holder IB-11730LMH)
Maximum specimen size (Planar surface milling)	40 mm (diameter) × 15 mm (T) (Option: Large specimen rotation holder IB-11550LSRH)
Specimen movements	X-axis : ± 6 mm, Y-axis : ± 2.5 mm
Operation	Touch panel, 6.5-inch display
Positioning for milling	Monitor from above the specimen stage with a camera. Milling position is also adjustable with OM.
Positioning camera	Magnification : approx. × 70 (on 6.5-inch display)
Monitoring camera*1	Magnification : approx. × 20 to 100 (on 6.5-inch display) (with IB-14510MCAM attached)
External monitor output*1	Positioning camera and Monitoring camera can be switched for displaying one on the external monitor (with IB-14510MCAM attached)
Preset function	4 sets of milling conditions (accelerating voltage, Ar gas flow, milling time, intermittent milling)
Gas for ion	Argon gas
Gas flow control	Mass flow controller
Pressure measurement	Penning gauge
Evacuation equipment	Turbo molecular pump, Rotary pump
Dimensions and weights Basic unit Rotary pump	 545 mm (W) × 550 mm (D) × 420 mm (H), Approx. 66 kg (with IB-14510MCAM attached) 150 mm (W) × 427 mm (D) × 230 mm (H), Approx. 16 kg

Installation Requirements

Power supply	Single phase 100 to 120 V AC, 50/60 Hz, Allowable input voltage fluctuation : less than 10%, Rating : 15 A or more
Maximum power consumption	650 VA
Grounding	100 Ω or less
Argon gas*2	Dry argon, Purity : 99.9999% or more Pressure : 0.1 to 0.2 MPa (1.0 to 2.0 kgf/cm^2), Hose joint : ISO 7/1 Rc 1/4
Room temperature	15 to 25 ℃
Room humidity	60% or less (no condensation)

*1 With IB-14510MCAM attached, the specimen can be monitored in real time. The status of the specimen can be observed while milling is in progress. The external monitor must be prepared by the customer.

*2 The argon gas, gas cylinders and regulator must be prepared by the customer.

To handle heat sensitive materials and materials that react to air

Cooling CROSS SECTION POLISHER™ IB-19520CCP

【With adjustment of cooling temperature and air-isolated system】

The IB-19520CCP is a CROSS SECTION POLISHER™ with the added functions of specimen cooling (with adjustment of cooling temperature) and isolation from the atmosphere. This is an ideal tool for preparing cross sections for SEM or low melting point materials, like solder, which is susceptible to thermal deformation during milling; low glass transition point materials like resins; and the materials that react to air, like battery materials.

IB-19520CCP

※ The screen images in the catalog include items that are still under development, and are subject to change without notice.

※ The specifications and appearance of the instrument are subject to change without notice.

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No. 1033G458E Printed in Japan, Kp