microPREP™ 2.0

High-Volume Laser-Based Sample Preparation for Semiconductor and Materials Failure Analysis

microPREP™ 2.0 enables high-volume sample preparation of metals, semiconductors, ceramics, and compound materials for microstructure diagnostics and failure analysis. The system can be used for a variety of semiconductor sample preparation applications, including in-plane geometries and bulk samples, cross-sections, box milling for diagnostics of electrical connections and 3D chip-level structures, and full line cuts for complex investigations of complete devices. microPREP™ 2.0 complements existing approaches to sample preparation such as FIB processing and is suited for SEM inspection of advanced-packaging devices, X-ray microscopy, atom probe tomography, and micro mechanical testing.

microPREP™ 2.0 offers:

- Shorter time to sample: up to 10 000 times faster than FIB
- Up to an order of magnitude lower CoO
- High degree of automation due to recipe-based, ergonomic user interface
- Virtually no structural damage and no elemental contamination by ps laser processing
- Providing larger-sized samples with micron-level precision
- Enables the creation of samples with complicated/3D shapes (TSVs, SiP)
- Meets the essential requirements of the SEMI S2/S8

3D MICROMAC

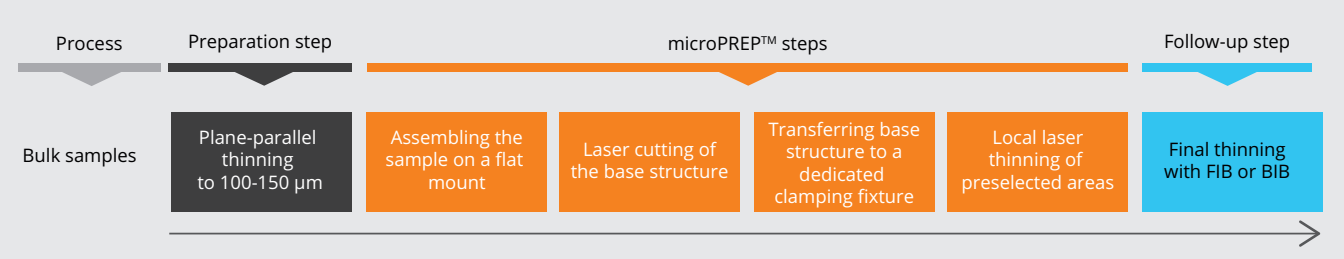
microPREP™ 2.0 - System Description

Workpiece size	▪ Up to 50 x 50 x 20 mm³
Alignment	▪ Work piece alignment with optical measurement system
Positioning	▪ Process accuracy ± 0.003 mm (XY) ▪ Customized motion concept
Fixtures	Fixtures included: ▪ Cutting ▪ Thinning ▪ XL-Chunk (manual) Fixtures optional: ▪ mXL ▪ XRM² ▪ Utility fixture
Processes	▪ TEM: grids, chunks, thinning of lamellas ▪ Failure Analysis and SEM-Inspection: box milling, line cutting, multiple forms and amounts, ramps ▪ X-Ray Microscopy and APT: grids, chunks, custom shapes, pillars ▪ Patterning: custom shapes
Laser unit	▪ Integrated pulsed DPSS laser source ▪ Galvanometer scanner ▪ Power measurement on sample level
Software	▪ Software driven workflows ▪ Recipe based process control ▪ Intuitive menu guided touch screen operation ▪ Multiple user concept by different user levels ▪ Integrated data and sample management
Safety	▪ Laser class 1 housing with integrated control panel ▪ Integrated exhaust system
Dimensions	▪ Desktop system: 980 x 700 x 759 mm³ (L x W x H), approx. 200 kg
Consumables	▪ Compressed air or inert gases: up to 250 l/min (max. 6 - 10 bar)
Electrical connection	▪ 230 V, 50/60 Hz, 8 A ▪ 110 V, 50/60 Hz, 16 A

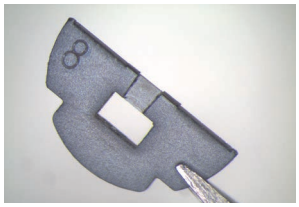
microPREP™ 2.0 - Process Flows

1. In-Plane Geometries and Bulk Samples

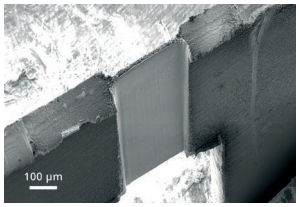
For investigation of bulk-samples by transmission electron microscopy (TEM), microPREP™ offers an unique three-stage approach, including laser-cutting of a monolithic basic structure from a feedstock followed by subsequent laser-thinning to a few micron thickness and final thinning to electron transparency using either a broad ion beam (BIB) or a focused ion beam (FIB), while offering up to 10,000 times higher ablation rates and an order of magnitude lower cost of ownership compared to FIB.



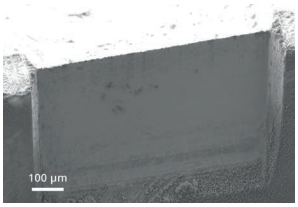
Examples of Application



Basic structure cut and thinned (Photovoltaic Si-Wafer)



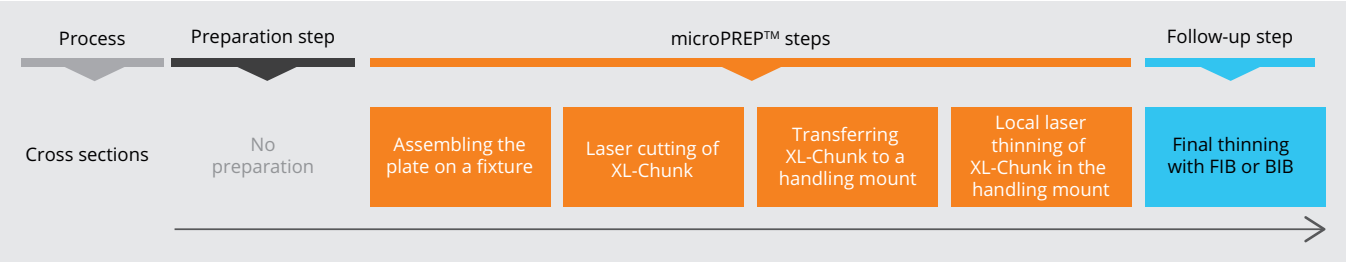
SEM micrograph of a basic structure in copper after local thinning in an open-box manner



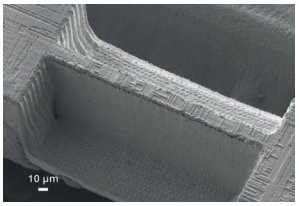
SEM micrograph of a basic structure in a Si-Wafer thinned to < 15 µm thickness (width of 1 mm)

2. Cross Sections (XL-Chunk™)

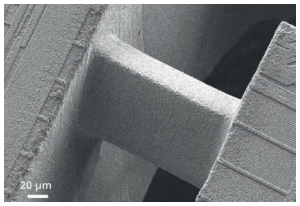
In order to enable TEM-inspection of cross-sections, microPREP™ enables „push-the-button"-preparation of site-specific XL-Chunks™ by excavating and undercutting a well-defined volume from an arbitrary but flat sample surface. To further reduce FIB-capacity, XL-Chunks™ can be laser-thinned automatically to a few micron thicknesses at a region of interest according to customer's needs, while providing order of magnitude time and cost savings compared to traditional sample preparation methods.



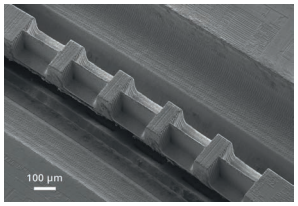
Examples of Application



SEM micrograph of the thinned area of an XL-Chunk™ prepared from an IC-sample



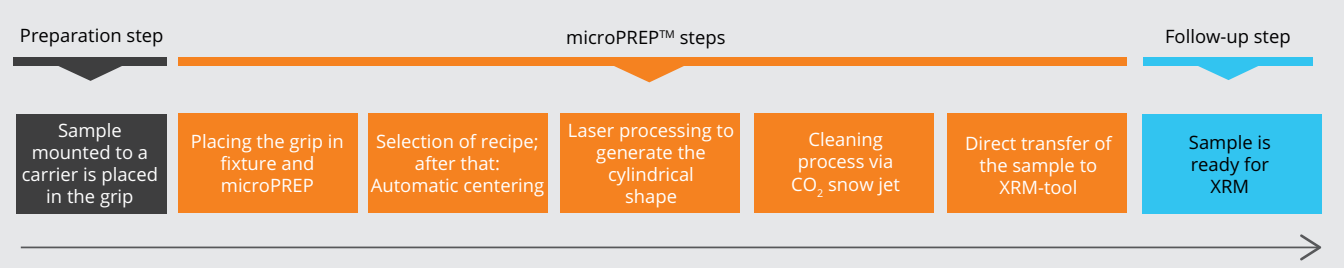
SEM micrograph of the supporting structure of an XL-Chunk™



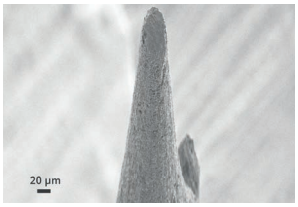
SEM micrograph of an XL-Chunk™ prepared from an IC-sample which has been thinned at multiple positions

3. X-Ray Microscopy

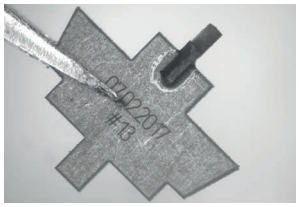
For non-destructive 3D-characterization using high resolution X-ray microscopy (XRM), samples of rotational symmetry with some 10 µm diameter are indispencible. While conventional FIB-micromachining would take days or weeks to prepare suitable sample, laser-micromachining of the same geometry using microPREP™ takes less than 5 minutes.



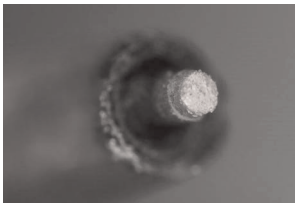
Examples of Application



SEM micrograph of an XRM-pillar in oil-shale



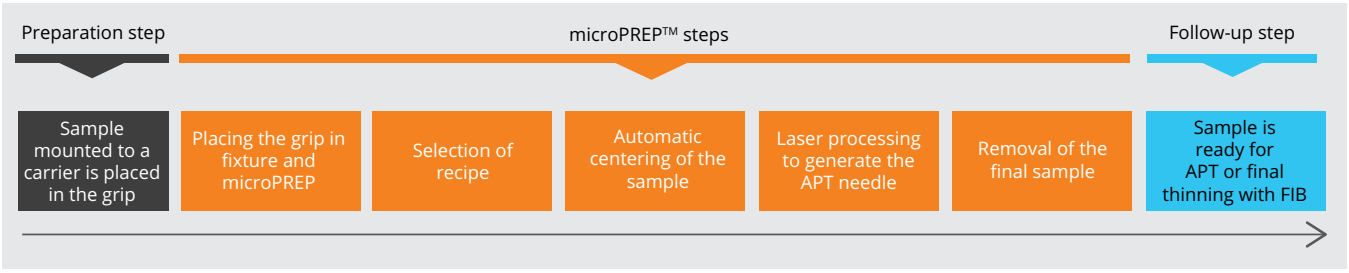
XL-Chunk™ for XRM mounted on a carrier structure



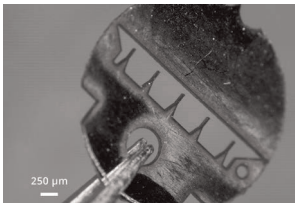
Effect pigments in a varnish mounted to a steel needle

4. APT Microscopy

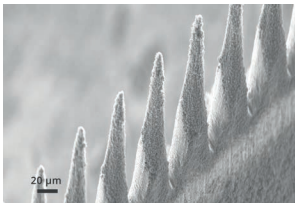
In order to improve sample preparation for atom-probe tomography (APT), microPREP™ enables side-specific cutting of dedicated APT-sample geometries and subsequent sharpening of tips to less than 15 µm diameter. Thus, microPREP™ not only helps to reduce FIB-capacity, but also improves yield and throughput for APT-measurements.



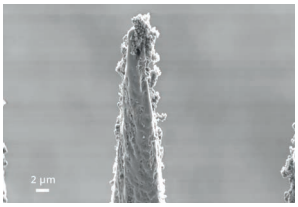
Examples of Application



Custom shape cut from stainless steel



SEM micrograph of a pillar array in silicon



SEM micrograph of an individual pillar in silicon (diameter < 5 µm)

Overview Sample Fixtures

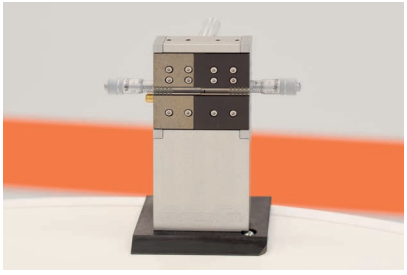
Fixture	Applications	Benefits
Cutting	▪ Sample structures for TEM ▪ Micro mechanics sample	▪ Samples up to 1 mm thickness ▪ Samples up to 25 x 25 mm²
Thinning	▪ In-plane samples ▪ Chunk samples ▪ Bulk samples	▪ Free selection and positioning of processing area ▪ Clamping force adjustable ▪ Supports any standard grids with and without notch

XL-Chunk	▪ X-sections in arbitrary samples
	▪ Bulk samples (chunks) for TEM and XRM
		▪ Supporting any standard 1" and ½" mount
		▪ Manual movable mount position for centering
		  ▪ Mount X/Y travel range 25 x 25 mm²
		  ▪ Mount rotation ± 10 °

mXL	▪ X-sections in arbitrary samples
	▪ Bulk samples (chunks) for TEM and XRM
		▪ Supporting any standard 1" and ½" mount
		▪ Automated mount position for centering and processing for multiple applications
		  ▪ Mount X/Y travel range 40 x 25 mm
		  ▪ Mount rotation 360°
		  ▪ Repeatability up to 0.5 µm

XRM²	▪ 3D structures for grids, bulk samples (chunks) for XRM and APT	▪ Supports ZEISS Xradia Ultra grips
		▪ Automated grip and sample positioning for real centric 3D shaping
		  ▪ Grip X/Y travel range ± 7.5mm
		  ▪ Grip rotation 360°

Utility	▪ Processing of custom shapes	▪ Sample size up to 50 x 50 mm² ▪ Positioning via fixing clamps ▪ Data import of customized shapes



3D-Micromac AG

Technologie-Campus 8
D-09126 Chemnitz
Germany

Phone: +49 371 40043 0
Fax: +49 371 40043 40
E-Mail: sales@3d-micromac.com
Web: www.3d-micromac.com

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