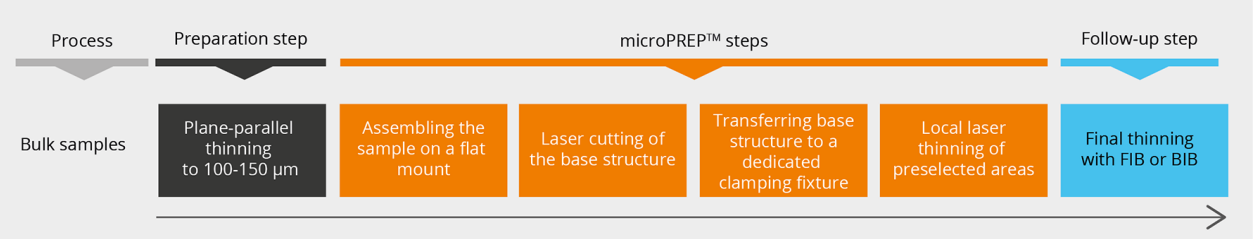
Laser-Based Sample Preparation for Microstructure Diagnostics

Laser micromachining opens up new vistas for targeted and high-throughput methods of microstructure diagnostics

Microstructure diagnostics and failure analyses are pivotal for the ongoing improvement of functional materials and sophisticated electronic components. Although lasers are well established tools and probes in manifold applications, they have been broadly ignored for use in sample preparation due to concerns regarding their potential for causing structural damage. Today, however, the use of ultrashort pulses and optimized processing routes is addressing these concerns and enabling laser processing to finally enter the scene – speeding up microstructure diagnostics and failure analysis as well as opening up access to deeply buried structures and large-area preparation.

Tradeoffs of Traditional Sample Prep Methods

There is an increased demand for preparation techniques tuned to manifold methods of microstructure diagnostics that need to be fast, reliable, cost effective, artifact-free and targeted. Traditional mechanical preparation and focused-ion-beam micromachining currently dominate the field. While the former is accompanied by high costs for skilled personnel, the latter is characterized by very high cost of ownership.

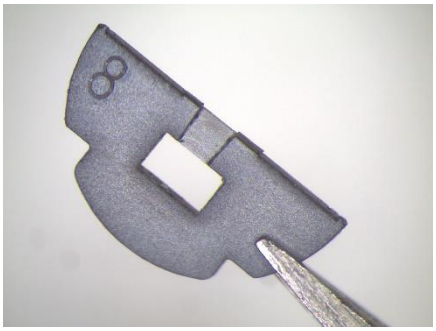


Process flow for in-plane geometries and bulk samples

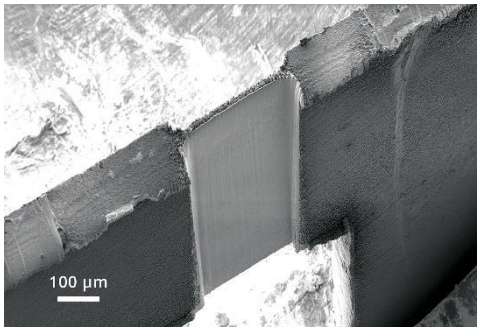
Laser-based preparation represents a very valuable alternative approach as shown below. Based on patented processing, 3D-Micromac's microPREP™ high-throughput sample preparation solution provides laser cutting of a base structure followed by local laser thinning in an almost entirely automated fashion. Making use of a rugged pulsed laser source, the process is characterized by very low running costs, suitability for semiconductors, metals, ceramics and compounds, and a very high targeted precision on the micron scale.

Unequaled Flexibility Helps Fulfill Manifold Demands

Using finely focused lasers as a tool for micromachining provides a wealth of flexibility. One can design and cut a supporting structure to exactly fit the needs for successive characterization of the microstructure (such as tips, bars, etc.). In addition, the second step of the laser-based preparation (the thinning of the supported structure) offers an unequaled choice of patterns to micromachine.



Basic structure cut and thinned with microPREP (Photovoltaic Si-Wafer)



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

Making use of this features allows the operator to exactly tune sample preparation to the requirement of microstructure diagnostics. Lined up with ion-beam thinning, electron transparent sections can be made at multiple positions of your choice, allowing for high-throughput screening of the microstructure. This feature is particularly valuable for gradient materials and if the homogeneity of a given microstructure needs to be evaluated.

Semi-Automated Processing

3D-Micromac's all-new microPREP™ workstation was developed to provide efficient laser micromachining fitted to the needs of microstructure diagnostics and failure diagnostics.

microPREP™ 1.1

The modular software design of microPREP™ ensures high flexibility for machining of samples for a broad range of microstructure diagnostics techniques. Besides the provision of recipes and the capability to mark samples for easy tracking, this novel approach features three orders of magnitude higher ablation rates in comparison to purely ion-beam-based processes.

microPREP™ 2.0

microPREP™ is suitable for transmission electron microscopy, X-ray microscopy (XRM), atom-probe tomography, transmission Kikuchi diffraction, and micromechanical testing. In addition to the microPREP 1.1 platform for small-scale and R&D applications, 3D-Micromac offers the microPREP 2.0 platform for high-volume sample preparation applications, which includes the ability to create complex and 3D-shaped

samples to enable more comprehensive analysis of certain structures in advanced packages, such as through silicon vias (TSVs), or even complete systems-in-package (SiP).

For more information, visit http://3d-micromac.com/laser-micromachining/products/microprep/.

Contact:

3D-Micromac AG

Technologie-Campus 8
09126 Chemnitz, Germany

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