Living up to Life

Leica MICROSYSTEMS

Leica EM RES102

Ion Beam Milling System

for TEM, SEM and LM preparation

ION BEAM MILLING

In recent years, ion milling has been developed into the most applicable method of sample preparation for the analysis of inorganic material. The ion beam milling method uses high energy ion bombardment to remove material or modify the surface of a sample. The ions are generated by an ion gun (in a high vacuum) toward the sample, which is orientated so the surface is bombarded at an angle.

For TEM sample preparation a low ion incidence with respect to the sample surface polishes the sample until it is electron transparent.

Surface modification for SEM samples, for example, can be realized with higher milling angles up to 90°. This includes surface cleaning, polishing and contrast enhancement.

Unique Solution

The Leica EM RES102 is a unique ion beam milling device that has two saddlefield ion sources with variable ion energy for optimum milling results. Like no other instrument on the market, it accommodates the preparation of TEM, SEM and LM samples in one single benchtop unit. In addition to high-energy milling, the Leica EM RES102 can be used for very gentle sample processing using low ion energy.

TEM SAMPLES

- Single-sided or double-sided low angle milling for uniform ion milling of materials. The saddle-field ion sources can prepare a large electron-transparent area of the sample.
- Program-controlled alternating milling angles of the ion sources are used to fulfill special sample preparation tasks, e.g. FIB cleaning, to reduce amorphizised layers.

SEM or LM SAMPLES

- Ion beam polishing of surfaces up to 25 mm in diameter with the highest possible surface finish
- Surface cleaning of contaminated samples or the removal of smearing effects after mechanical polishing
- Contrast enhancement of sample surfaces instead of chemical etching
- 35° slope cutting for cross-sectioning of layered materials
- 90° slope cutting for cross-sectioning of structured semiconductor material and packaging with minimal mechanical pre-preparation work load

KEY FEATURES

- One single benchtop unit for TEM, SEM and LM sample preparationn
- External control of the milling process via LAN
- Preparation of samples up to 25 mm diameter
- Fully computer-controlled milling parameters

TEM, SEM or LM preparation – a matter of choice

To support the diverse range of application possibilities, the Leica EM RES102 can be equipped with a variety of sample holders for the preparation of TEM, SEM and LM samples. The load-lock system provides high sample throughput with fast sample exchange.

SEM

Sample holder for the cleaning, polishing and contrast enhancement of SEM and LM samples at environment temperature or with LN_2 cooling. The SEM holder allows you to prepare a sample size up to 25 mm diameter. An adapter is available to clamp commercially available SEM stubs with a 3.1 mm diameter pin.

SEM

Slope cutter holder for the production of cross-sectioned (90°) and angled sections (35°) for SEM investigation of vertical structured samples. Specimens can be prepared at environment temperature or with LN_2 cooling.

SEM

Clamp holder to hold small samples with maximum dimensions of 5 (H) × 7 (W) × 2 (D) mm. This holder is easily transferred directly to the SEM without removing the sample.

TEM

Sample holder (Quick clamp holder) for single and double-sided low angle milling down to 4°.

TEM

Cooling holder for the preparation of temperature-sensitive samples in combination with the LN_2 cooling device.

FIB

Cleaning holder used to reduce the amorphisized layer of a FIB sample.

Your Benefits

Leica EM RES102 can thin, clean, cross section, polish and provides contrast enhancement with the highest level of flexibility for the user.

EASY OPERATION

› PC control unit with 19" touch screen for process monitoring and controlling

› Integrated applications library

› Programmable process parameters accelerate the learning curve of beginners

› Help files for beginners and maintenance

EFFECTIVE AND COST EFFICIENT

› One system for TEM, SEM and LM applications

› Improved effectiveness in TEM sample preparation by large electron transparent area of TEM samples

› SEM preparation of samples up to 25 mm diameter

› Reduced holding time due to Load-lock system for rapid sample transfer and permanent high vacuum

› LAN capability for external operation and monitoring

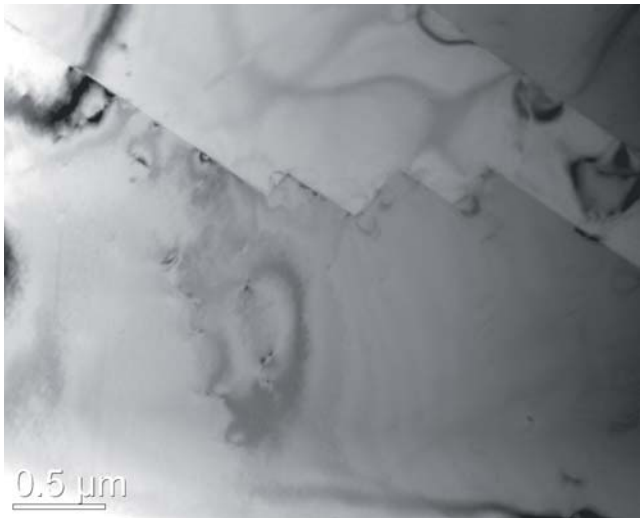
› LN_2 sample stage cooling to keep temperature sensitive specimens under the optimum conditions for milling

SAVE

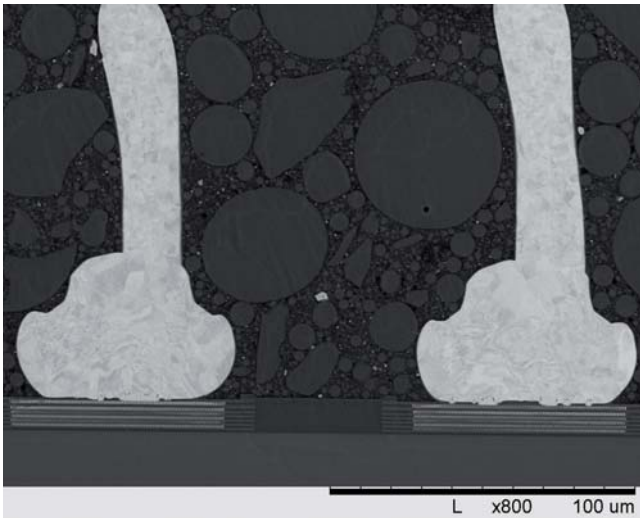
› Precise automatic termination feature with optical image processing or Faraday cup for light transparent samples

› Storage of live images and videos for documentation of the milling process – to provide the maximum documentation material

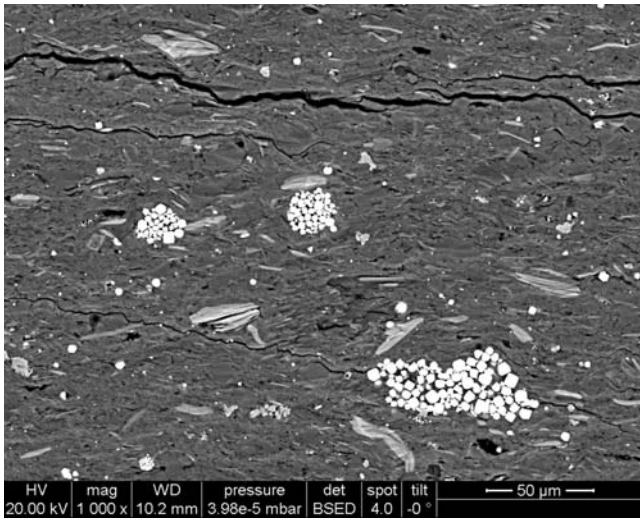
› Fully program controlled motorized ion source and sample movements for reproducible results



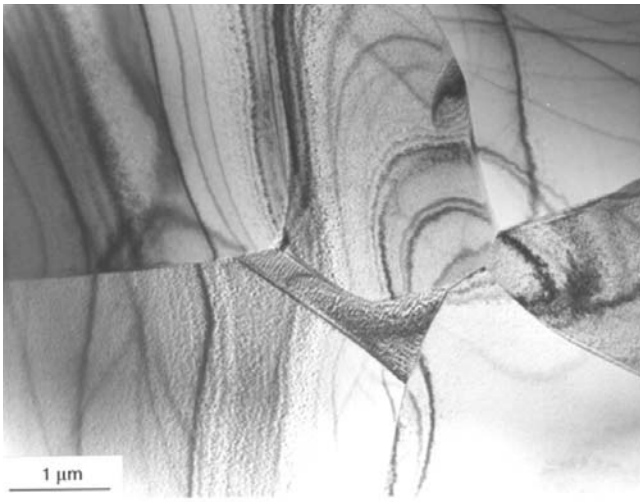
TEM image of X_5CrNi_8



Gold wire bonds after ion beam polishing

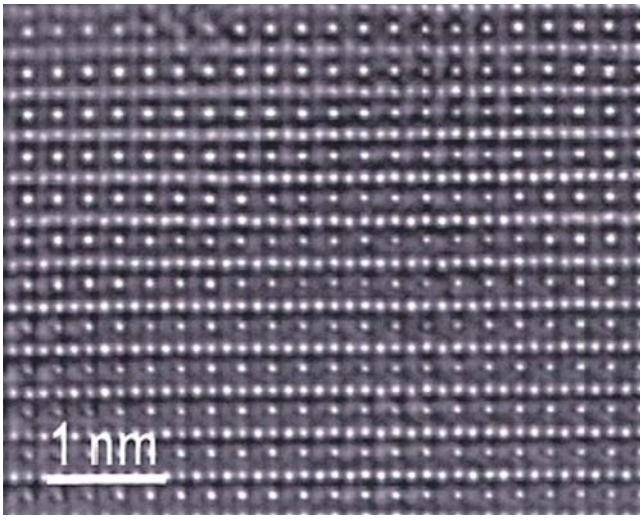


Oil Shale at the rim of 25 mm diameter after ion beam polishing



STEM images of a Ti film that has been ion beam milled at an angle of 6°

Solder ball after ion beam polishing



HRTEM image of $SiTiO_3$ after FIB cleaning

Specifications

ION SOURCE

Ion gun	Two saddle-field gun with large area milling properties
Ion energy	0.8 keV to 10 keV
Source current	Up to 4.5 mA (per ion source)
Ion current density	~ 1 mA/cm^2 at 8 kV/3 mA (per ion source)
FWHM	0.8 mm (at 10 keV), 2.5 mm (at 2 keV)
Gas used	Argon (Ar 5.0)
	Incoming pressure 500 mbar
Gas flow	< 1 sccm/ion source with automatic control

MOTORIZED ANGLE SETTINGS (PC CONTROLLED)

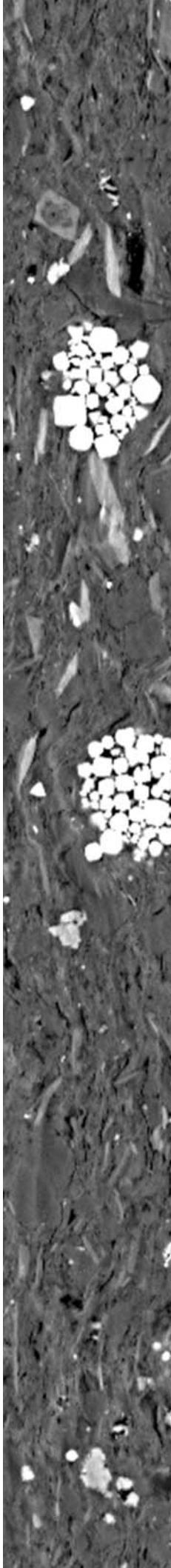
Gun tilting	
– Gun 1	± 45° (0.1° setting accuracy)
– Gun 2	± 45° (0.1° setting accuracy)
Sample holder tilting	–120° to 210° (0.1° setting accuracy)
Milling angle range	–90° to 90° (dependent on the sample holder)

SAMPLE MOVEMENTS (PC CONTROLLED)

Rotation	0.6 to 10 rpm
Oscillation	Up to 360°, in 1° steps
Zero point set up	In 1° steps
In x direction	± 5 mm, 0.1 mm accuracy
Tilting	–120° to 210°

SAMPLE HOLDERS (DIMENSIONS)

Sample size SEM holder	max. Ø 25 mm × 12 mm
Prepared area SEM holder	max. Ø 25 mm
Sample size TEM and FIB holder	Ø 3 mm or Ø 2.3 mm
Sample size SEM clamp holder	max. 5 mm (H) × 7 mm (W) × 2 mm (D)
Sample size SEM slope cut holder	max. 5 mm (H) × 5 mm (W) × 3 mm (D)



COOLING DEVICE (OPTIONAL AVAILABLE)

- Automated liquid nitrogen cooled contact mechanism
- Automated heat up control to avoid moisture contamination of the sample
- LN_2 consumption ~ 0.6 l/1 h

CONTROL (USER INTERFACE)

- PC control unit with 19" touch screen
- LAN capability for external operation and monitoring
- Integrated application library (programs)
- Individual programming and storage of milling parameters in steps or sequences

VACUUM SYSTEM

- Oil-free $< 1 \times 10^{-5}$ mbar, four stage system diaphragm and turbo molecular pump (70 l/s)
- Vacuum load lock system for sample transfer within 1 minute

PRESSURE MEASUREMENT

- Compact full range gauge, Pirani for low vacuum, cold cathode for high vacuum

OBSERVATION SYSTEM

- Digital CMOS-colour camera with motorized zoom, aperture diaphragm and automated focus adaptation
- Storage of live images and videos
- Beam cam function (false-color image) for precise gun alignment

AUTOMATED TERMINATION OF THE MILLING PROCESS

- Time controlled
- Optical image termination for opaque material
- Faraday cup for opaque and light transparent material (optional)

ELECTRICAL DATA

Supply voltage	90–260 VAC, 50/60 Hz
Power consumption	max. 400 W

DIMENSIONS AND WEIGHT	Width	Depth	Height	Net weight
Basic instrument	720 mm	700 mm	950 mm	~ 100 kg

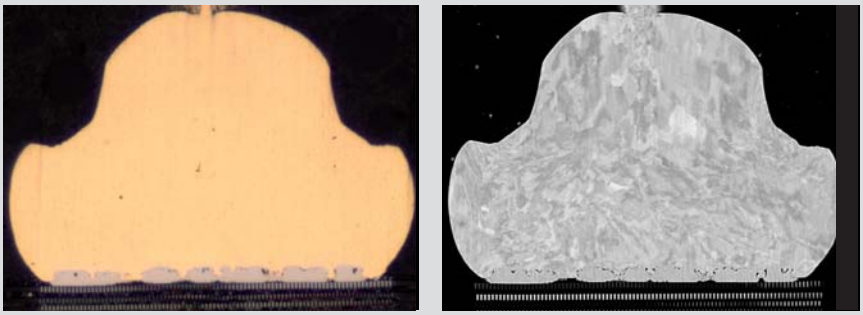
Synergies with the Leica EM TXP

Prior to using the Leica EM RES102, mechanical preparation is often required to get as close as possible to the area of interest. The Leica EM TXP is a unique target surfacing system developed for cutting and polishing samples prior to follow-on techniques with instruments such as the Leica EM RES102. The Leica EM TXP is specially designed to prepare samples by sawing, milling, grinding and polishing. It excels with challenging specimens where pin-pointing and preparing difficult targets becomes easy.

The Leica EM TXP is a unique target surfacing system developed for cutting and polishing samples. It can be used prior to follow-on techniques with the Leica EM RES102.

Leica EM TXP/EM RES102 for SEM

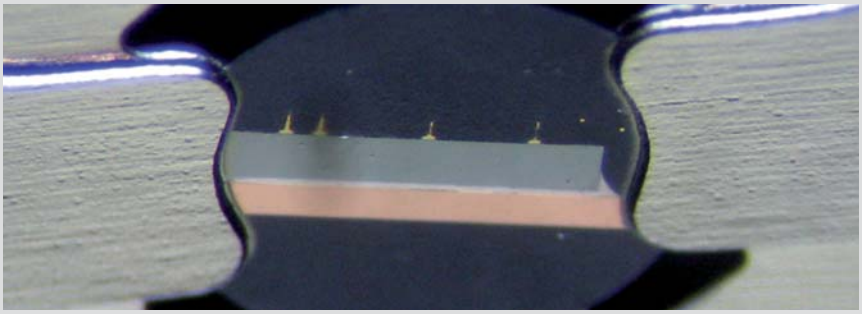
Gold wire bonding prepared with the Leica EM TXP (left). Same gold wire bonding after additional ion polishing step (about 30 minutes) with the Leica EM RES102 (right).



Picture 2

Leica EM TXP / EM RES102 for TEM

3 mm disc of a cross-sectioned IC-package with a thickness of 40 µm, mechanically prepared with the Leica EM TXP, clamped in the TEM sample holder of the EM RES102.



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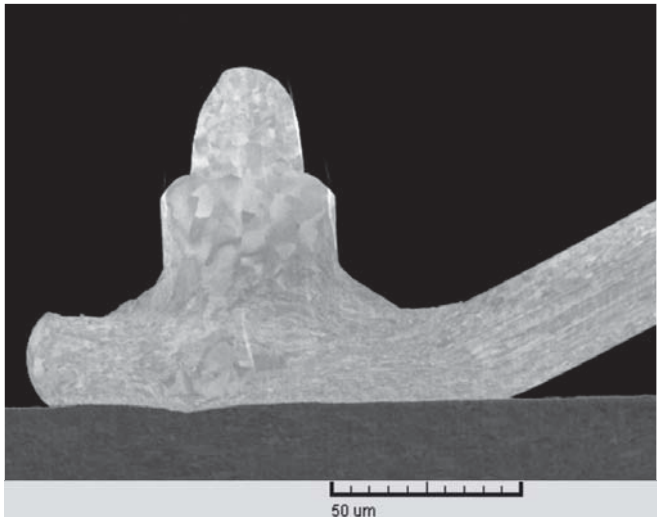
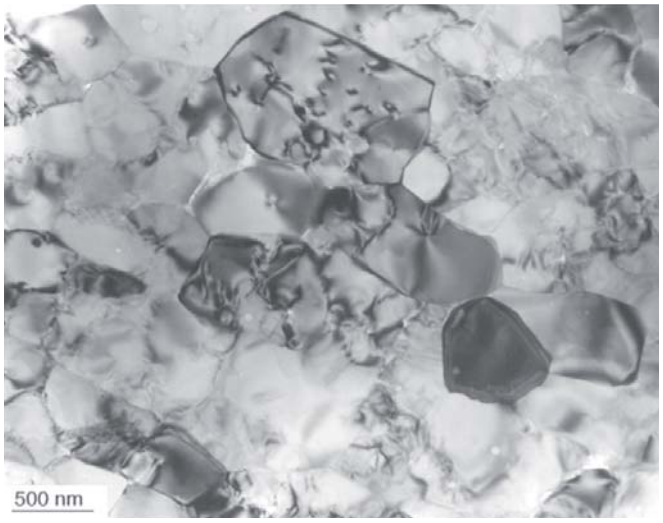


90° slope cut of an Au wire bond



TEM image of a milled ceramic sample (Al_2O_3)

The statement by Ernst Leitz in 1907, "With the User, For the User," describes the fruitful collaboration with end users and driving force of innovation at Leica Microsystems. We have developed five brand values to live up to this tradition: Pioneering, High-end Quality, Team Spirit, Dedication to Science, and Continuous Improvement. For us, living up to these values means: Living up to Life.

Leica Microsystems operates globally in three divisions, where we rank with the market leaders.

LIFE SCIENCE DIVISION

The Leica Microsystems Life Science Division supports the imaging needs of the scientific community with advanced innovation and technical expertise for the visualization, measurement, and analysis of microstructures. Our strong focus on understanding scientific applications puts Leica Microsystems' customers at the leading edge of science.

INDUSTRY DIVISION

The Leica Microsystems Industry Division's focus is to support customers' pursuit of the highest quality end result. Leica Microsystems provide the best and most innovative imaging systems to see, measure, and analyze the microstructures in routine and research industrial applications, materials science, quality control, forensic science investigation, and educational applications.

MEDICAL DIVISION

The Leica Microsystems Medical Division's focus is to partner with and support surgeons and their care of patients with the highest-quality, most innovative surgical microscope technology today and into the future.

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