microPREP™

High-Throughput Laser Based Microdiagnostics Sample Preparation

3D-Micromac's microPREP™ is the first instrument to enable fast, clean, and efficient laser ablation available for the preparation of samples for microstructure diagnostics and failure analysis.

microPREP™ provides key benefits of micromachining using ultrashort pulsed lasers, particularly low structural damage, high power densities and targeted precision on the micron scale. Thus microPREP™ is up for laser cutting and local laser thinning in semiconductors, metals, ceramics, as well as compounds.
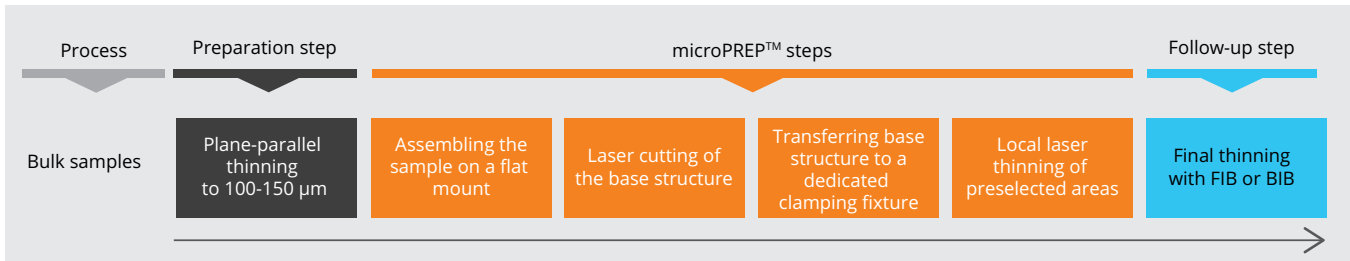
microPREP™ offers:

- Shorter time to sample: up to 10,000 times faster than FIB
- Analysis-adopted sample geometry
- Minimized risk of sample loss
- Recipe-driven GUI for sample geometries and materials
- Reduced FIB capacity requirements
- Enhanced efficiency of existing (TEM) analysis tools
- Custom recipes and fixtures on request
- Meets the essential requirements of the SEMI S2/S8

microPREP™ - Process Flows

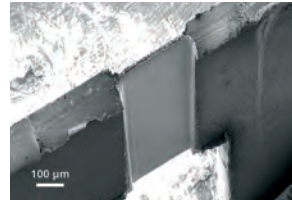## 1. In-Plane Geometries and Bulk Samples (Cutting/Thinning)

For investigation of bulk-samples by transmission electron microscopy (TEM), microPREP™ offers an unique three-stage approach. This includes 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.

| Process	Preparation step	microPREP™ steps				Follow-up step
Bulk samples	Plane-parallel thinning to 100-150 µm	Assembling the sample on a flat mount	Laser cutting of the base structure	Transferring base structure to a dedicated clamping fixture	Local laser thinning of preselected areas	Final thinning with FIB or BIB

Examples of Application

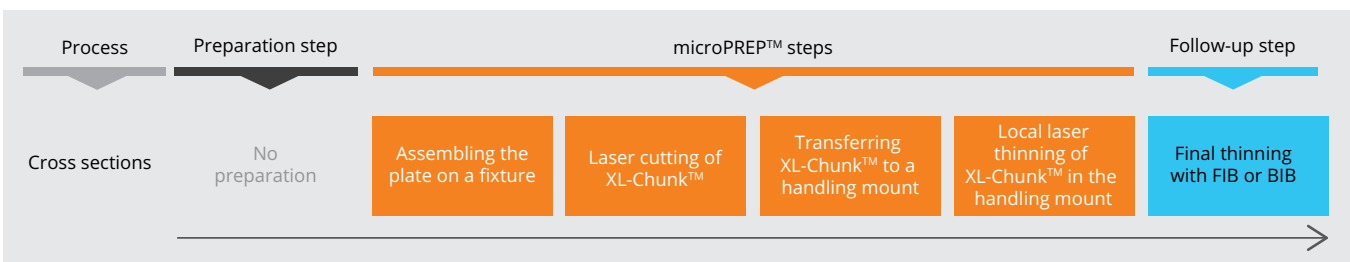Basic structure cut and thinned (Photovoltaic Si-Wafer)

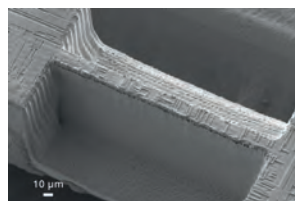SEM micrograph of a basic structure in copper after local thinning in an open-box manner
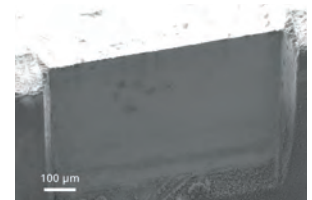
SEM micrograph of a basic structure in a Si-Wafer thinned to < 15 µm thickness (width of 1 mm)

## 2. Cross Sections (XL-Chunk™)

In order to achieve 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.

| Process	Preparation step	microPREP™ steps				Follow-up step
Cross sections	No preparation	Assembling the plate on a fixture	Laser cutting of XL-Chunk™	Transferring XL-Chunk™ to a handling mount	Local laser thinning of XL-Chunk™ in the handling mount	Final thinning with FIB or BIB

Examples of Application

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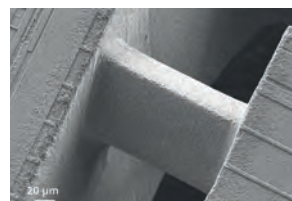
SEM micrograph of the supporting structure of an XL-Chunk™
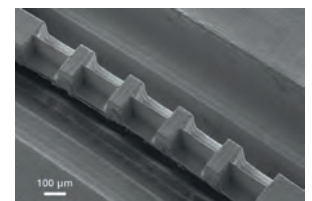
SEM micrograph of an XL-Chunk™ prepared from an IC-sample which has been thinned at multiple positions

System Description
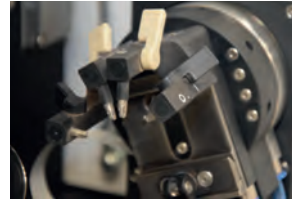
microPREP™ is suited for

- Fast sample preparation of semiconductors, metals, ceramics, and compounds
- High accuracy target preparation of ± 0.005 mm
- Marking for sample track and trace (DMC, QR code, plain text, etc.)
- Increasing the workflow throughput of FIB and broad ion beam tools
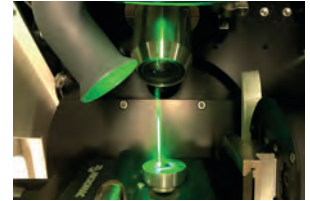- TEM, X-SEM, and micromechanical testing
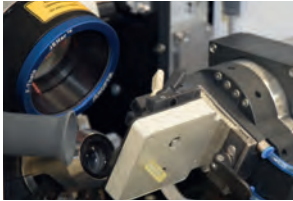
Working setup

Sample fixtures with dovetail guide

Air jet for particle removal while laser machining

In-plane sample preparation

Workpiece size	- Contour cutting: 25 x 25 x 0.1 - 1 mm³, volume samples on request (cutting fixture) - XL-Chunk™ isolation: 25 x 25 x 10 mm³ (x-y-theta fixture)
Alignment	- Manual work piece alignment with optical measurement system
Positioning	- Process accuracy ± 0.005 mm (XY) - Customized motion concept
Sample fixtures	- Thinning fixture with force setting, optional adjusted for each material and sample thickness - Contour/cutting fixture
Basic processes	- In-plane cutting - Laser thinning - XL-Chunk™ isolation (H-Bar, Z-Shape, and Pillar)
Laser unit	- Integrated pulsed DPSS laser source - Galvanometer scanner - Power measurement on sample level
Software	- Software guided workflows - Recipe based process control - Intuitive menu guided touch screen operation - Multiple user concept with different user levels - Integrated data and sample management
Safety	- Laser class 1 housing with integrated control panel - Integrated exhaust system
Dimensions	- Desktop system: 825 x 760 x 420 mm³ (L x W x H), approx. 135 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
Options	- Various sample fixtures for different tasks and analysis techniques (on request) - CAD-Import - Machine stand for stand-alone installation

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Changes in accordance to technical progress are reserved.