



# Leica EM RES101

**Ion Beam Milling System**  
for TEM, SEM and LM Preparation

Living up to Life

**Leica**  
MICROSYSTEMS

# 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 supplied in a high vacuum by an ion gun towards the sample which is placed so that the surface is bombarded at an angle.

A low ion incidence with respect to the sample surface polishes the sample until it is electron transparent. Surface modification for samples can be realised with higher milling angles up to 90°. This includes surface cleaning, polishing and contrast enhancement.





# All-In-One Solution

The Leica EM RES101 is a unique ion beam milling device that has two saddle-field ion sources with variable ion energy for fast milling results.

Like no other instrument on the market, it combines the preparation of TEM, SEM and LM samples in one single bench top unit. In addition to high-energy milling, the Leica EM RES101 can also be used for the very gentle sample processing using low ion energy.

## TEM samples

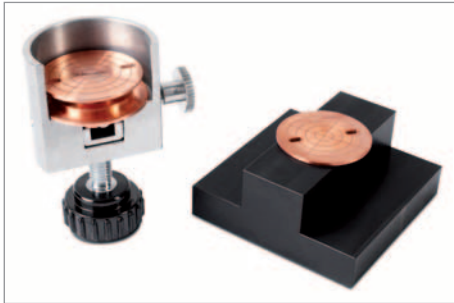
- Single-sided or double-sided low angle milling for uniform ion milling of materials
- Low energy cleaning of FIB samples to reduce the damaged surface region

## SEM or LM samples

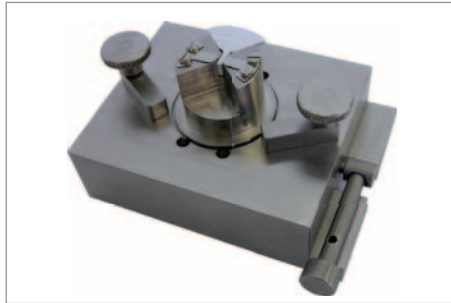
- Polishing of rough surfaces
- Surface cleaning of contaminated samples or the removal of smearing effects after mechanical polishing
- Contrast enhancement of sample surfaces instead of chemical etching
- 35° slope cutting for layered materials
- 90° slope cutting for structured semiconductor material and packaging

# Innovative. Unique. Leica Microsystems.

To support the diverse range of application possibilities, the Leica EM RES101 can be equipped with a variety of sample holders for the preparation of TEM, SEM and LM samples. The load-lock system guarantees high sample throughput with fast sample exchange.



Standard SEM Sample Holder for the cleaning, polishing and contrast enhancement of SEM and LM samples at room temperature or under LN<sub>2</sub> cooling. Specimens up to 25 mm diameter and 12 mm height can be prepared. Each set contains the holder, an adjustment tool, the loading stage as well as an adapter for SEM stubs.



FIB Cleaning Holder used to reduce the lamella thickness and damaged surface region of typical FIB samples. The cleaning consists of a loading stage, a FIB holder, and a sample alignment device.



Slope Cutter Holder for the production of cross-sectional (90°) and angled sections (35°) for the SEM investigation of the vertical structure of the sample. Specimens can be prepared at room temperature or under LN<sub>2</sub> cooling. Each set contains a loading stage, 35° and 90° specimen carriers as well as spare masks.



Quick Clamp Holder (Standard-TEM holder) for single and double-sided low angle milling down to 4°. The set contains the Quick Clamp Holder with the loading stage and beam adjustment discs.



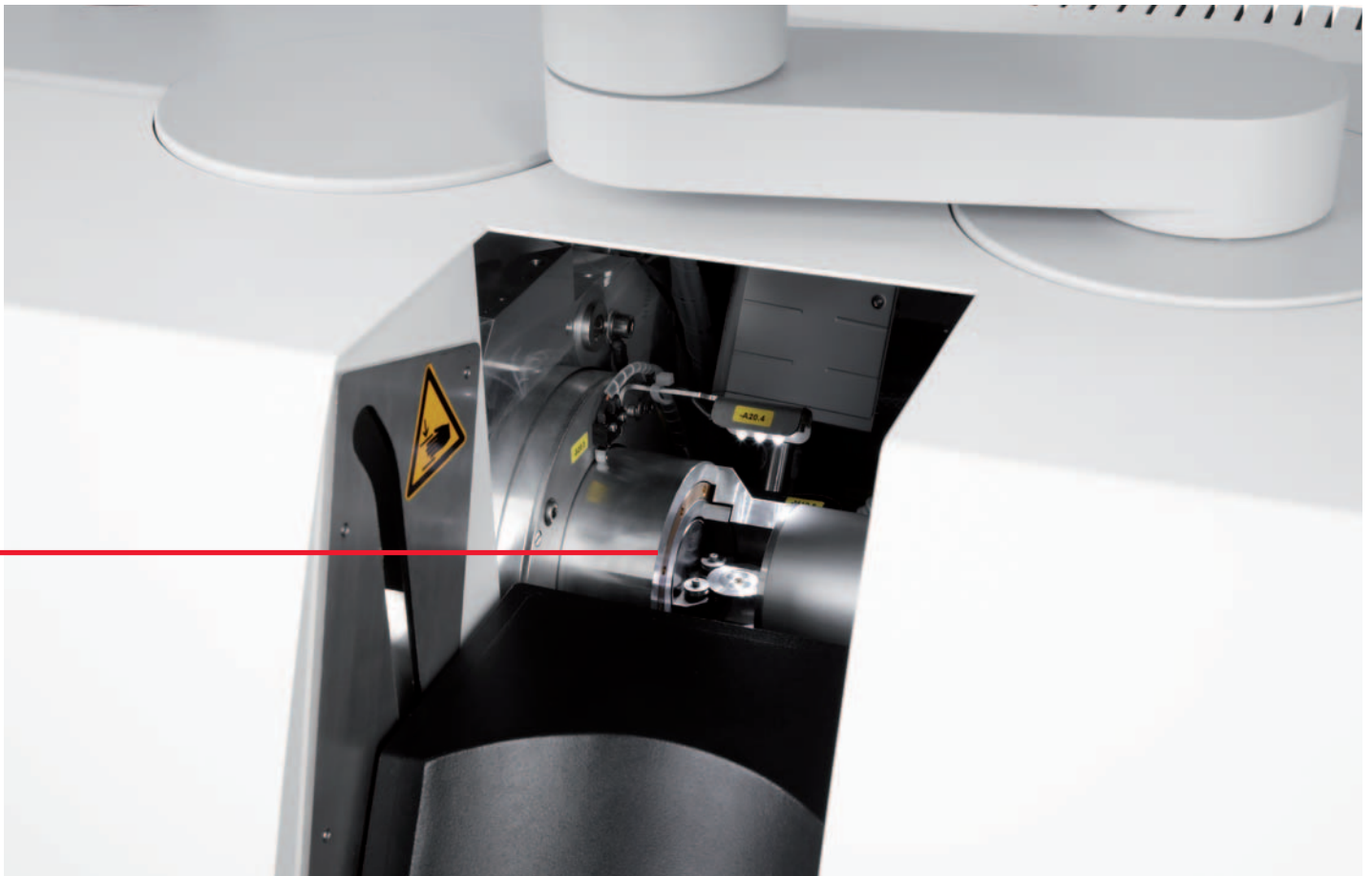
TEM Cooling Holder for the preparation of temperature sensitive samples in combination with the LN<sub>2</sub> cooling. The set contains the TEM Cooling Holder, adjustment discs and a wear part set.



The Leica EM RES101 can thin, clean, cut slopes, polish, and structure samples with the highest level of flexibility for the user.

### Key Features of the Leica EM RES101

- Adjustable milling angle between 0° and 90°
- Adjustable ion energy for high and low energy sample milling
- Sample holders for different SEM, LM and TEM applications
- Preparation of samples up to 25 mm diameter
- PC control unit with touch screen for process monitoring and controlling
- Automated milling for overnight processing
- Efficient LN<sub>2</sub> sample stage cooling for temperature sensitive specimens
- Load-lock system for rapid sample transfer and permanent high vacuum
- Programmable process parameters
- LAN capability for external operation and monitoring
- Integrated applications library
- Precise automatic termination feature with optical image processing
- Storage of live images for documentation of the milling process



# Advanced Technology Solutions

## Wide range of milling applications.

Two ion sources arranged opposite one another allows double or single-sided sample processing. Incident and transmitted light sources provide excellent specimen viewing for precise target termination. The milling angle can be adjusted between 0° and 90°. With the wide range of parameter settings for the milling angle and ion energy, practically all pre-preparation challenges for SEM, TEM and LM analysis can be mastered.

## Video monitoring

A sample can be observed during the milling process and later accessed using the powerful CCD colour video camera. The video camera has a motorised zoom objective with a total magnification between 8 and 60x. Optionally, an additional microscope with an optical magnification between 60 and 350x is available. Live images can be stored at anytime.

## No contamination

The two-stage vacuum system consisting of a diaphragm pump and a turbo molecular pump (70 l/s) creates an oil-free vacuum of  $< 1 \times 10^{-5}$  mbar which in turn provides the user with a contamination-free sample.

## Stable operation

The innovative computer-controlled gas inlet system guarantees a stable operation of the ion sources at working pressures around  $2 \times 10^{-4}$  mbar.

## Fast sample exchange

The sample transfer takes place under vacuum conditions in the vacuum chamber within 30 seconds via a vacuum load-lock.

## Network compatibility

The milling process can be manipulated from another PC via a local network (LAN). This allows the user remote access to monitor and control sample preparation. This is an excellent feature used by researchers where multi-tasking is required.





### Computer-controlled system

The Leica EM RES101 is fully computer-controlled and permits a very precise setting of multiple milling parameters. All parameters are displayed in the menu. Settings can be changed via the touch screen. Once the RES 101 program has been initiated, the computer takes control of the complete milling process.

This includes:

- the vacuum system
- the regulation of the gas inlet and the high voltage for the ion sources
- all movements of the ion sources (milling angle) and of the sample holder (x-movement, tilting)
- the vacuum load-lock for the sample transfer

This results in the following possibilities:

- The ability to exactly set and control all process parameters through the user-friendly Leica EM RES101 program.
- Complete automation of the preparation process with
  - the ability to create complete milling programs a program library for the precise preparation of recurring applications
  - precise automatic termination feature with optical image processing
  - sample control with CCD camera and the storage of live images for the documentation of the milling progress
  - external PC control of the milling process via a local network (LAN)

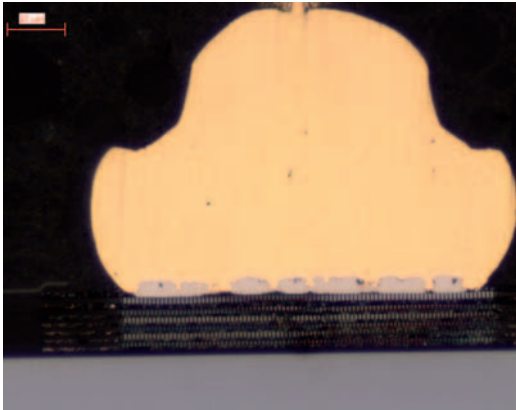
### Automated termination of the milling process

An automatic switch-off mechanism, using optical image termination processing, accurately halts sample milling of opaque material once the determined sample thickness has been reached. Consequently, very time-consuming preparation can be carried out overnight with optimum results. A large number of parameter settings, with regard to the switch-off option, permits a wide range of sample preparation applications. Complete milling programs and multiple preparation steps can be programmed, stored and reused for reproducible results. Unique to the Leica EM RES101 is the ability of the instrument, using a faraday cup, to automatically terminate the milling process not only with opaque but also with light transparent material such as glass. No other ion beam milling system can accomplish this.

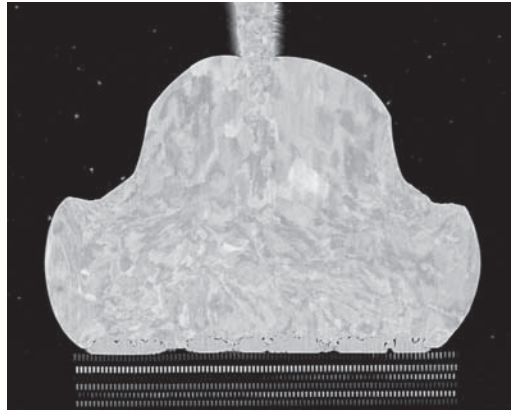
# Synergies with the Leica EM TXP

Prior to using the Leica EM RES101, 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 RES101. The Leica EM TXP is specially designed to preprepare samples by sawing, milling, grinding and polishing. It excels with challenging specimens where pinpointing and preparing difficult targets becomes easy.

## Leica EM TXP/EM RES101 for SEM



Gold wire bonding prepared with the Leica EM TXP



Same gold wire bonding after additional ion polishing step (about 30 minutes) with the Leica EM RES101

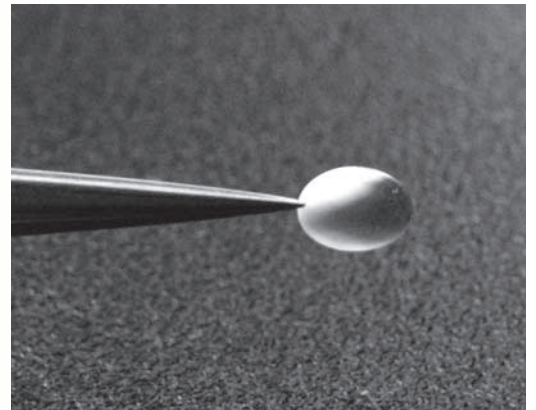
The Leica EM TXP is a unique target surfacing system developed for cutting and polishing samples prior to follow-on techniques with the Leica EM RES101.



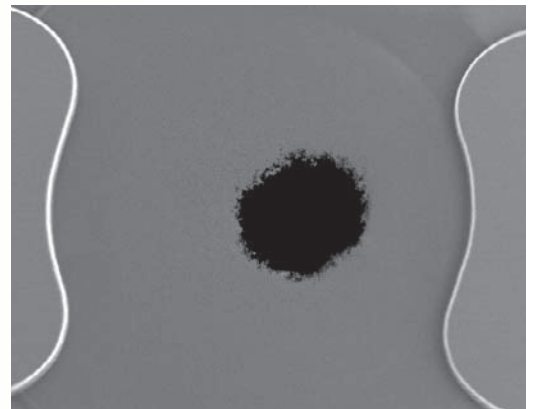




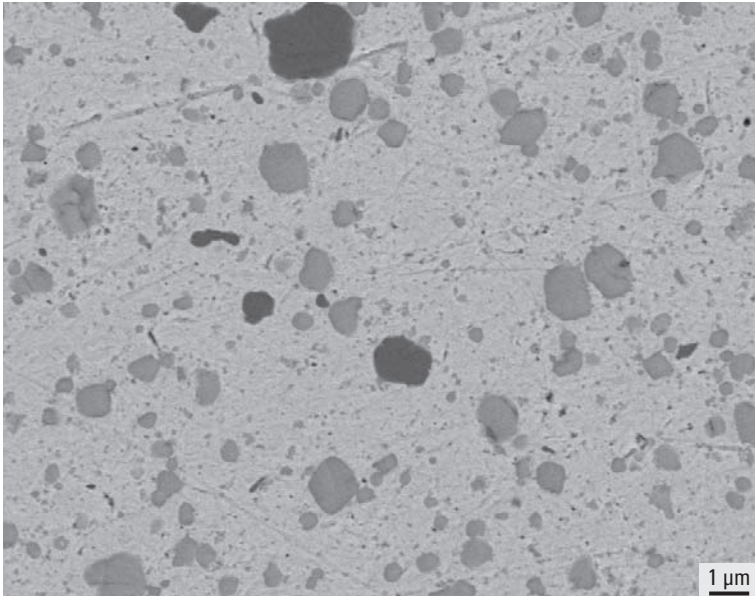
## Leica EM TXP/EM RES101 for TEM



3 mm tungsten carbide disc with a thickness of 9  $\mu\text{m}$  mechanically prepared with the Leica EM TXP

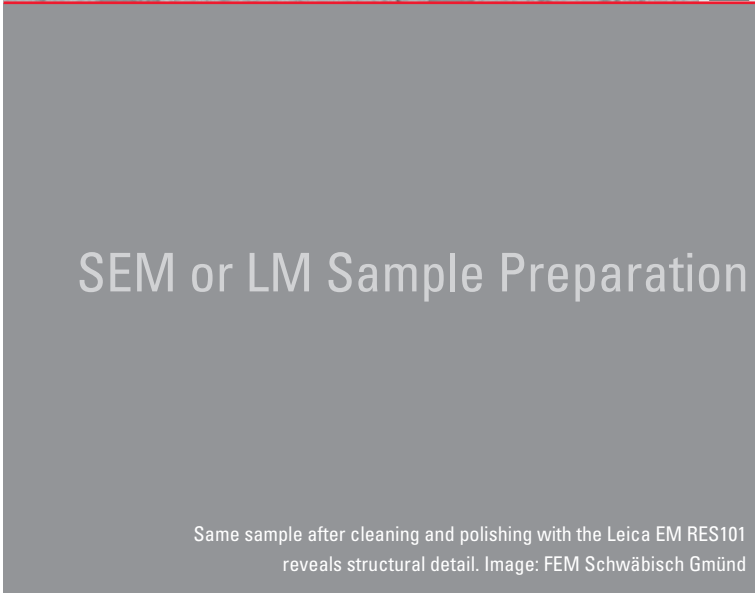


Same sample ion thinned using the Leica EM RES101  
Image: TEM



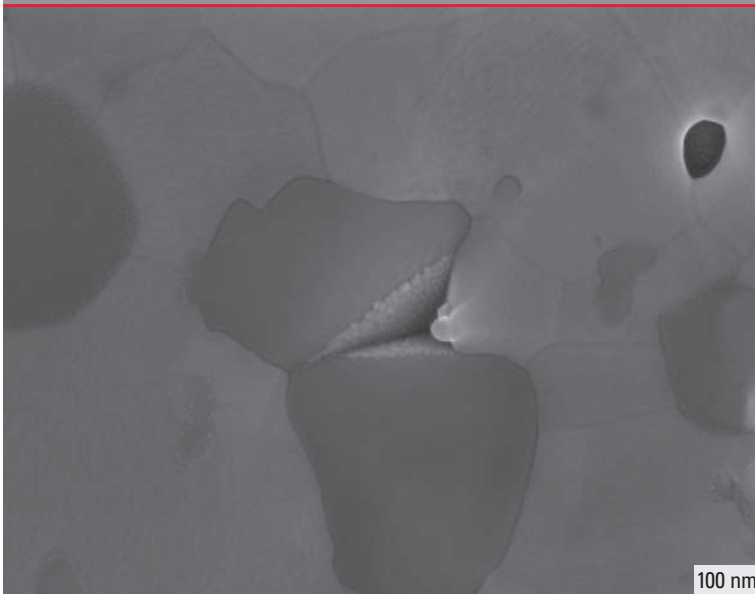
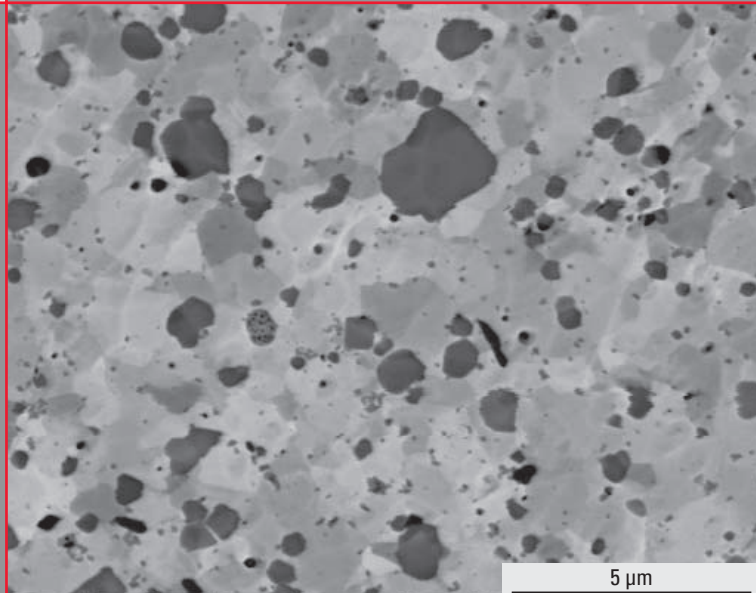
## SEM or LM Sample Preparation

Ag sample with metal oxide damage after mechanical polishing. No detailed structural analysis of the surface is possible. Image: FEM Schwäbisch Gmünd



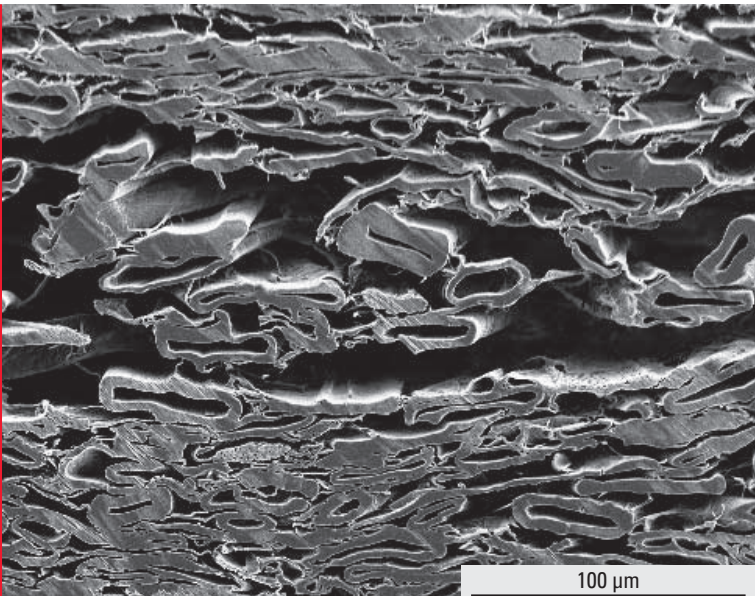
## SEM or LM Sample Preparation

Same sample after cleaning and polishing with the Leica EM RES101 reveals structural detail. Image: FEM Schwäbisch Gmünd



## SEM or LM Sample Preparation

Mechanical polishing can create smears on the surface of a sample thus making structural analysis impossible. With additional ion processing (cleaning and polishing) the true structure is exposed and even the smallest structural detail can be observed. Image: FEM Schwäbisch Gmünd.



100  $\mu\text{m}$

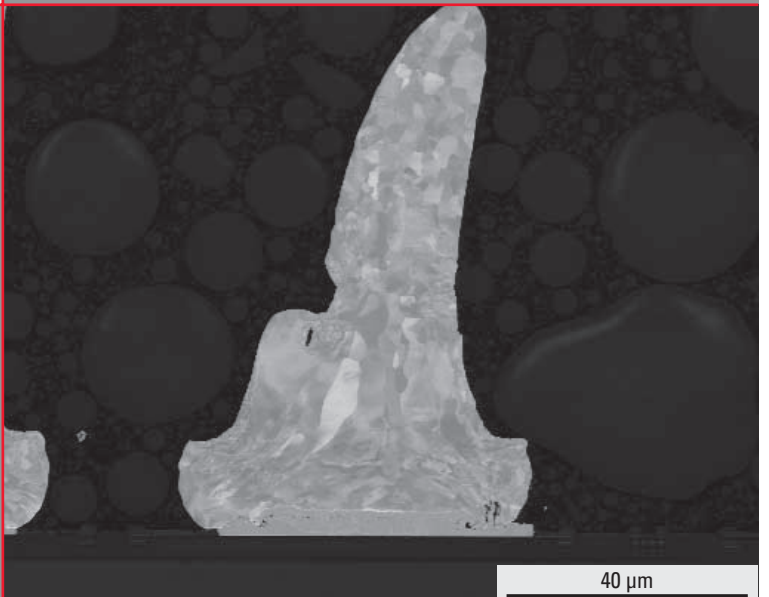
## Slope-cutting

90° slope cut of soft and porous material. Images: X-SEM images of soft cardboard for packaging purposes, development project FH Hannover.



## Slope-cutting

90° slope cut of a Au wire bond



40  $\mu\text{m}$



100 nm

## TEM Sample Preparation

Preparation of multilayer systems.  
Images: X-TEM images of W-layer deposited on TiN/Si

# “With the user, for the user”

## Leica Microsystems

Leica Microsystems operates internationally in four 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.

### • Biosystems Division

The Leica Microsystems Biosystems Division brings histopathology labs and researchers the highest-quality, most comprehensive product range. From patient to pathologist, the range includes the ideal product for each histology step and high-productivity workflow solutions for the entire lab. With complete histology systems featuring innovative automation and Novocastra™ reagents, Leica Microsystems creates better patient care through rapid turnaround, diagnostic confidence, and close customer collaboration.

### • Surgical Division

The Leica Microsystems Surgical 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.

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.**

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