

Living up to Life

**Leica**  
MICROSYSTEMS



# Leica EM TIC 3X

Triple Ion-Beam Cutter

High Quality Surface Finishing For Almost Any Material



# Leica EM TIC 3X: Ion Beam Slope Cutter

Ion beam slope cutting with the Leica EM TIC 3X is a technique used to produce cross-sections of hard, soft, porous, heat sensitive, brittle and/or heterogeneous material, for scanning electron microscopy (SEM) microstructure analysis (EDS, WDS, Auger, EBSD) and AFM investigations.

Most often it is the only method capable of achieving high quality cross-sections of almost any material. The process reveals the internal structures of a sample whilst minimizing deformation or damage.

The technology of the Leica EM TIC 3X surpasses conventional slope cutting instruments. With its three ion beams, cooling stage and multiple sample stage the Leica EM TIC 3X can mill at high rates, cut broad and deep into the sample and create smooth surfaces resulting in quality cross-sections for almost any material, quickly and easily.

## Leica EM TIC 3X – INNOVATIVE FEATURES IN DESIGN AND OPERATION

### High throughput, cost-efficient

- › Cuts high quality cross-sections with large areas of  $>4 \times 1$  mm
- › Multiple sample stage capable of processing up to three samples in one run
- › High milling rates of 150  $\mu\text{m}/\text{h}$  for Si, 50  $\mu\text{m}$  from edge, fulfills the needs of high throughput labs
- › Samples up to a size of  $50 \times 50 \times 10$  mm can be clamped for processing
- › Various sample holder sizes can be used

### Ease of use, high process accuracy

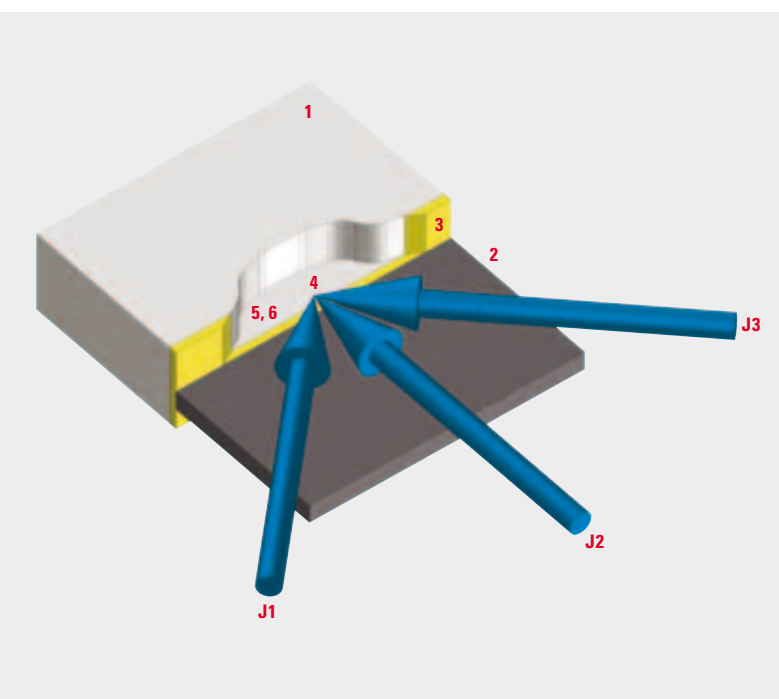
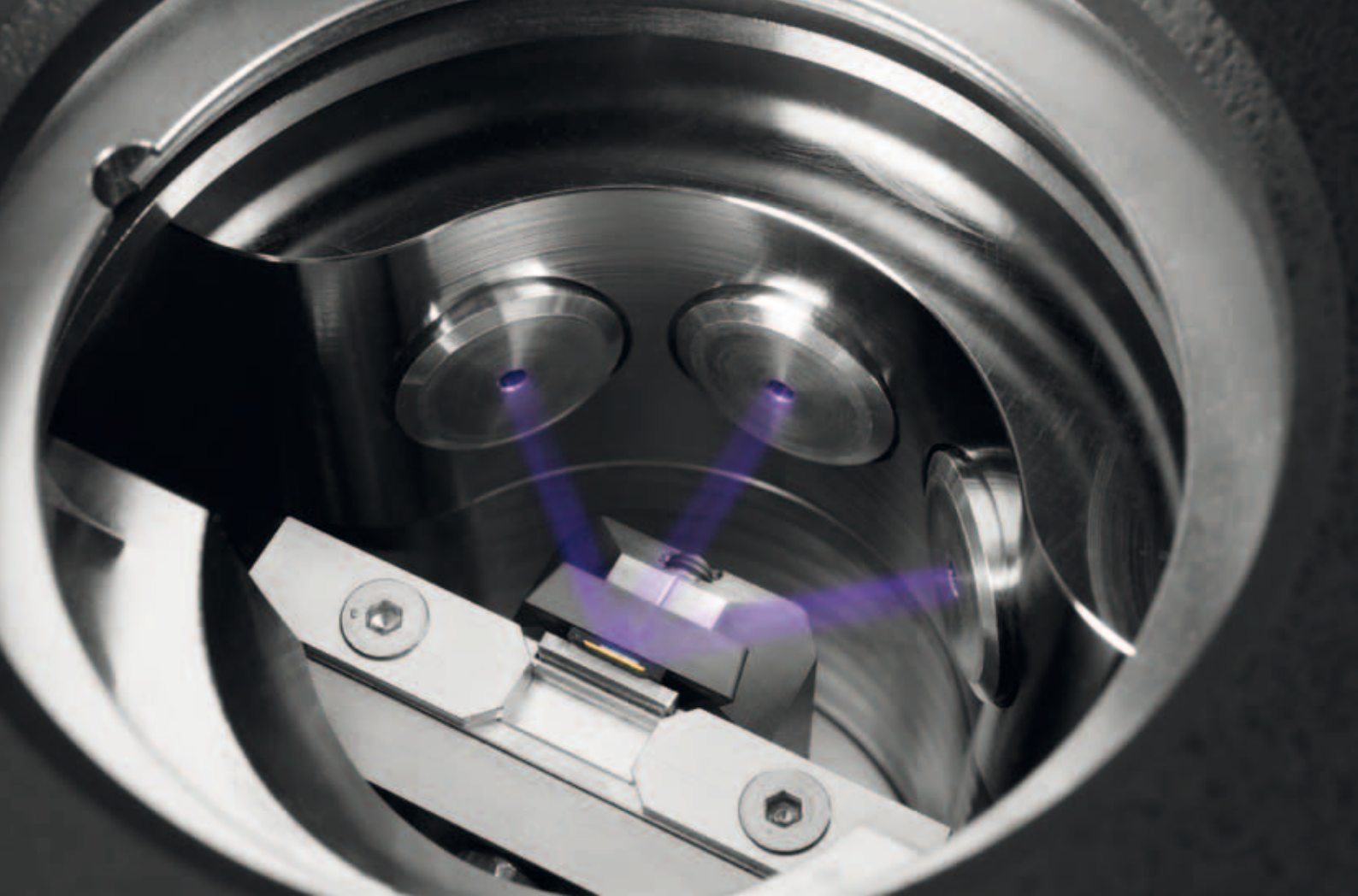
- › Easy and accurate sample mounting and alignment to the mask
- › Simple operation via touch screen, no special skills necessary
- › Process monitoring via stereomicroscope or HD-TV camera
- › LED illumination for optimal specimen viewing and alignment
- › Integrated, decoupled roughing pump provides vibration-free observation

- › Contrast enhancement at  $90^\circ$  to the prepared surface

- › Parameter and program upload and download on USB stick

### Usable for almost any material

- › Cooling stage provides temperatures of mask and sample down to  $-150^\circ\text{C}$



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- 1 Sample
  - 2 Mask
  - 3 Sample surface
  - 4 Cross over point of ion beams
  - 5 Area of interest
  - 6 Direction of observation
  - J1, J2, J3 Ion beams



# Triple Ion Beam Techniques

The Leica EM TIC 3X features three saddle field ion sources located in one assembly.

## GENERAL

The assembly is arranged perpendicular to the sample surface, so the sample (mounted on a holder) does not require an oscillating movement to reduce shadowing/curtaining effects. Also, it enables an efficient heat transfer from the sample.

## TECHNIQUE

Three ion beams intersect at the center edge of the mask, forming a milling sector of 100° cutting the exposed sample (~20 to 100 µm above the mask) until the area of interest is reached. A new design of the ion guns develops a milling rate of 150 µm/hour (Si 10 kV, 3.0 mA, 50 µm from edge).

The unique triple ion beam system optimizes the cross-section quality and reduces working time with its ability to cut broad and deep at high speeds.

This unique technique produces a vast preparation area of  $>4 \times 1$  mm at a very high material removal rate with a high quality finish.

## USAGE

For processing, each gun can be controlled and switched separately. This enables the user to set different gun parameters depending on the application, e.g. for contrast enhancement or gentle milling.

# Configure Your System

Today's research facilities seek faster and simpler methods of sample preparation without having to forgo quality. The innovative technology of the Leica EM TIC 3X triple ion beam cutter offers the solutions to help laboratories with high expectations achieve their goals. Depending on the preparation needs, the Leica EM TIC 3X can be configured for applications of standard preparation, high throughput processing and the preparation of extremely heat sensitive samples at low temperatures (e.g. polymer, rubber).

Three easily interchangeable stages are offered to fulfill individual application demands:

## STANDARD STAGE

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Standard stage for routine applications and contrast enhancement of the prepared surface.

## MULTIPLE SAMPLE STAGE

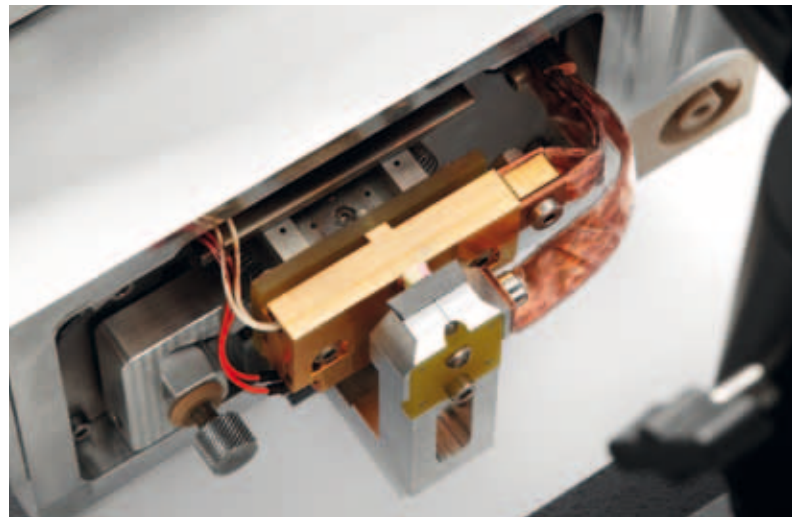
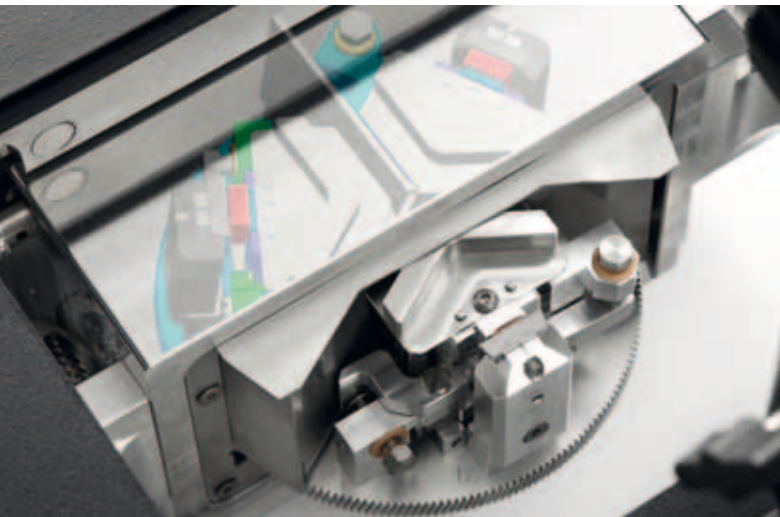
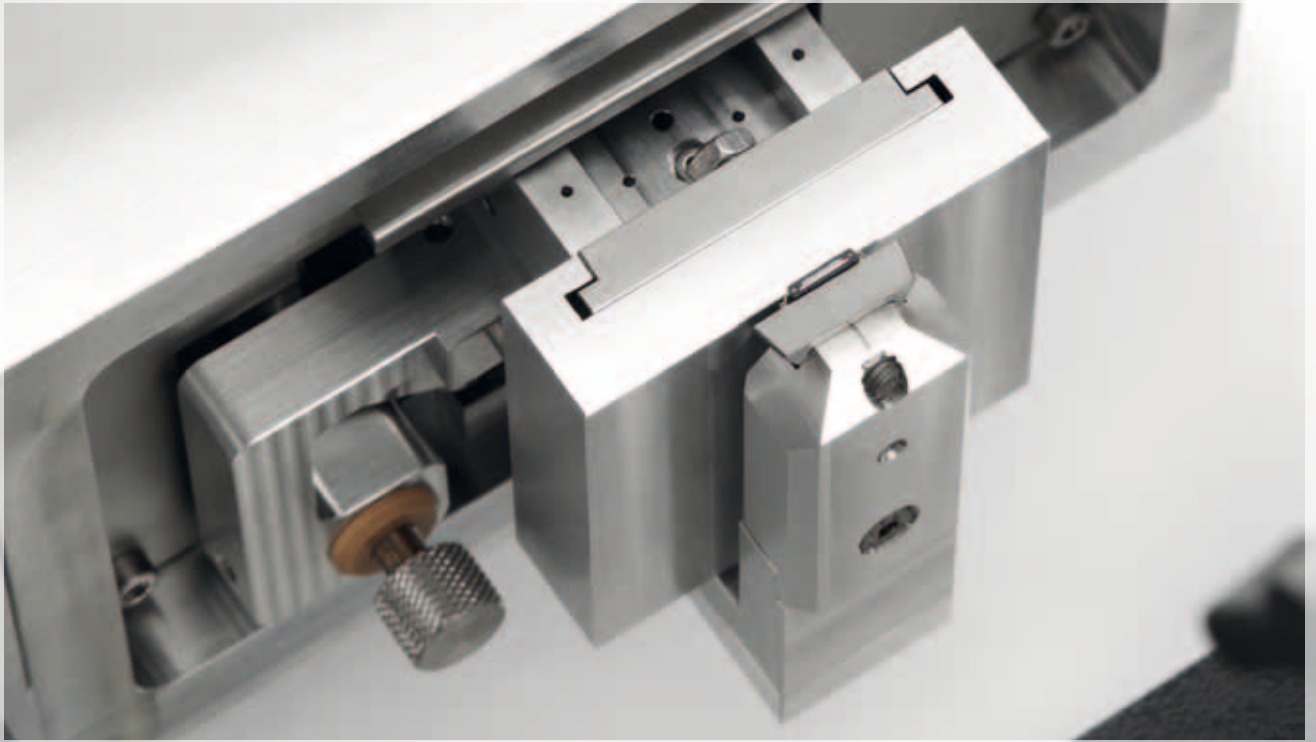
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Multiple sample stage is used if high throughput is desired. Three samples can be loaded and automatically processed in one session (e.g. overnight) without any user interaction.

## COOLING STAGE

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Cooling stage provides very low temperature processing. With temperatures of the sample holder and mask down to  $-150^{\circ}\text{C}$ , extremely heat sensitive samples such as rubber, water soluble polymer fibers or even marshmallows (if desired) can be processed to a high quality. The 25 liter dewar provides at least enough  $\text{LN}_2$  for a full working day without refilling. Warming up of the sample is automatically carried out at the selected temperature under low vacuum, thus avoiding moisture contamination.

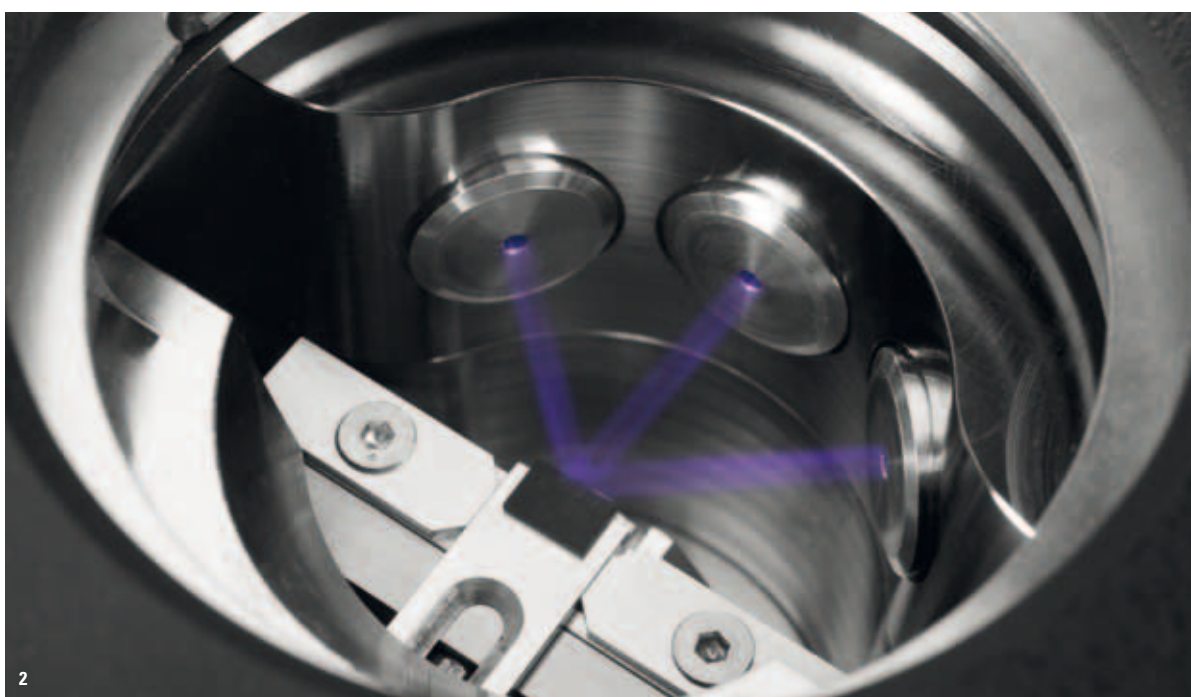


**VARIOUS SAMPLE HOLDERS:** Various sample holders for almost every sample size and a wide range of use are available e.g. one sample holder for the complete process from mechanical pre-preparation (Leica EM TXP) to ion beam slope cutting (Leica EM TIC 3X) to SEM investigation to the point of storage.

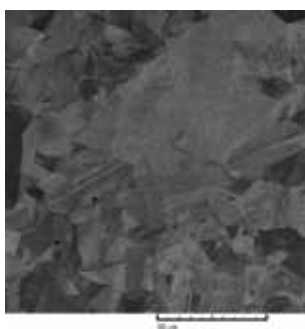




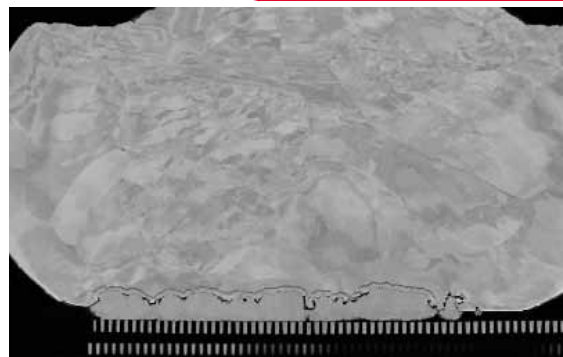
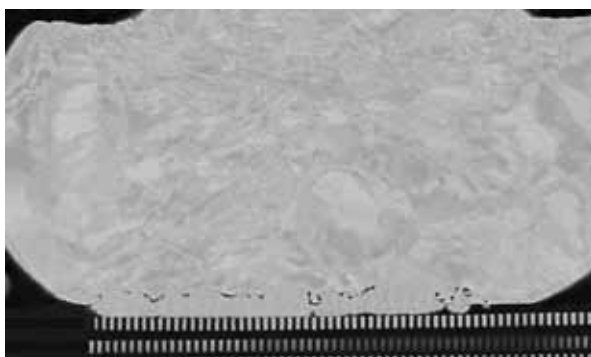
**CONTRAST ENHANCEMENT  
HOLDER OF THE STANDARD  
STAGE:** 1) sample in slope cut  
position; 2) contrast  
enhancement at low kV for few  
minutes



**COPPER SAMPLE:** Left: after  
slope cutting; middle: after  
additional contrast enhance-  
ment step; right: enlarged view



**GOLD-WIRE BOND:** Left: after  
slope cutting; right: after  
additional contrast enhance-  
ment step





# Contrast Enhancement

In addition to slope cutting, the same holder can be used for cleaning and contrast enhancement to provide clear visualization of the surface topography (e.g. grain boundaries).

## HIGH PROCESS ACCURACY

Nowadays, smaller and smaller sample details need to be revealed within the sample. Achieving a cross-section through, for example, small TSVia holes, becomes easier than ever before. All stages are designed to adjust the sample within  $\pm 2 \mu\text{m}$ . Not only does the stage accuracy provide this fine target adjustment, but an observation system is offered to resolve sample details of around  $3 \mu\text{m}$  which is needed for such accurate alignment. To help orientate the sample, the segment-controlled ring LED or LED coaxial illumination is an additional feature to provide a clear image via the stereo microscope or HD-TV camera.

As the roughing pump is integrated into the instrument, a separate space in the laboratory is no longer required. Due to the decoupled design, sample observation during the process is not influenced by annoying vibrations caused by the roughing pump.

**RING LED CONTROL** for brightness,  
segment selection and segment rotation



# Featuring Ergonomy and Ease of Use

The stereo microscope of the Leica EM TIC 3X is not only used for aligning and process observation. A work-plate attached beneath the microscope can be used for handling the sample or attaching the sample to its holder. Thus, no additional observation system is needed for manipulating small samples.

The outstanding performance of the integrated touch screen controller is not only reflected in its intuitive operation but hints and helpful information are also displayed to allow the most effective use of the instrument. A USB-stick can be attached to upload and download parameters for reporting and processing.

## SPECIAL INSTRUMENT TABLE

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A specially designed instrument table is offered, featuring numerous additional benefits such as:

- › Passive damping elements to reduce vibrations introduced from the environment
- › LN<sub>2</sub> pump storage
- › Clamping device for the Argon gas bottle for safe installation
- › Elbow rests allow an ergonomic posture during sample handling
- › A specially designed chair completes the ergonomic concept of this exceptional instrument table
- › Contrast enhancement at 90° to the prepared surface
- › Simple operation via touch screen, no special skills necessary
- › Process monitoring via stereomicroscope or HD-TV camera
- › LED illumination for optimal specimen viewing and alignment
- › Parameter upload on USB stick
- › Highly reliable, high throughput, cost-efficient



# Synergies with the Leica EM TXP

Prior to use of the Leica EM TIC 3X, 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 TIC 3X. The Leica EM TXP is specially designed to pre-prepare samples by sawing, milling, grinding and polishing. It excels with challenging specimens where pinpointing and preparing difficult targets becomes easy.

## ADVANTAGES

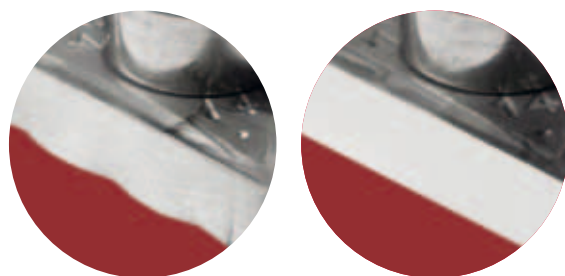
Using a dedicated sample holder, the sample can be left in situ on the holder from mechanical pre-preparation with Leica EM TXP, through ion beam cutting and contrast enhancement with the Leica EM TIC 3X, to SEM examination and finally storage of the sample on its holder in case future investigations are needed.

## SPECIAL EDGED MASK

A special edged mask (optional) has been designed to intensify this synergy. Now the Leica EM TXP can be used to remove "useless" material within minutes, just by beveling the sample. By doing so, the material around the area of interest can be easily removed without changing the specimen holder. Thus, not only the ion-beam processing time is drastically reduced, which could save many hours of lead-time, but the gun's lifetime per sample is significantly increased as well.

## SPECIAL HOLDER

Additionally, a special holder for the Leica EM TXP is offered. This holder is used to re-sharpen the standard EM TIC 3X mask to a very high quality.

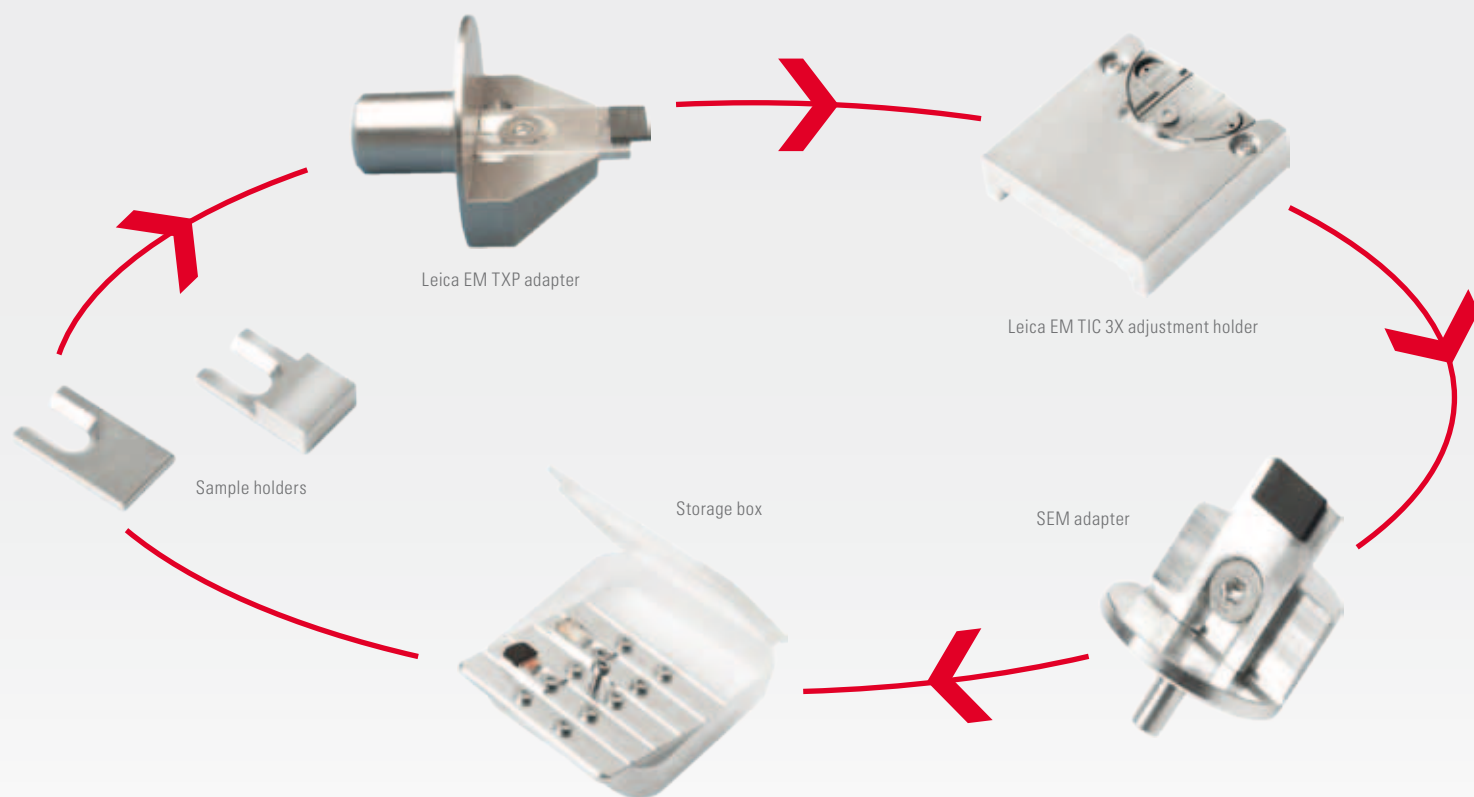


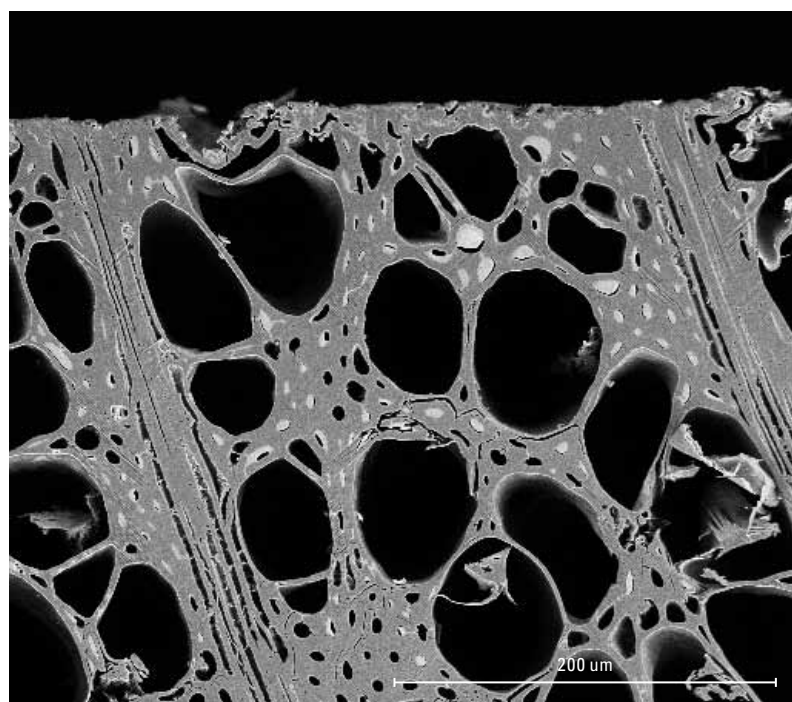
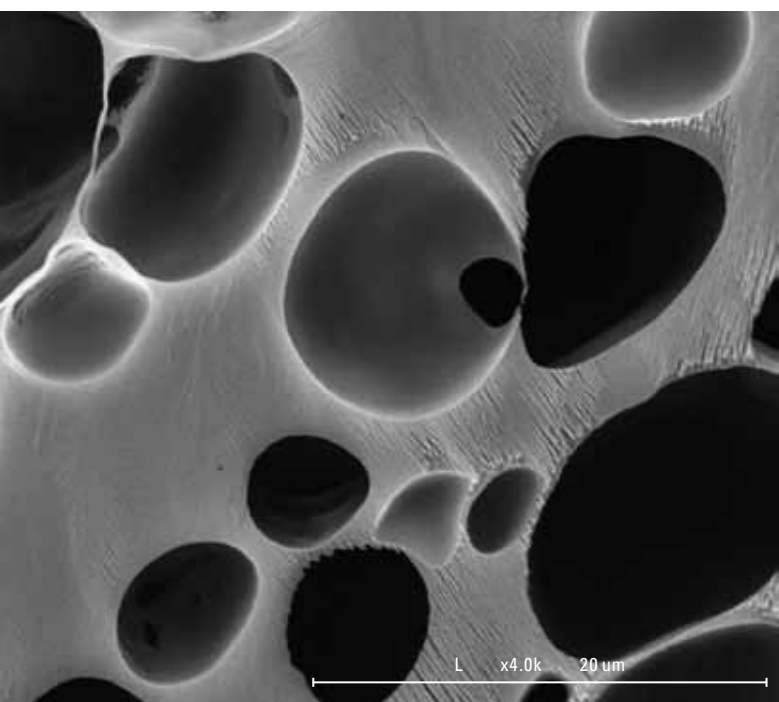
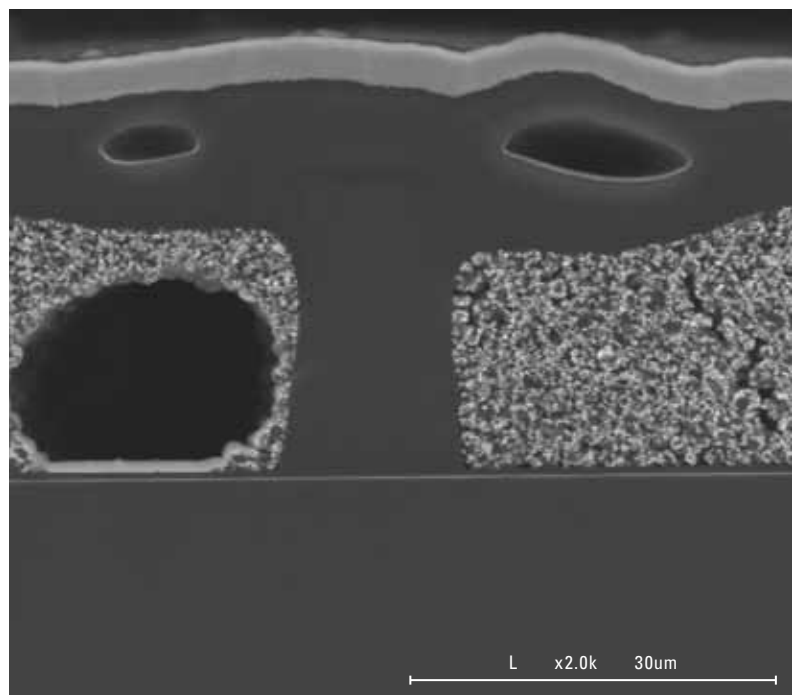
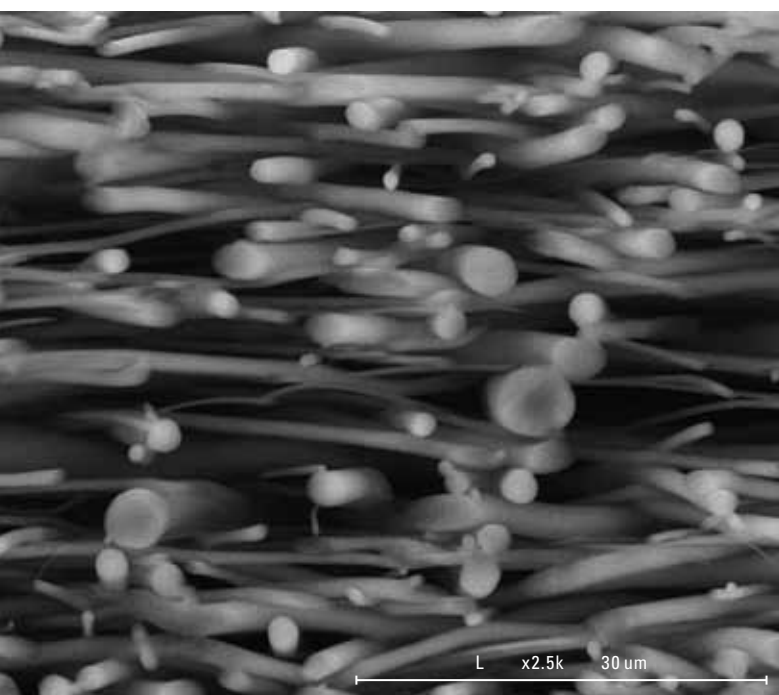
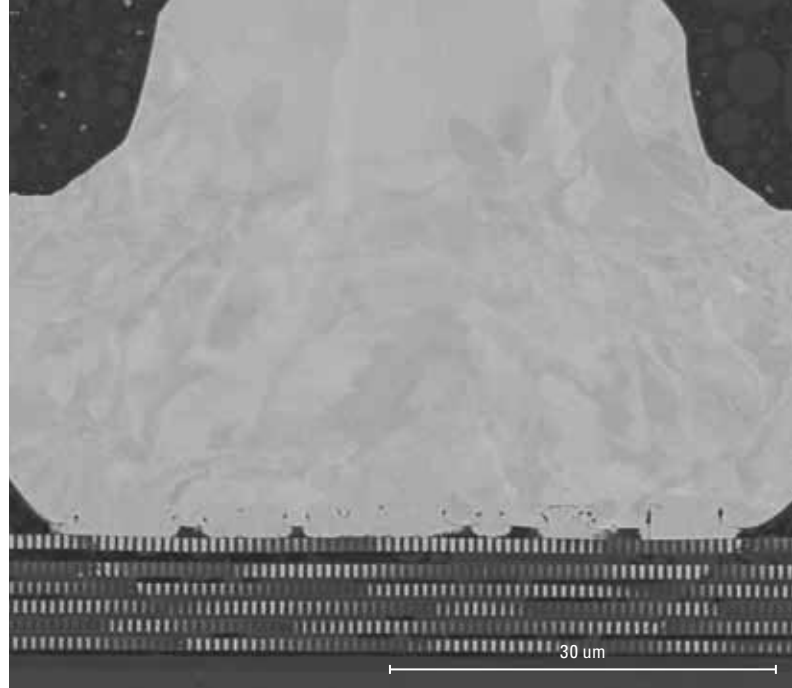
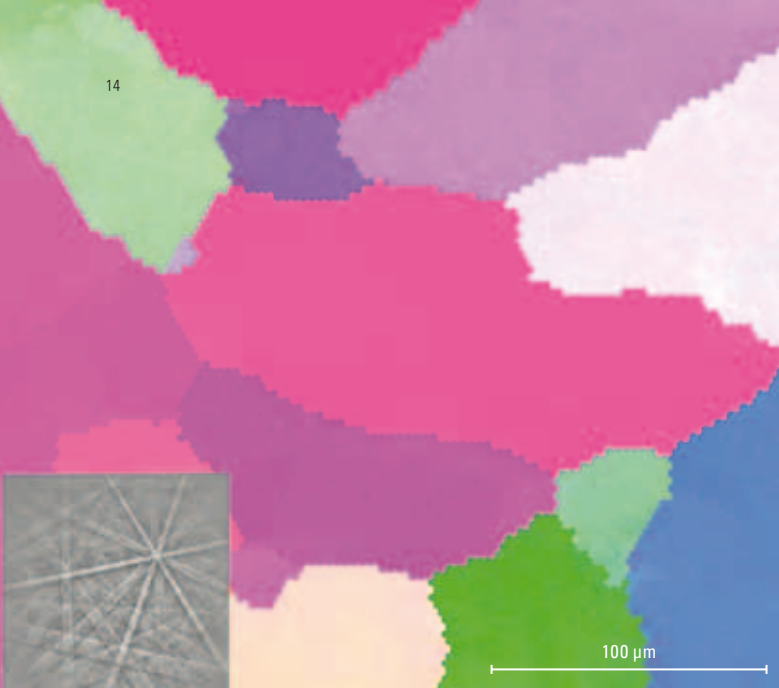
**SPECIAL HOLDER:** Standard mask on the special holder for the Leica EM TXP. Left before and right after re-sharpening with the Leica EM TXP

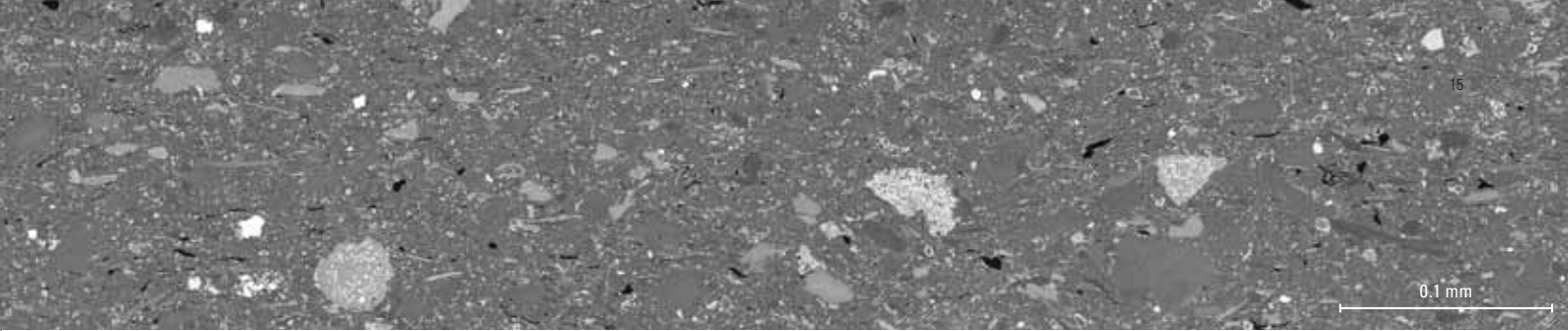


**SPECIAL EDGED MASK:** Around 300 µm of "useless" material above the wire bonding was removed with the Leica EM TXP. In conjunction with the specially designed edged mask the sample was completely prepared within 1 hour (including pre-preparation).









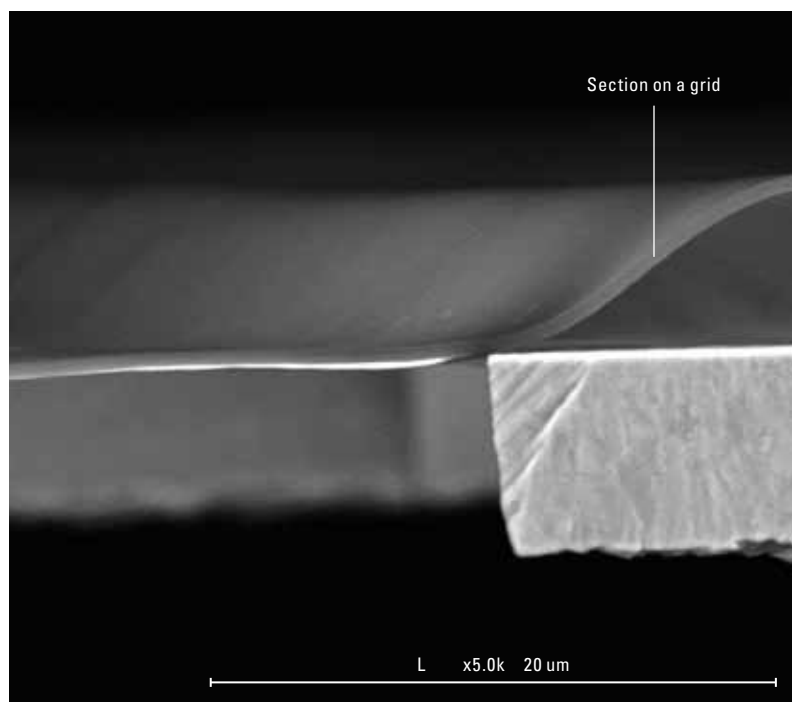
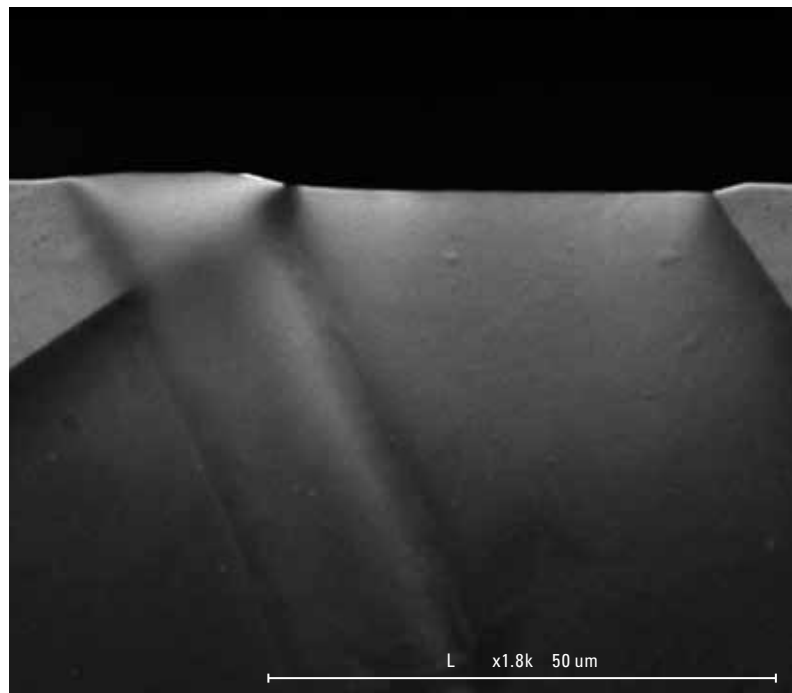
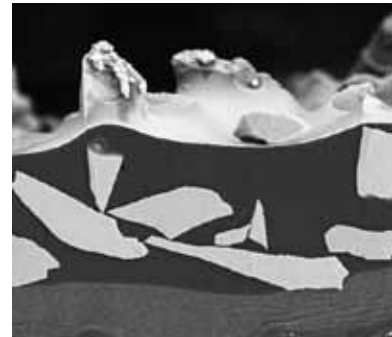
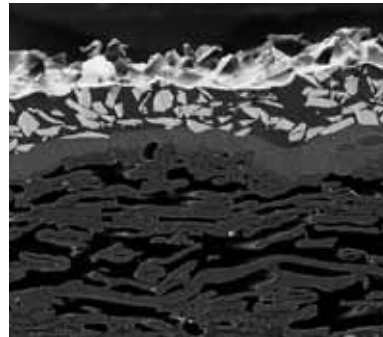
# Applications

Left side, from top left to bottom right:

- › EBSD und OIM image of an ion-beam slope cut area of Al-alloy
- › SEM image of a 90° slope cut of gold wire bonding of IC-package
- › Coaxial polymer fiber (water soluble) prepared at  $-120^{\circ}\text{C}$
- › Cross-section of e-paper, prepared at  $-150^{\circ}\text{C}$
- › Cross-section of marshmallow prepared at  $-150^{\circ}\text{C}$
- › Cross-section of veneer

Right side, from top to bottom:

- › Clay, imaged by Lukas Keller, EMPA Switzerland
- › Cross-section of SiC abrasive paper
- › Cross-section of ultramicrotomed liver tissue on carbon coated copper grid (TEM sample).  
Top: plan view; right: cross-section.



## WITH THE USER, FOR THE USER

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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.

### 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.

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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