nanores lab

the state-of-the-art independent laboratory of nanotechnology

About our work

We are a modern, independent research and development laboratory focused on providing the highest quality services and raising the standards of cooperation between science and business.

The Nanores Lab's staff is a team of engineers and scientists from various scientific fields who can be entrusted with research services, creating breakthrough solutions or seeking answers to pressing questions.

Aneta Zięba
scientific director
of the laboratory

- qualified staff of engineers and scientists
- opportunity to participate on-site and online
- research vouchers for time flexible projects, help with EU funding
- rapid order processing time
- IP Protection: including NDAs, restricted access, safe for valuable samples etc.

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Micro- and nano-
components production

Materials research

Materials research

Measurements of the topography and morphology of semiconductor structures like nanowires, heterostructures, distributed bragg reflectors, quantum wells, etc. based on Ultra High Resolution Scanning Electron Microscopy (SEM) combined with Energy Dispersive Spectroscopy (EDS) for elemental analysis and Focused Ion Beam (FIB) for analysis of cross section and Transmission Electron Microscopy (TEM) lamella preparation.

- **Quality Assurance:** These techniques allow for the inspection of semiconductor structures at a microscopic level, ensuring that the structures meet quality standards. Detecting defects or irregularities early in the process can prevent costly errors later on.
- **Failure Analysis:** In the event of a malfunction or failure, SEM, FIB, and EDS can be used to analyze the root cause.
- **Research and Development**: SEM, FIB, TEM and EDS are valuable tools for research and development in the semiconductor industry. They enable scientists and engineers to explore new materials, fabrication techniques, and device architectures, leading to innovation and advancement in the field.

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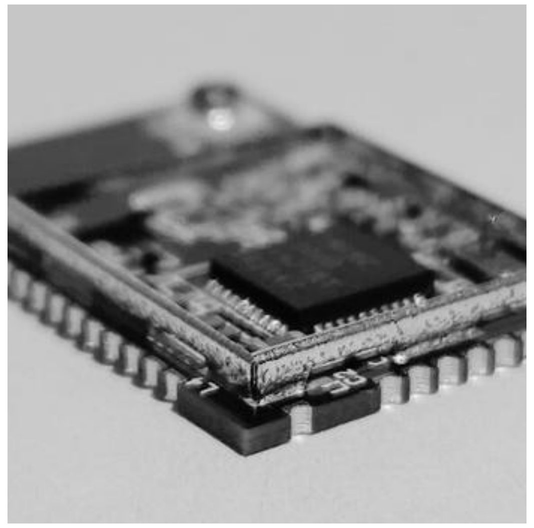
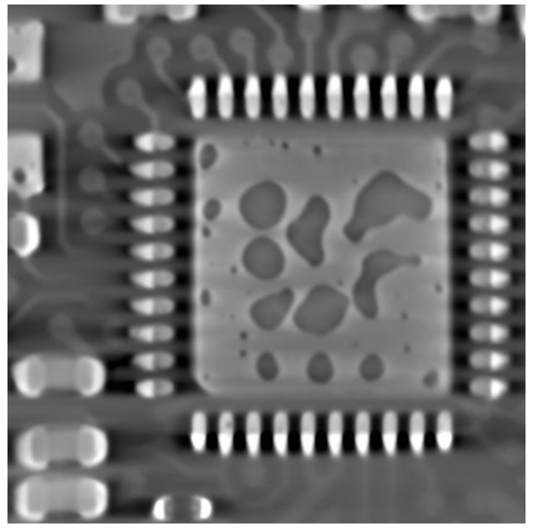
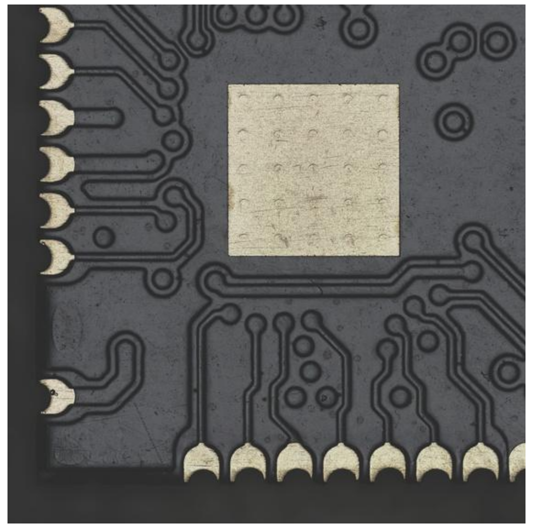


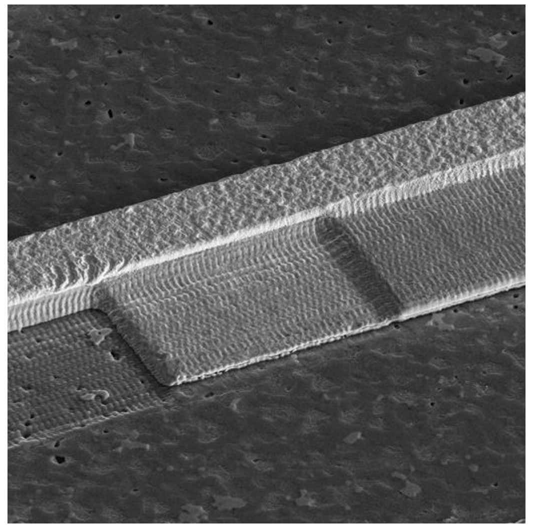
General inspection



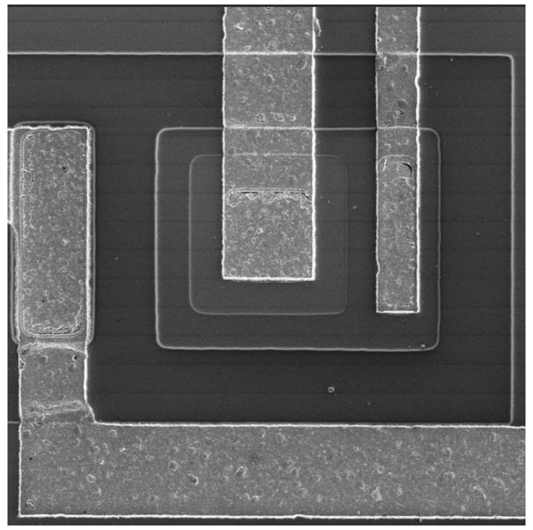
uCT scan



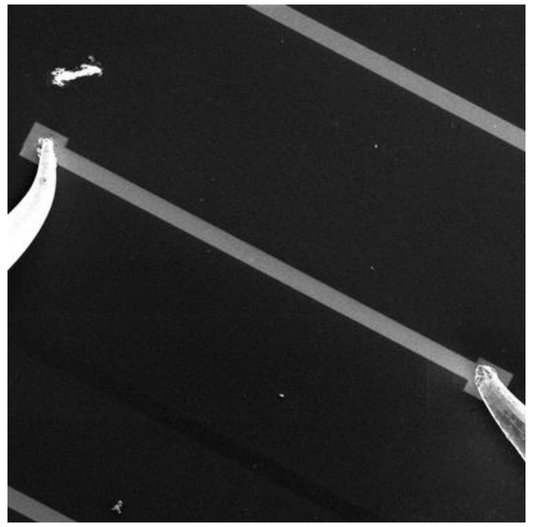
Confocal microscopy



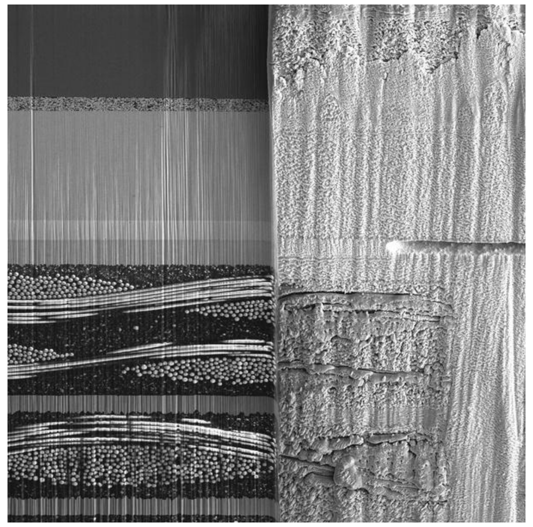
Laser delayering



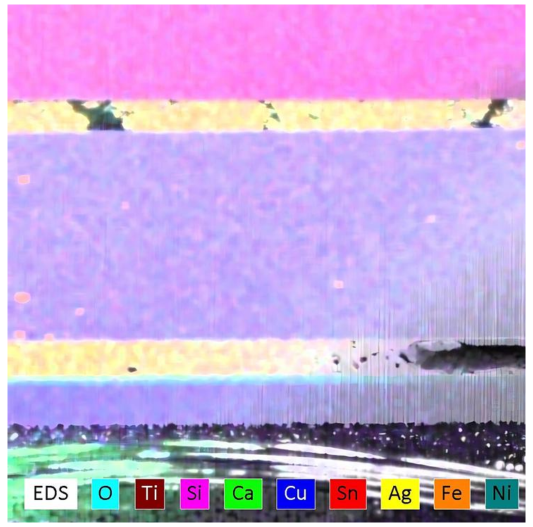
SEM observations



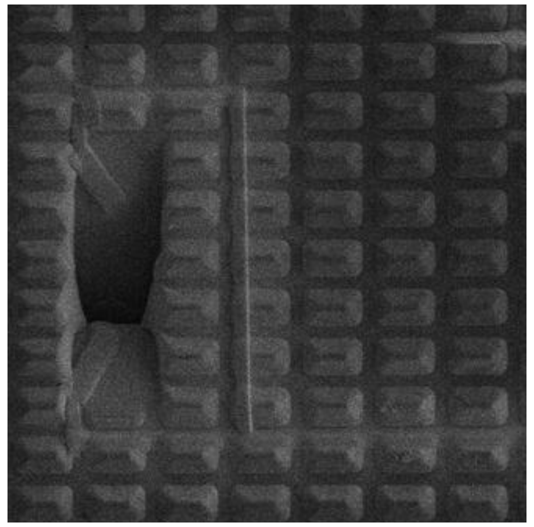
miBot™ nanoprobing



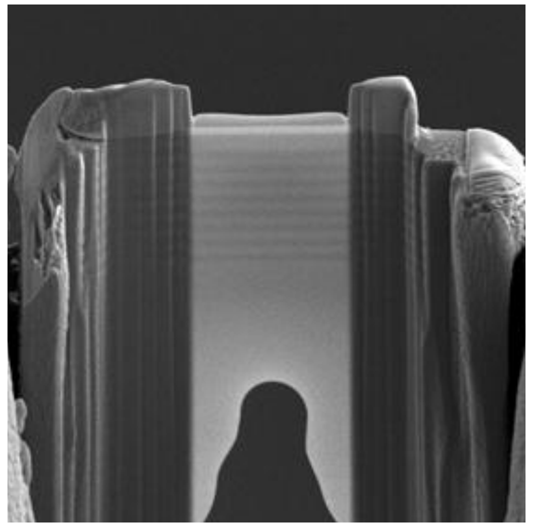
Laser & FIB cross-sections



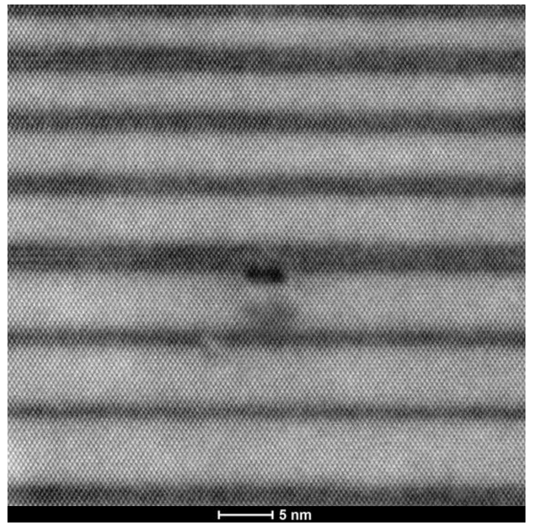
EDS



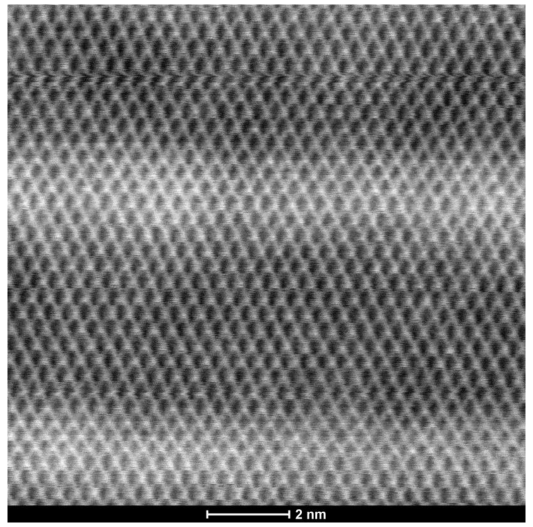
FIB circuit edit and FIBID



TEM lamellea preparation



TEM observations



UHR TEM observations

Cutting with a Focused Ion Beam Ga-FIB and Xe-PFIB

Focused Ion Beam (FIB) systems use a finely focused beam of ions to mill, cross-section, or modify materials with nanometer precision. They are indispensable in semiconductor manufacturing, failure analysis, and IC/MEMS research, where access to subsurface structures without mechanical polishing is critical. Plasma FIB (PFIB) is an evolution of this technique that replaces the conventional gallium ion source with a Xenon plasma source. This enables significantly higher ion currents and faster sputtering rates, making PFIB especially suitable for large-volume cross-sections and package-level investigations.

Using the method of delayering an IC Xe-PFIB is important due to its efficiency, precision, and minimal contamination. The high milling rates, combined with fine control and minimal damage, make Xe-PFIB an essential tool for detailed IC analysis.

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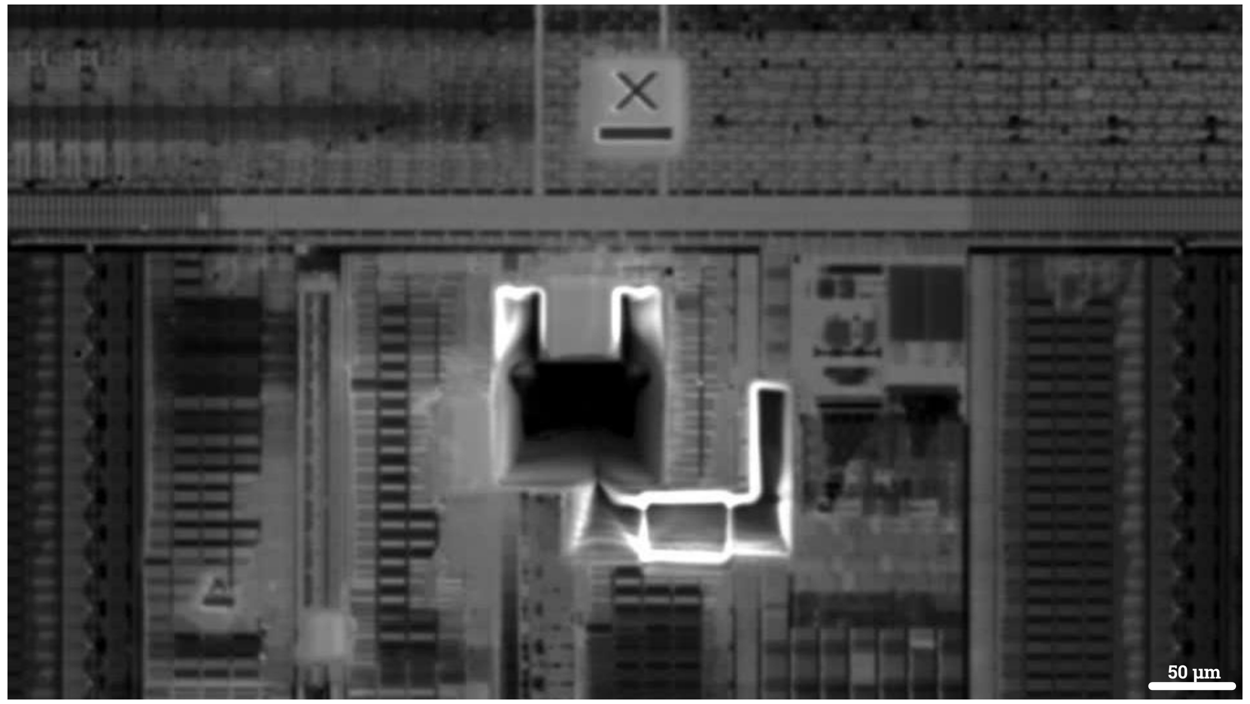

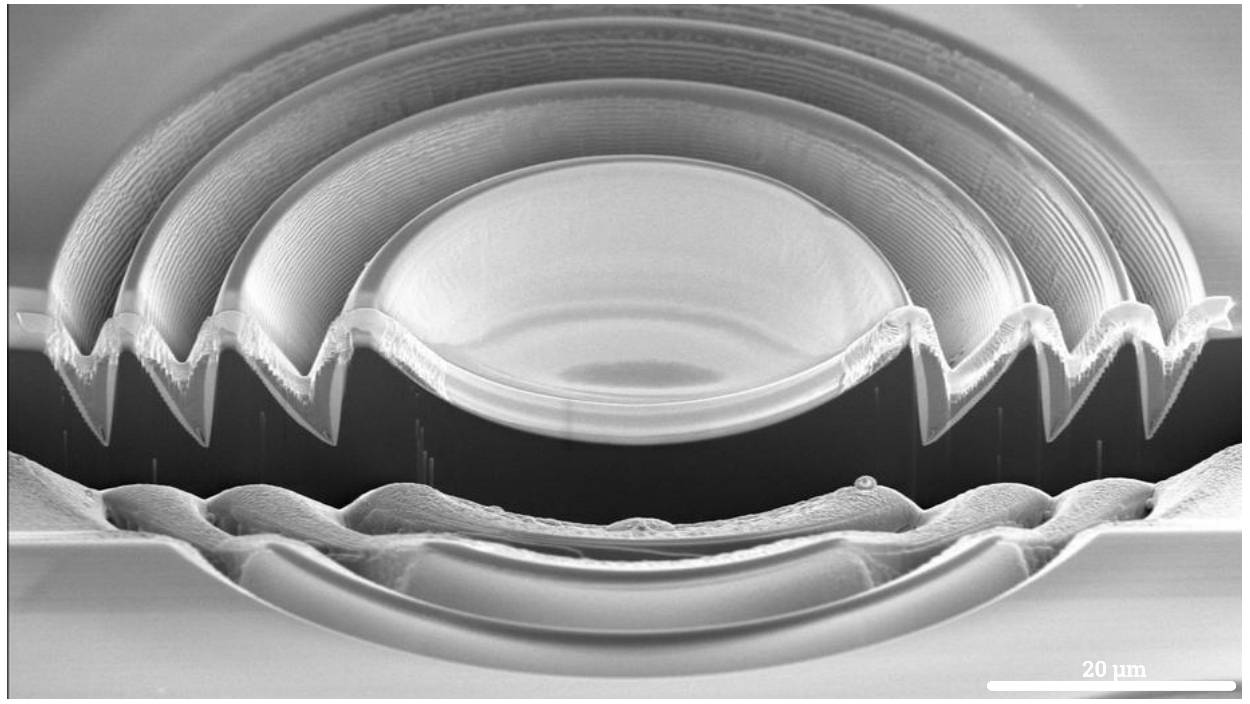

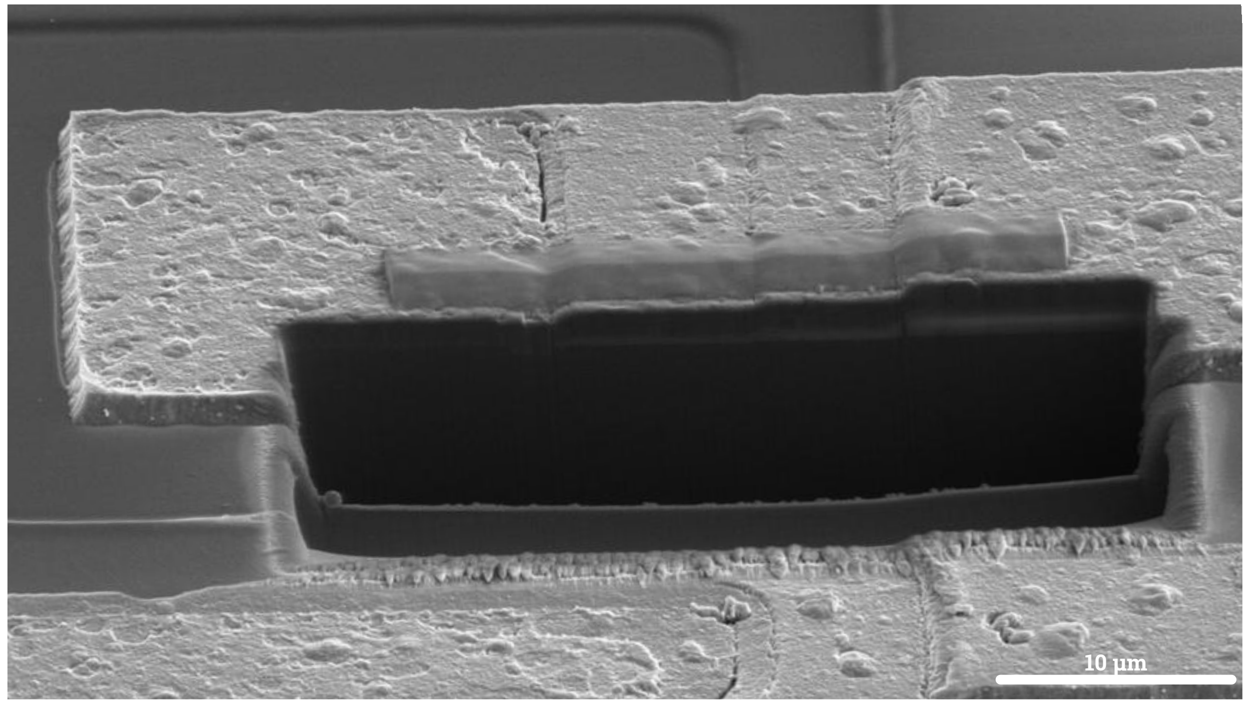

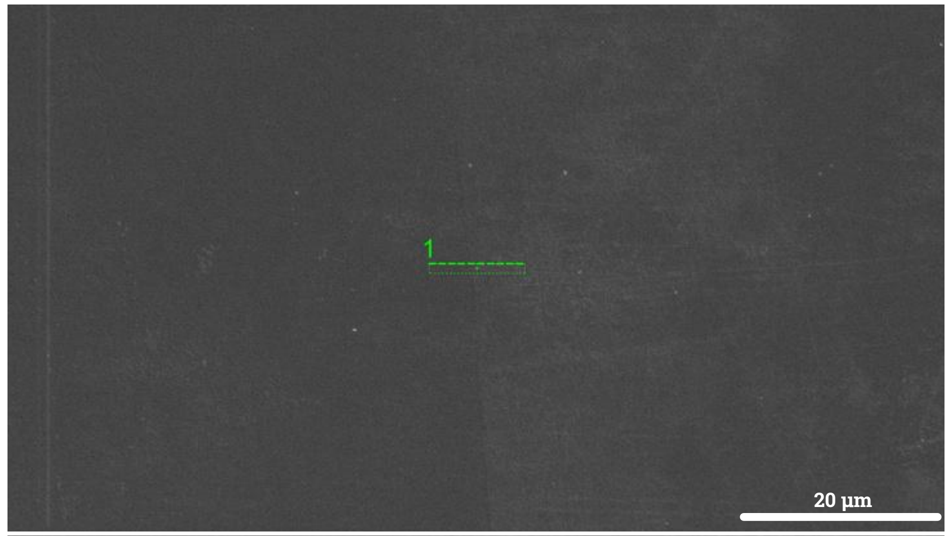

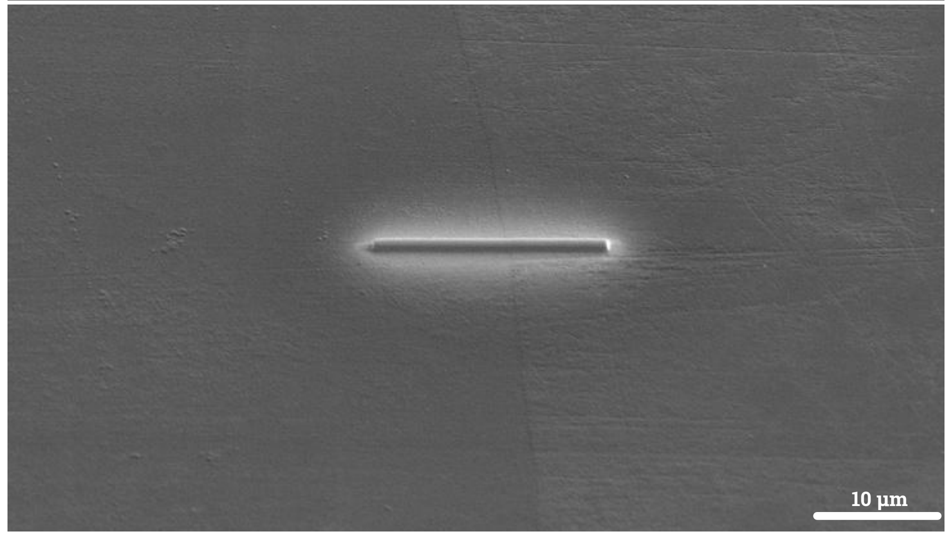

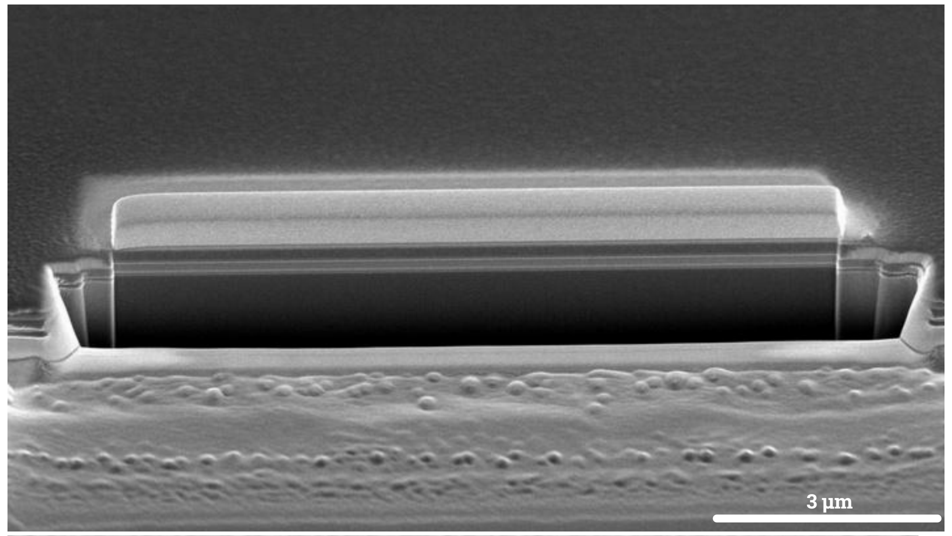

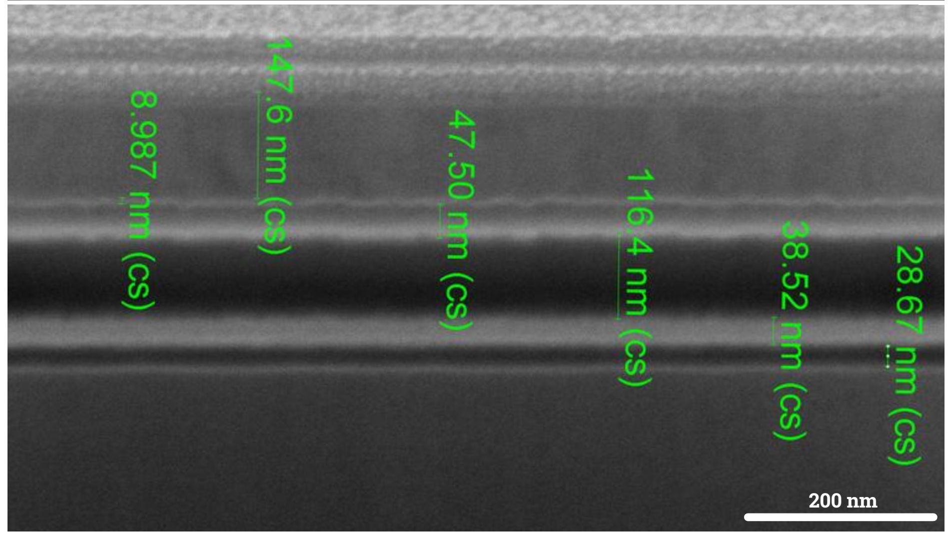

Cutting with femtosecond laser followed by polishing it with a Focused Ion Beam (FIB and PFIB)

The combined use of femtosecond laser ablation and FIB polishing for cross-sectioning ICs offers significant advantages in terms of speed, precision, and quality. This approach enables detailed and accurate analysis of ICs, facilitating failure analysis, quality control, and research and development in the semiconductor industry.

- Rapid Bulk Removal: The femtosecond laser quickly removes large volumes of material, significantly speeding up the cross-sectioning process compared to using FIB alone.
- Non-Thermal Laser Ablation: The femtosecond laser minimizes thermal damage to the surrounding material, preserving the integrity of the IC features near the cross-section.
- Precision Polishing: FIB provides the fine control needed for the final polishing steps, ensuring a high-quality cross-section suitable for detailed analysis.

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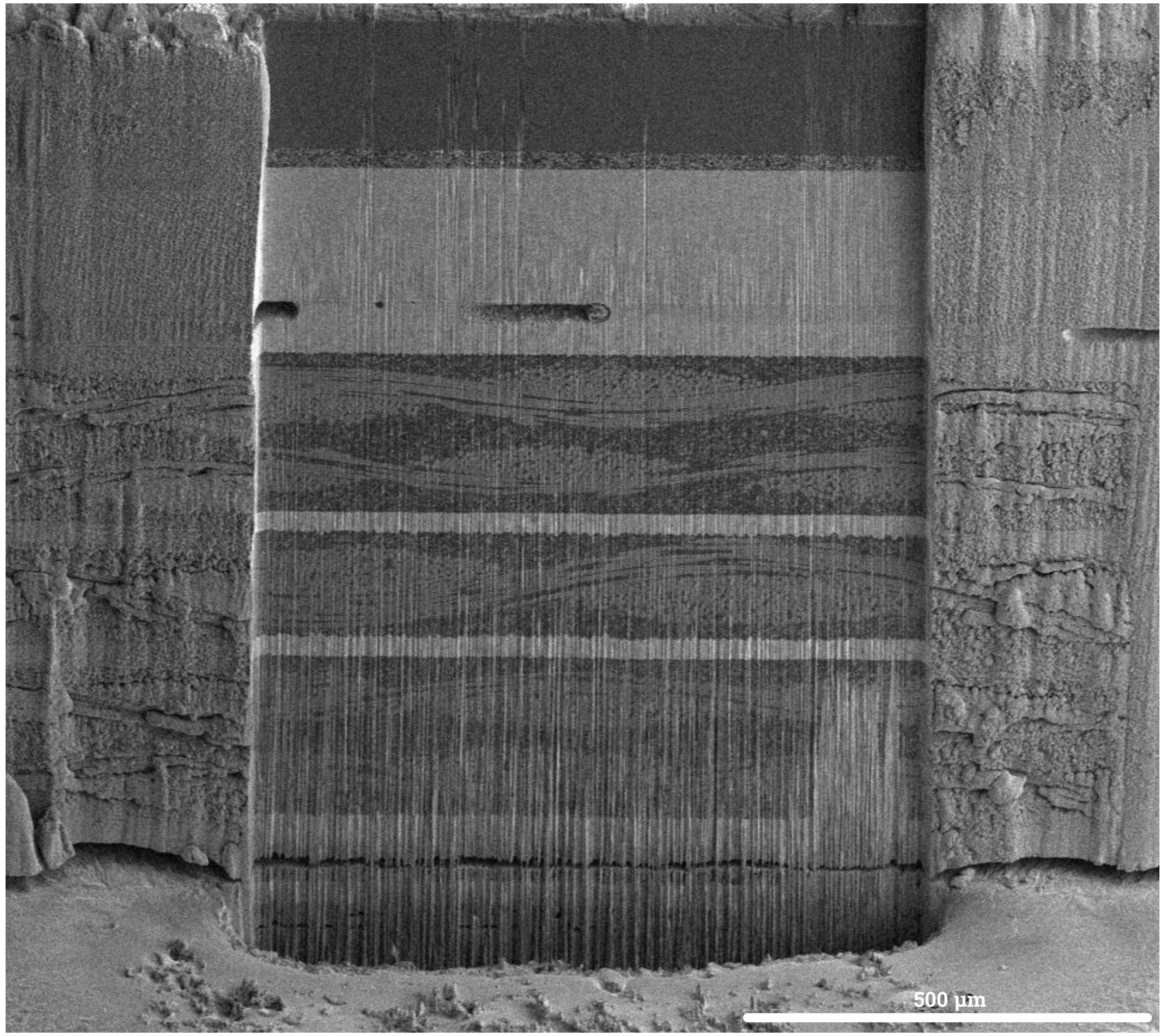

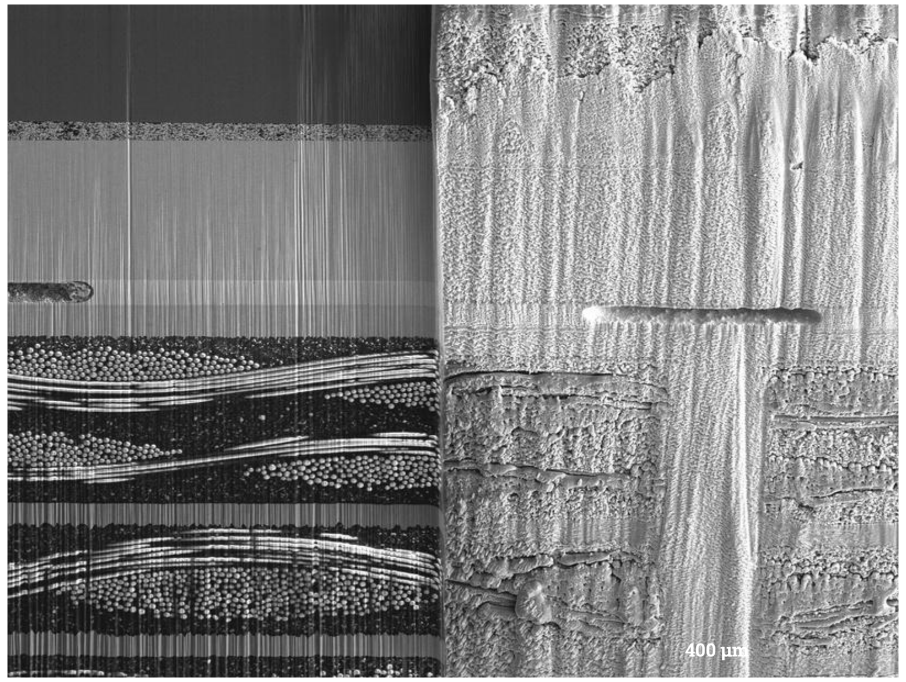

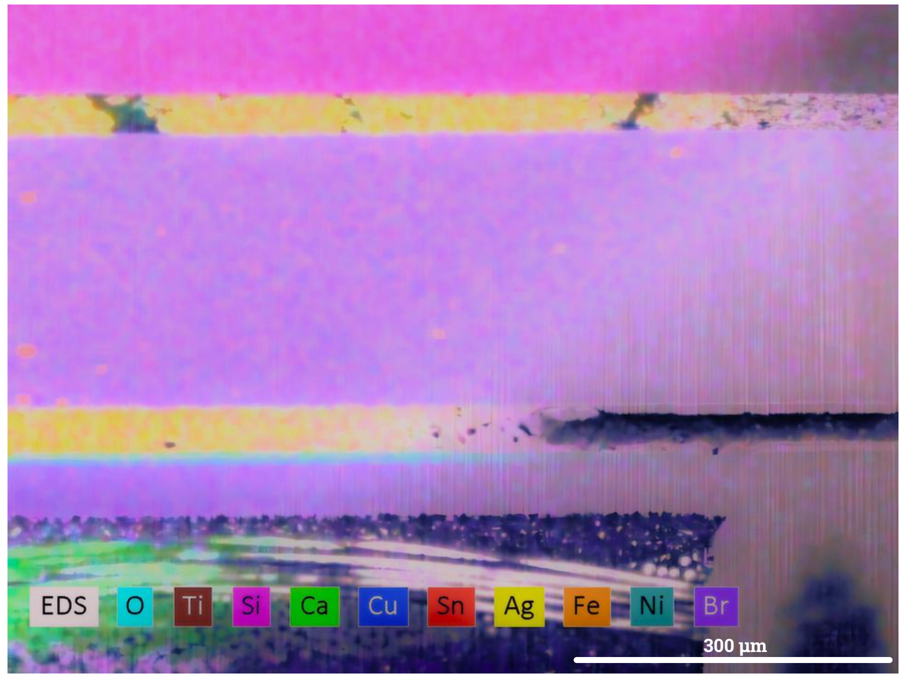

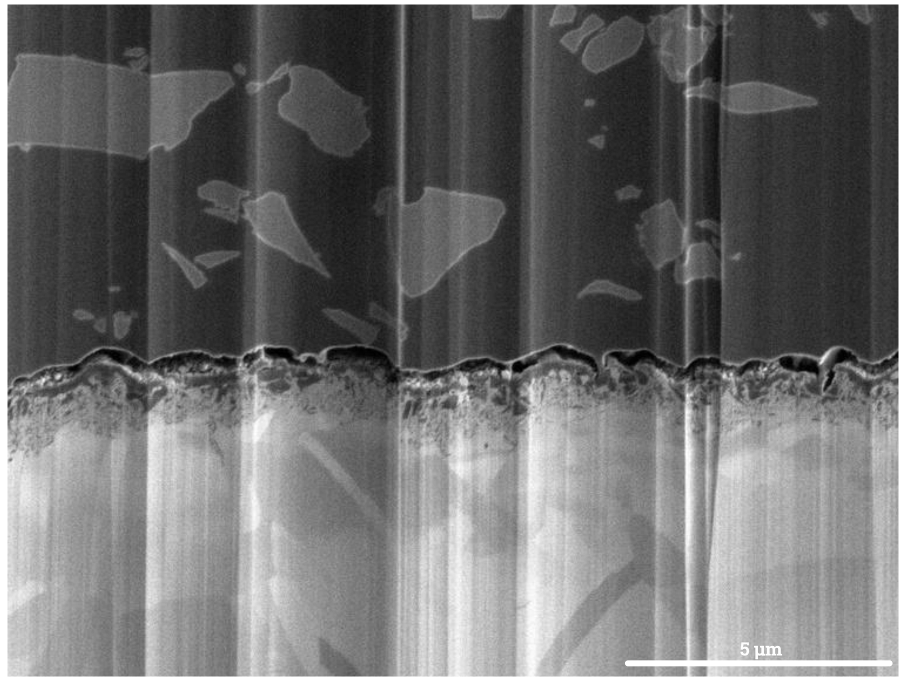

FIB circuit edit and rapid prototyping

IB circuit edit is a set of precision techniques that allows direct modifications on functional integrated circuits. Instead of committing to costly and time-consuming mask re-spins, engineers can cut, connect, reroute, and access signals with nanometer accuracy, validating design changes in a matter of hours.

- **Cutting Paths Across Layers.** Precise disconnection without a costly mask respin. FIB path cutting enables selective disconnection of signals at chosen metal or semiconductor levels, with nanometer accuracy. By working directly on the finished device, design hypotheses can be validated within hours instead of weeks, avoiding the expense and delay of new mask sets.

- **FIBID Platinum Path Connection.** Bridge, reroute, restore functionality. Through platinum deposition, FIB creates micro-bridges and new connections between nodes, even across complex topography. This provides stable conductive paths that allow engineers to reroute signals or repair open circuits with unmatched flexibility.

- **Surface Delayering.** Controlled access to covered device layers. FIB enables planar, layer-by-layer removal of metal and dielectric films. This method cleanly exposes specific layers, preparing sites for edits or inspection while preserving adjacent structures.

- **Probe Pad Creation.** Enabling electrical access where you need it. FIB can create or expose probe pads by removing dielectric layers and depositing conductive pathways to the surface, giving reliable access points for electrical probing and functional verification directly on wafer.

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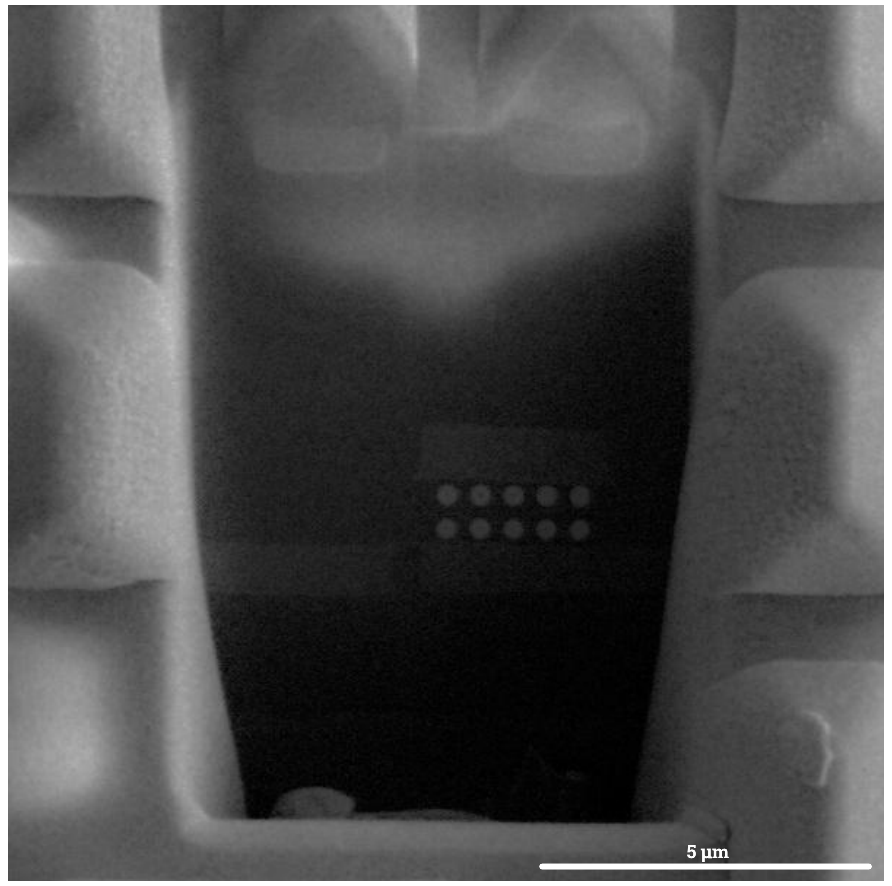
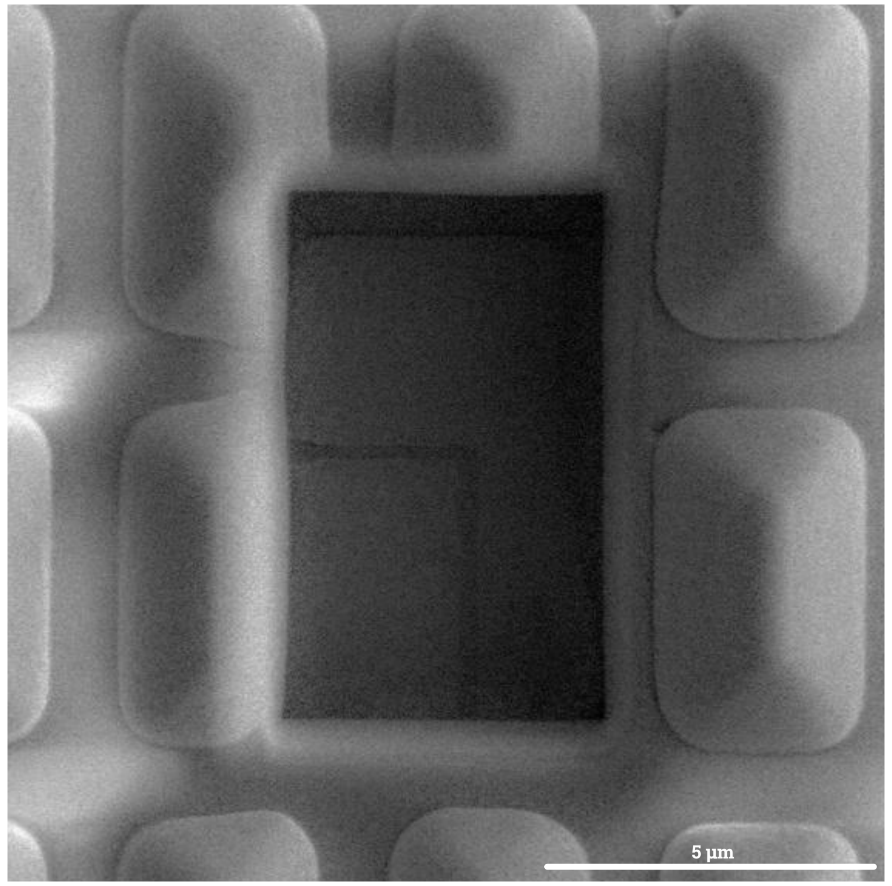
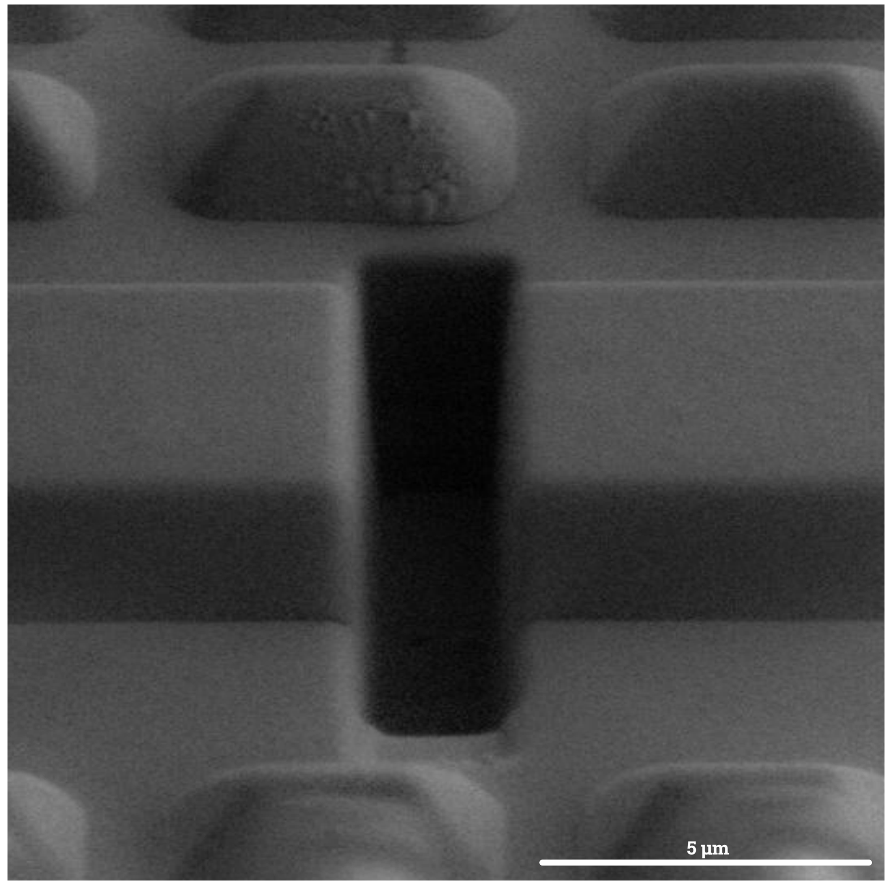


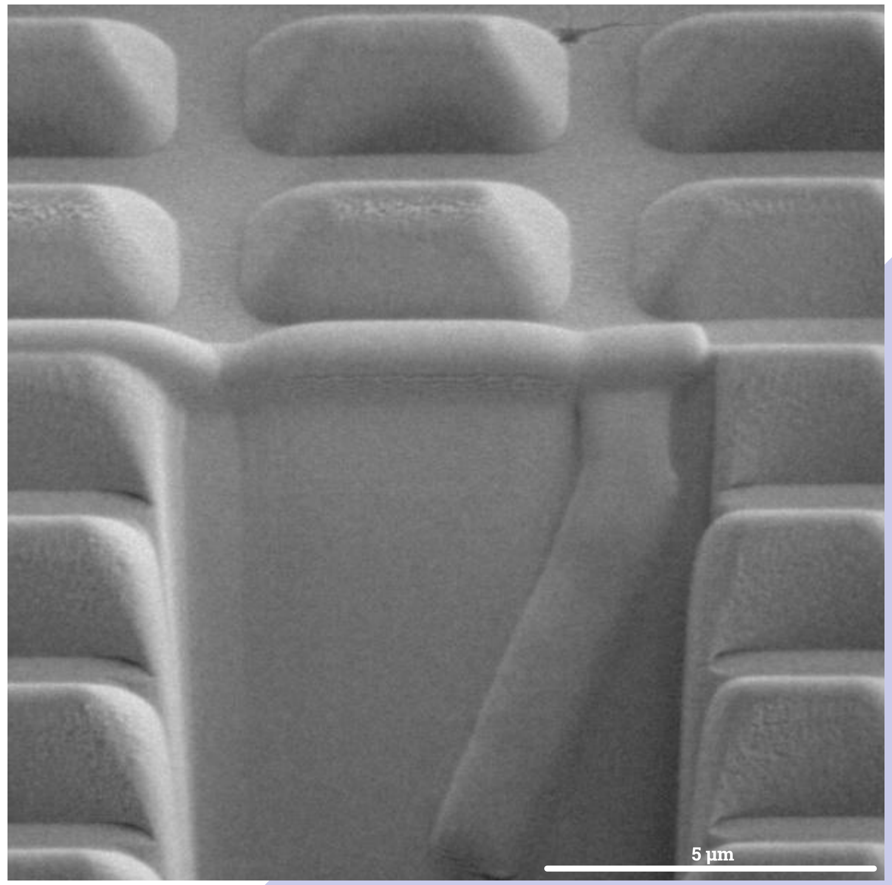
FIB Cutting Paths Across Layers



FIB Surface Delayering



FIB Cutting Across Paths



FIBID Platinum Path Connection

Advanced TEM Characterization of Lamellae

Transmission Electron Microscopy (TEM), along with Energy Dispersive Spectroscopy (EDS) and Selected Area Electron Diffraction (SAED), provides unparalleled insight into the properties of semiconductor lamellae. Our facility offers comprehensive sample preparation using both Gallium Focused Ion Beam (Ga-FIB) and Xenon Plasma Focused Ion Beam (Xe-PFIB) techniques, followed by Ultra-High Resolution Transmission Electron Microscopy (UHRTEM) analysis.

- UHRTEM allows for direct imaging of the internal structure of semiconductor materials at atomic resolution.
- Elemental Composition Energy Dispersive Spectroscopy (EDS) integrated with TEM enables precise elemental analysis by detecting X-ray emissions from the sample.
- Crystallographic Analysis Selected Area Electron Diffraction (SAED) is a tool for investigating the crystallographic structure of semiconductor lamellae.

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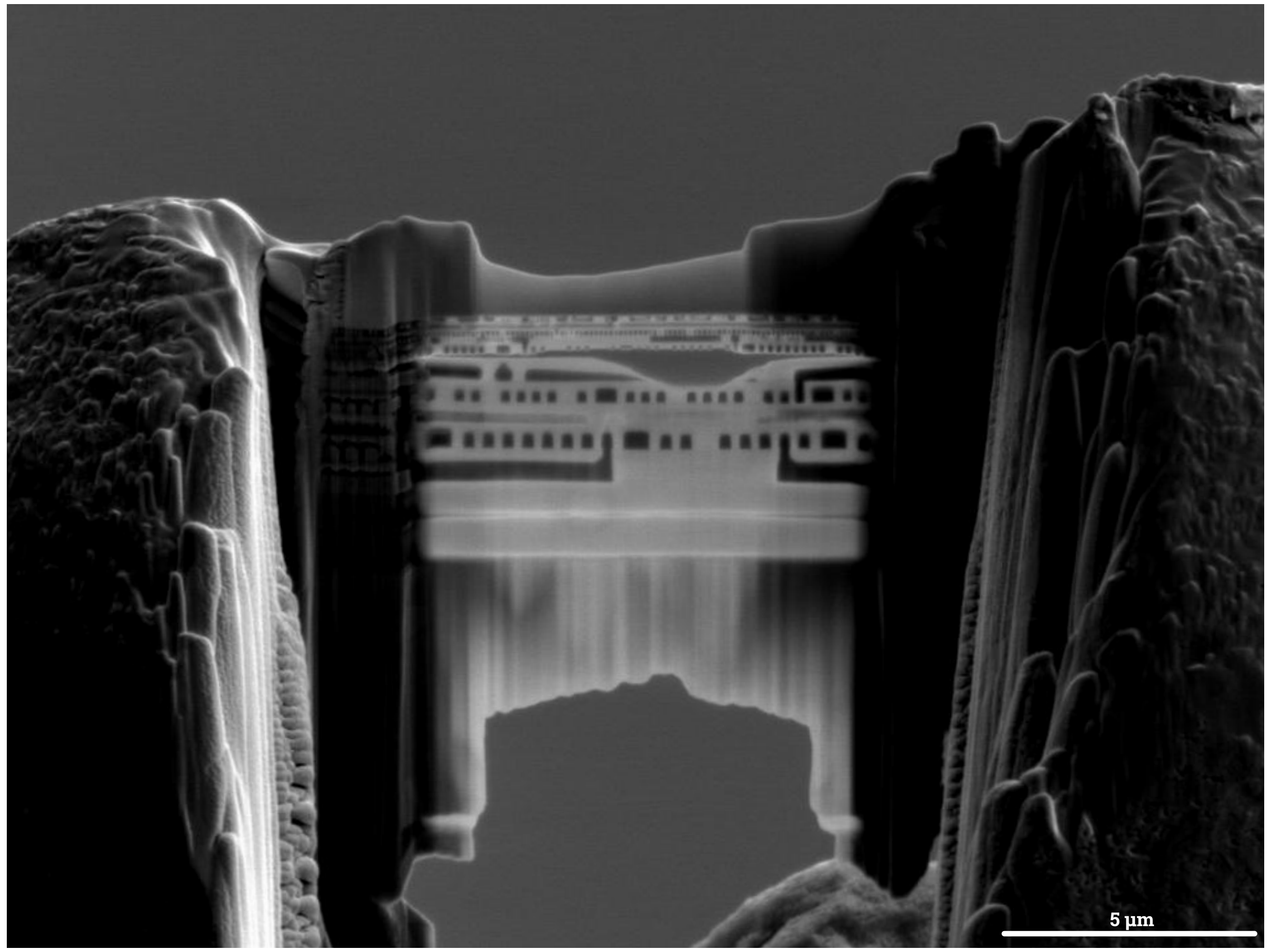

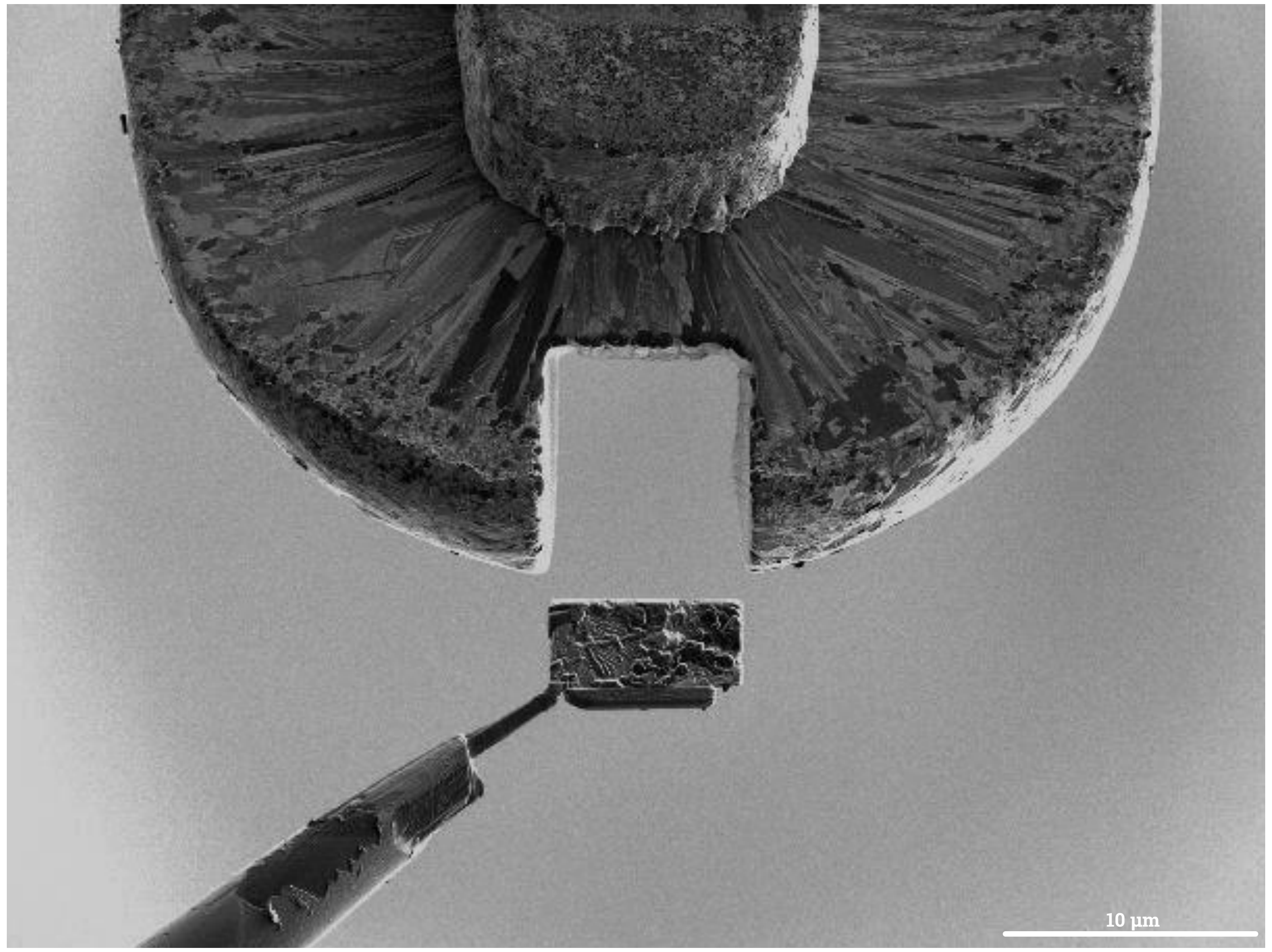

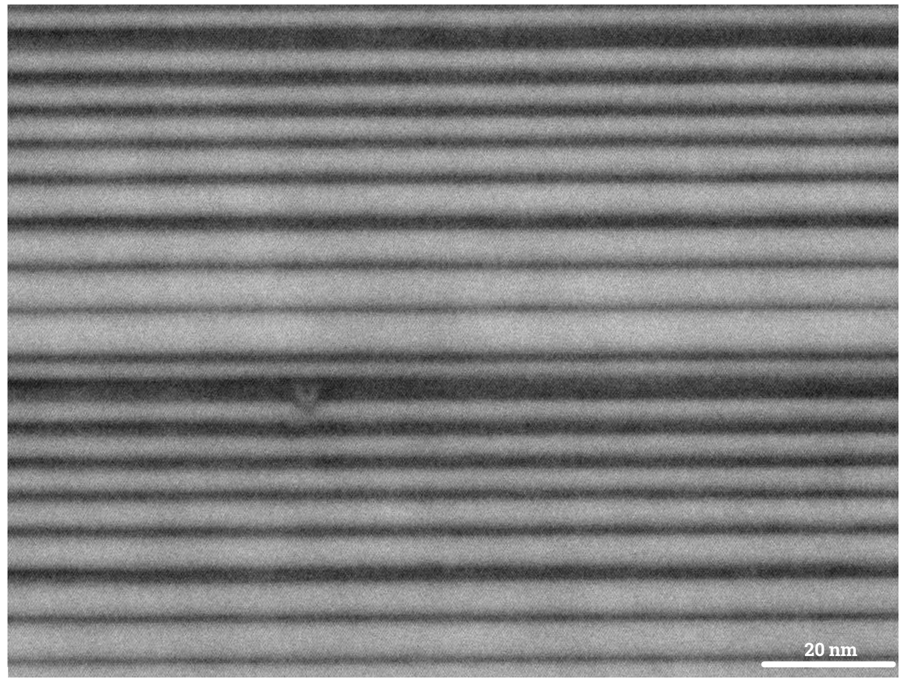

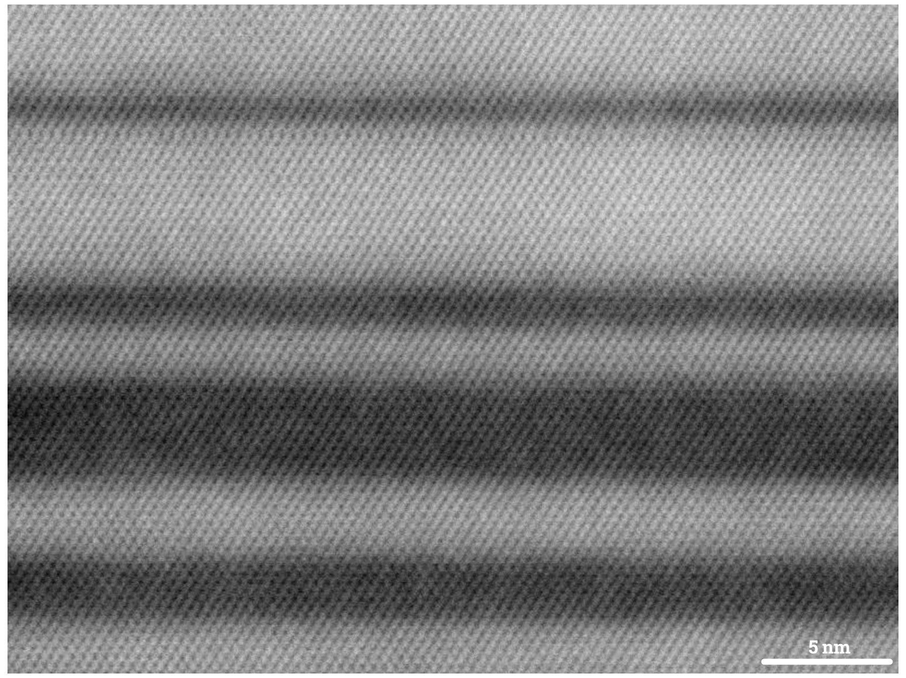

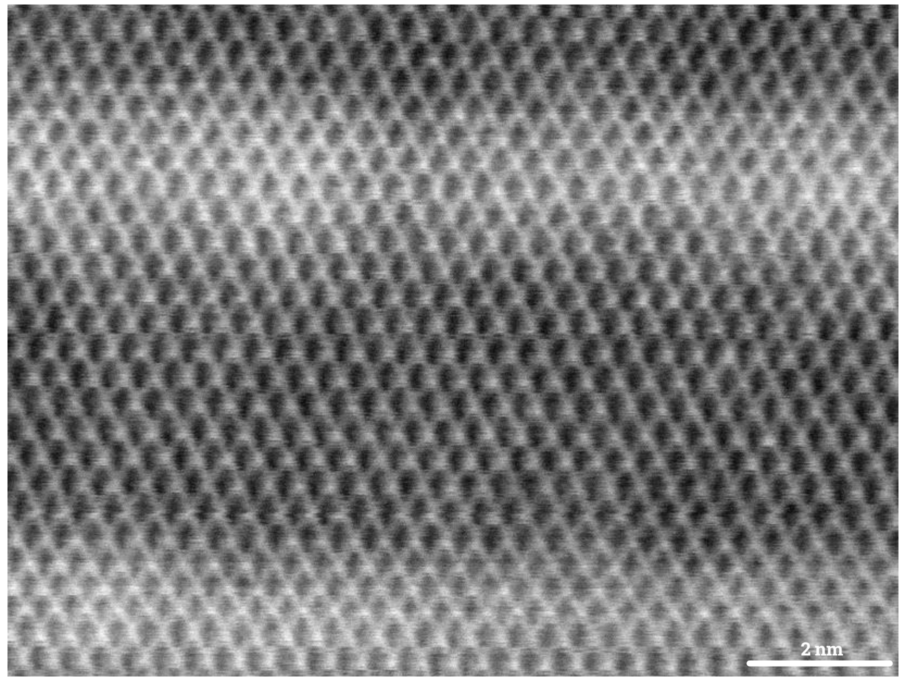

Prototyping

Our offer includes comprehensive services within the modification and production of micro- and nanocomponents, ensuring quality and precision tailored to the specific needs of our clients.

Our offer includes:

- **Modification of supplied components** - modification and processing of components or semi-finished products provided by the customer in accordance with the agreed specification and product quality.
- **Delivery of a finished component** – purchase of raw materials based on client's guidelines, modification and processing according to the agreed specifications and quality standards.

Currently, our monthly production capacity allows us to deliver thousands of various components. At the same time, we are conducting a project funded by a 3.5 million EUR grant awarded by the Polish Agency for Enterprise Development. The project aims to automate the production of micro- and nanocomponents, boosting the monthly production capacity per workstation by ten times.

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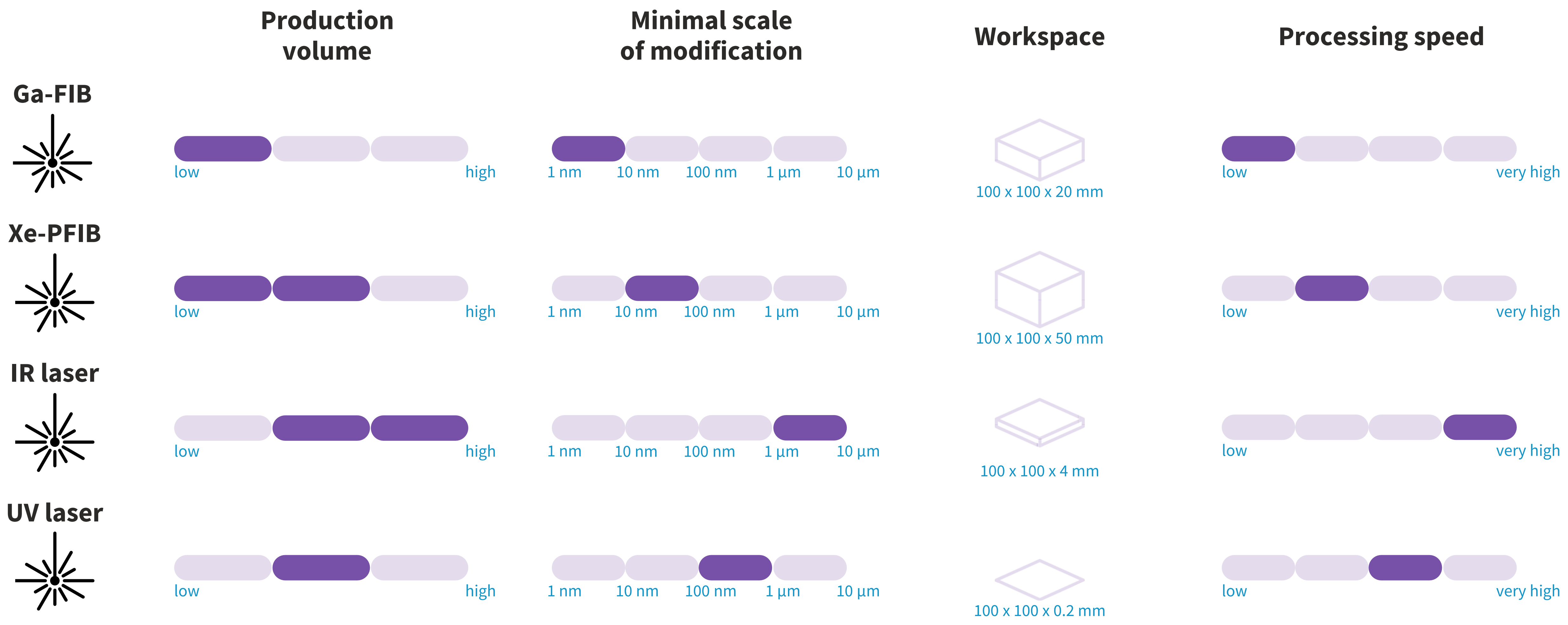
Micro- and nano-components production



Ga-FIB

Focused Gallium Ion Beam (Ga-FIB) is an advanced technique that uses a focused ion beam for precise modification and fabrication of structures at the nanometric scale. Unlike traditional laser or mechanical processing, the FIB method allows for extremely controlled material removal or deposition with greater accuracy.

- Ultra-high precision and resolution for fine milling and polishing — ideal for nanoscale features
- Optimized for small volumes: controlled, repeatable material removal with clean edges
- Best when surface quality matters more than speed

Production volume

low — high

Minimal scale of modification

1 nm — 10 nm — 100 nm — 1 µm — 10 µm

100 x 100 x 20 mm

Processing speed

low — very high

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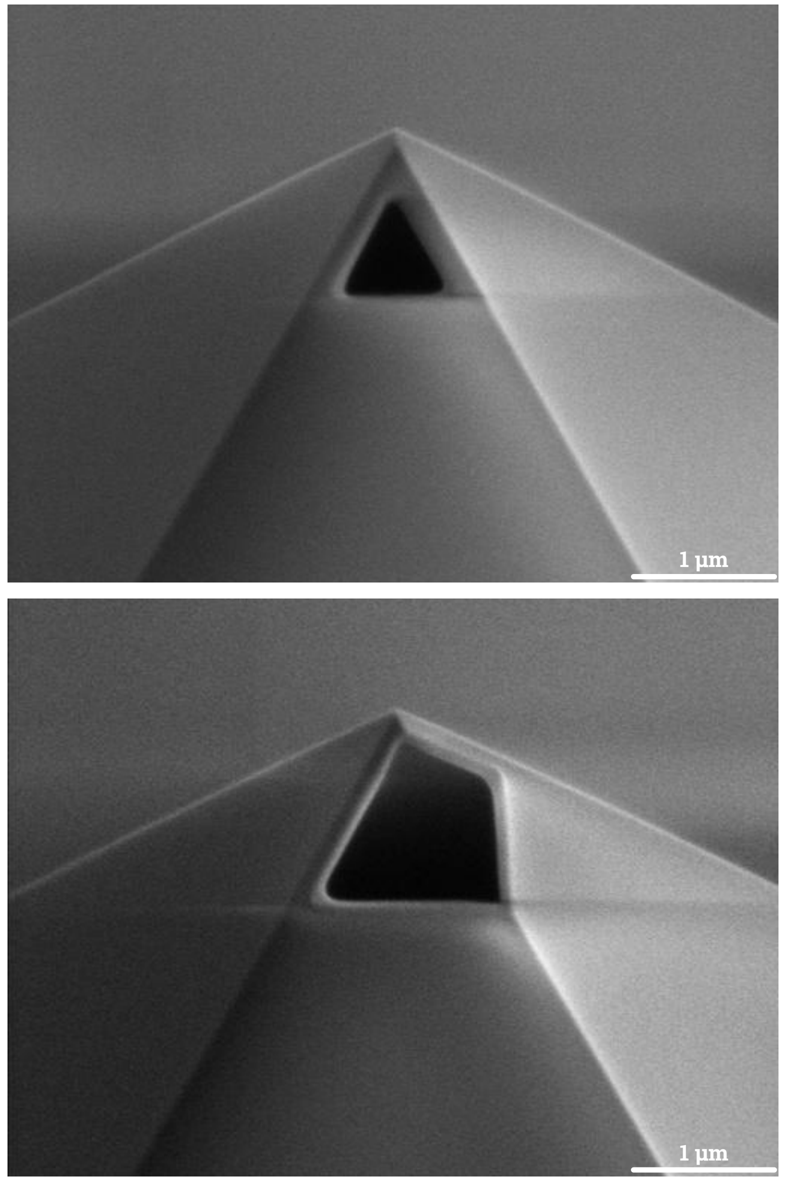
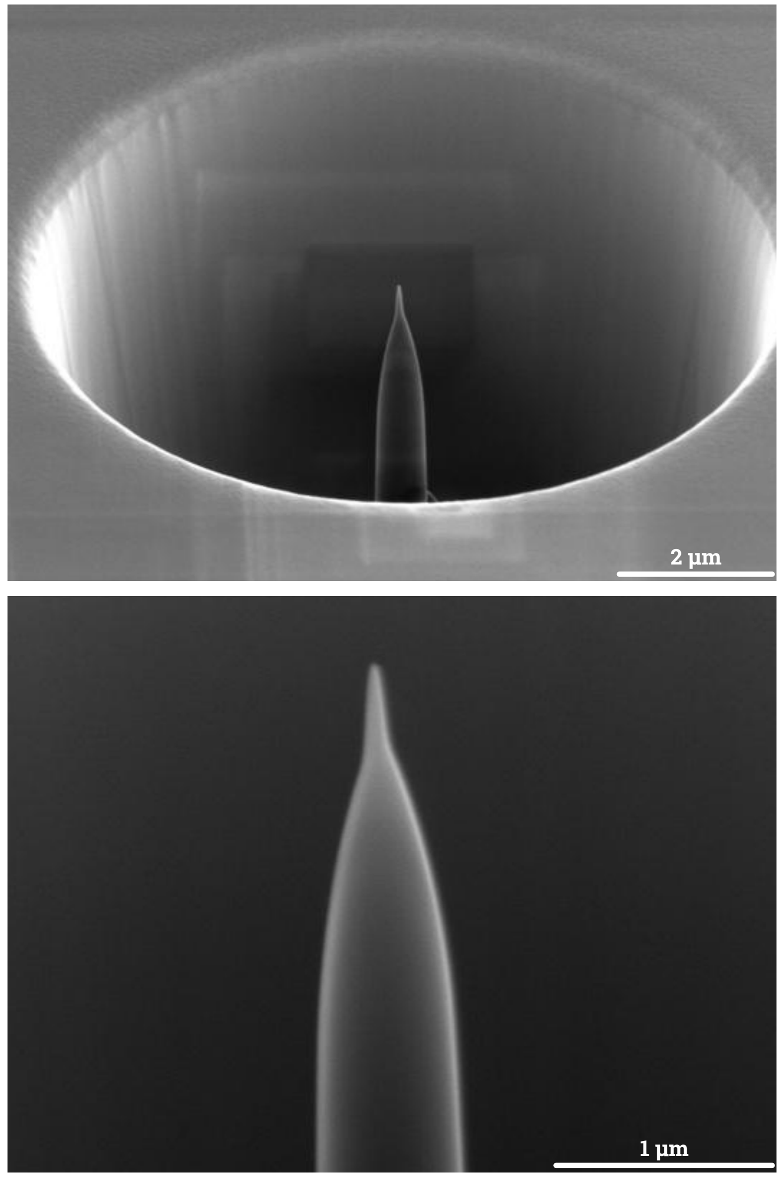


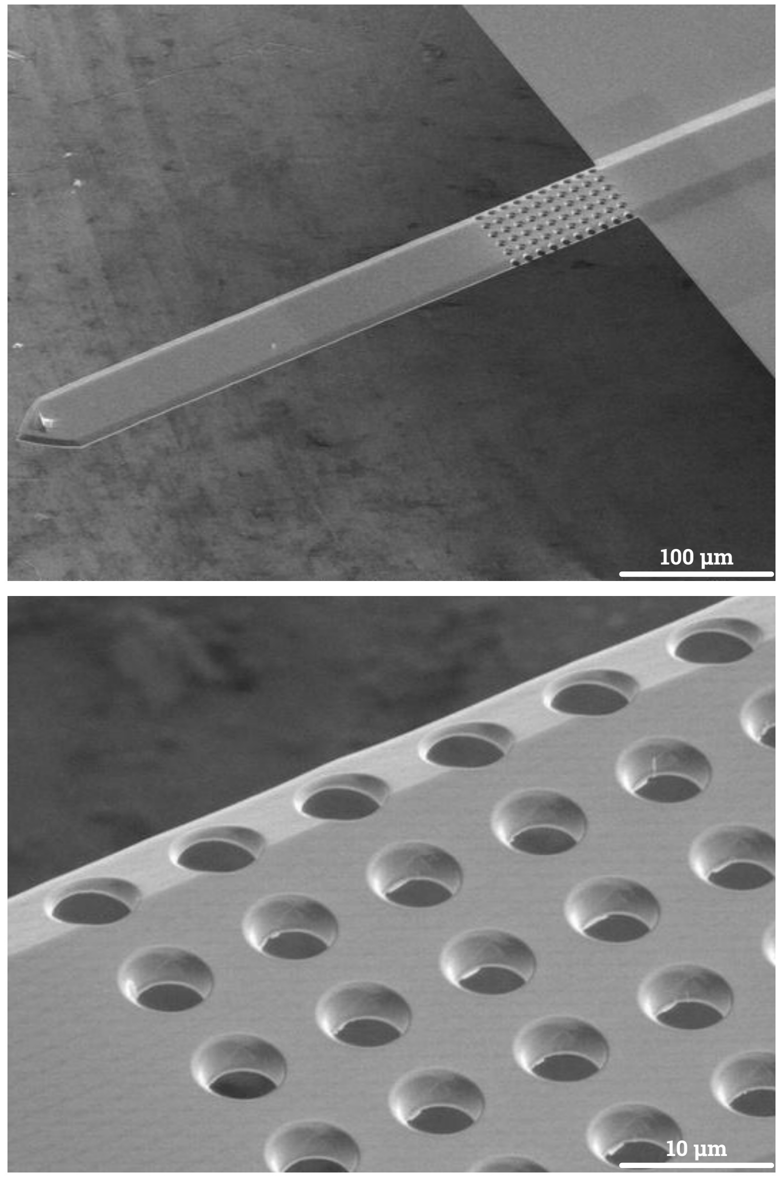
Material: Silicon nitride

Triangular aperture fabicated in a AFM cantilever tip for microfluidic applications



Material: Silicon

Fabrication of a field emitter using Ga-FIB method



Material: Silicon nitride

Ga-FIB modification of the AFM cantilever to change its stiffness

Xe-PFIB

Focused Xenon Plasma Beam (Xe-PFIB) enables faster work with materials such as gallium or aluminum, as it prevents gallium ion implantation, avoiding changes in elemental composition and properties.

- Maximum throughput for rapid prototyping, with beam currents up to the microamp range
- Inert Xenon ions minimizes contamination risk compared with Ga ions, preserving material integrity
- Slightly larger spot size at high currents — unbeatable for bulk removal and pre-finish sample preperation
- Stitchless large-area patterning and high-throughput fabrication of uniform modification arrays

Production volume

low — high

Minimal scale of modification

1 nm — 10 nm — 100 nm — 1 µm — 10 µm

100 x 100 x 50 mm

Processing speed

low — very high

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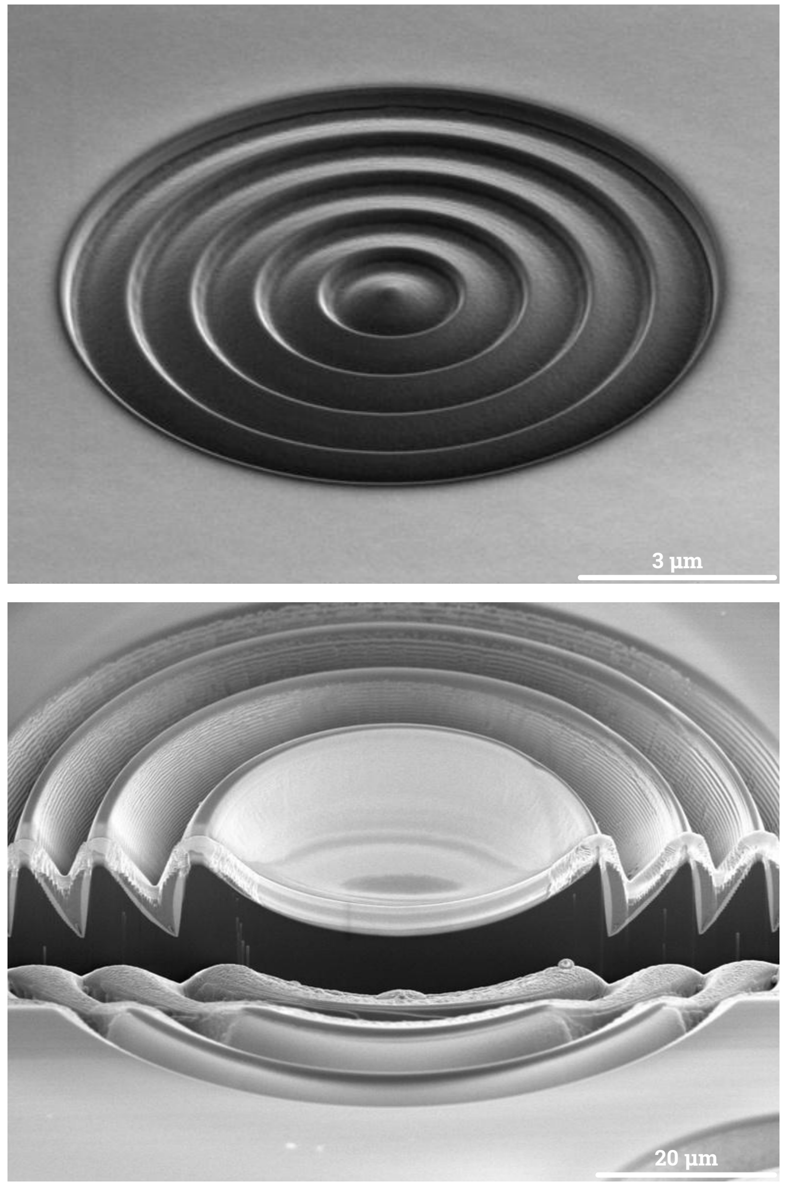
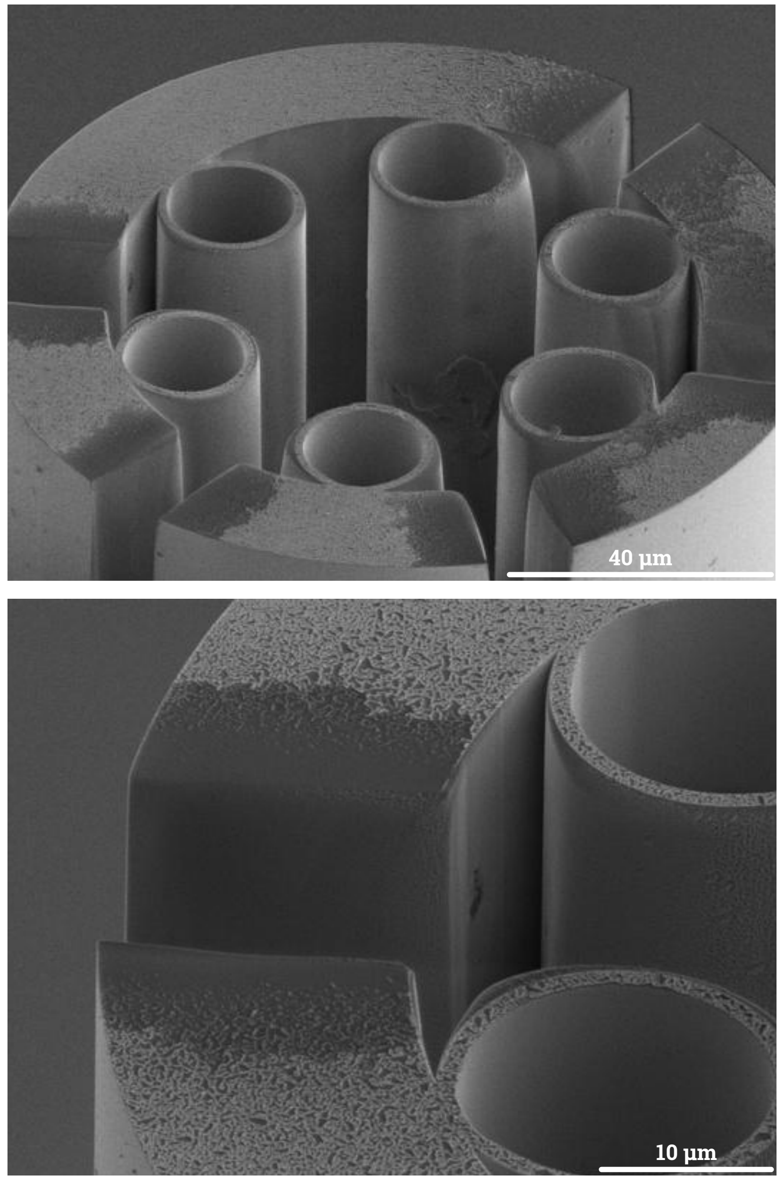


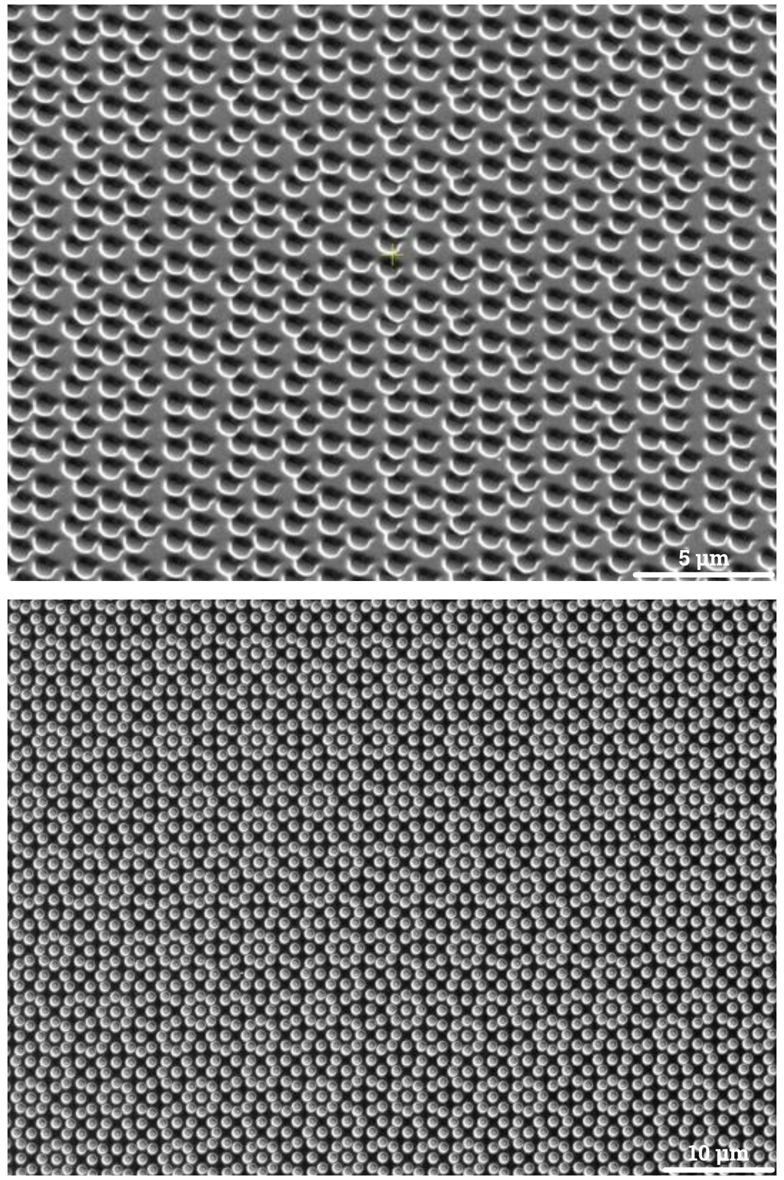
Material: Diamond

Fresnel lense obtained on the surface of a diamond using the Xe-PFIB method



Material: Glass fiber

Hollow core fibre (HCF) modification made by the Xe-PFIB method



Material: Diamond

Nanostructure obtained on the surface of a diamond to change optical properties using the Xe-PFIB method

IR-laser

A femtosecond laser is an advanced ultrashort-pulse laser that emits light pulses lasting only a few hundred femtoseconds. Such short pulses allow for extremely precise material processing with minimal thermal impact.

1 fs | 10−15 · 1 ps | 10−12 · 1 ns | 10−9 · 1 µs | 10−6 · 1 ms | 10−3 · 1 s

Capability to process any solid material, removing it only where intended (layer-by-layer processing)

5-axis beam positioning (x, y, z, α, β), enabling the creation of complex geometries

Ability to achieve vertical sidewalls with a maximum structure aspect ratio of 10:1

Production volume: low – high

100 x 100 x 4 mm

Minimal scale of modification: 1 nm · 10 nm · 100 nm · 1 µm · 10 µm

Processing speed: low – very high

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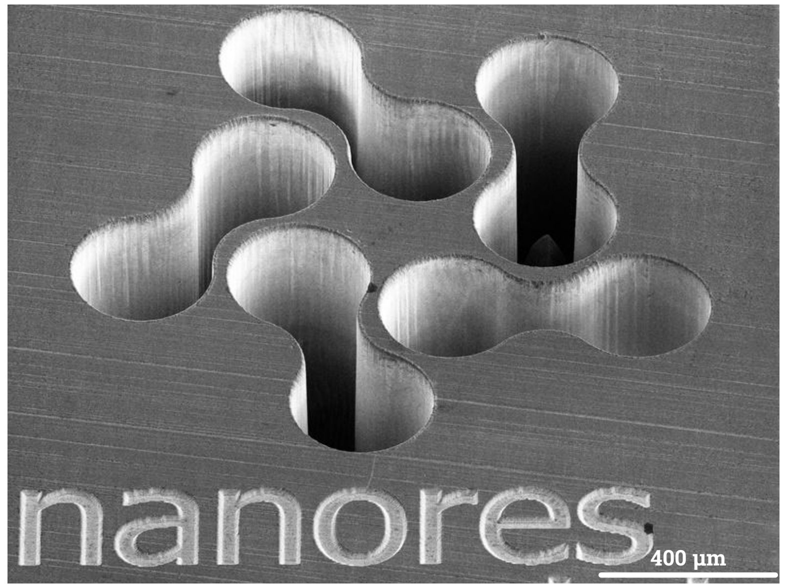
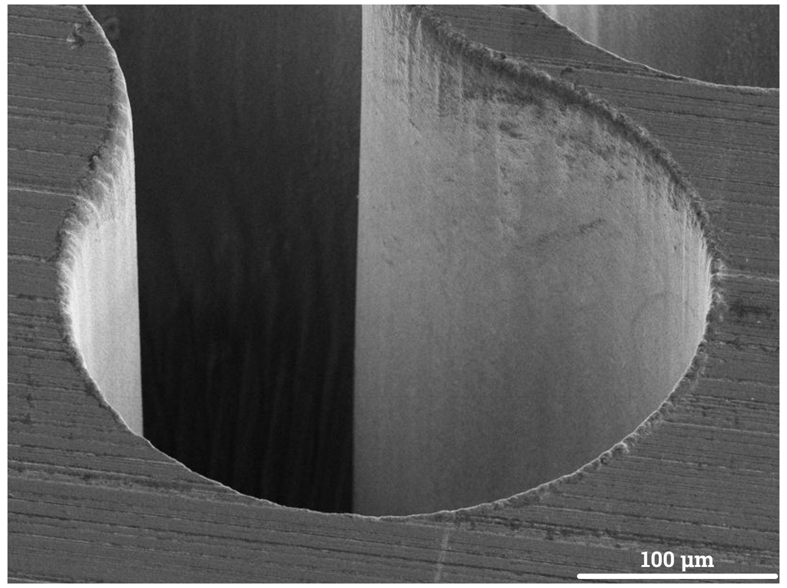
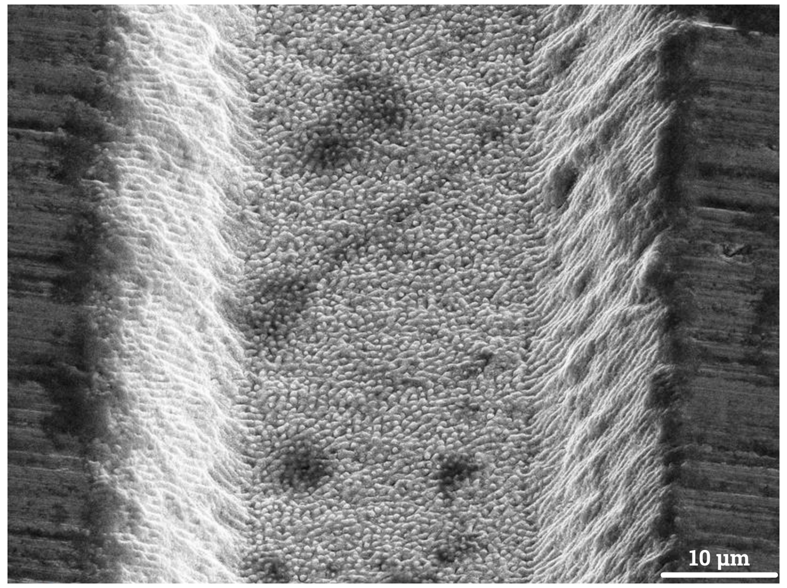
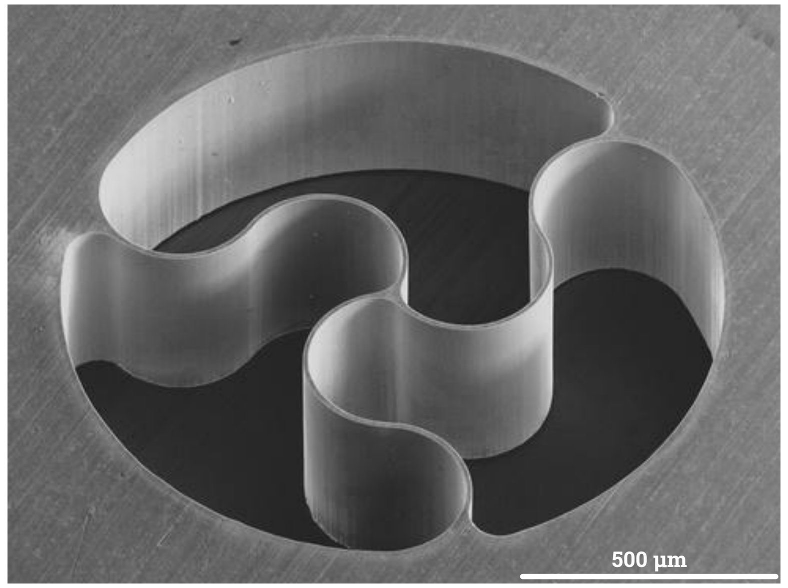


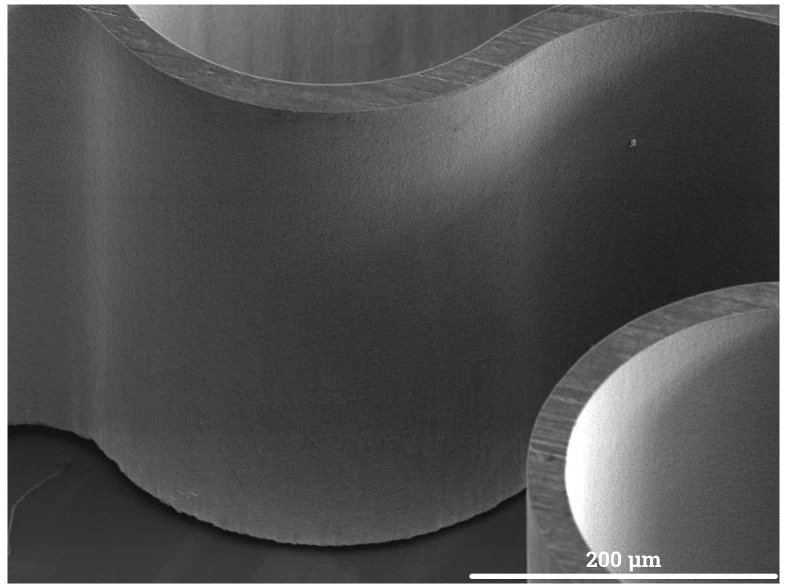


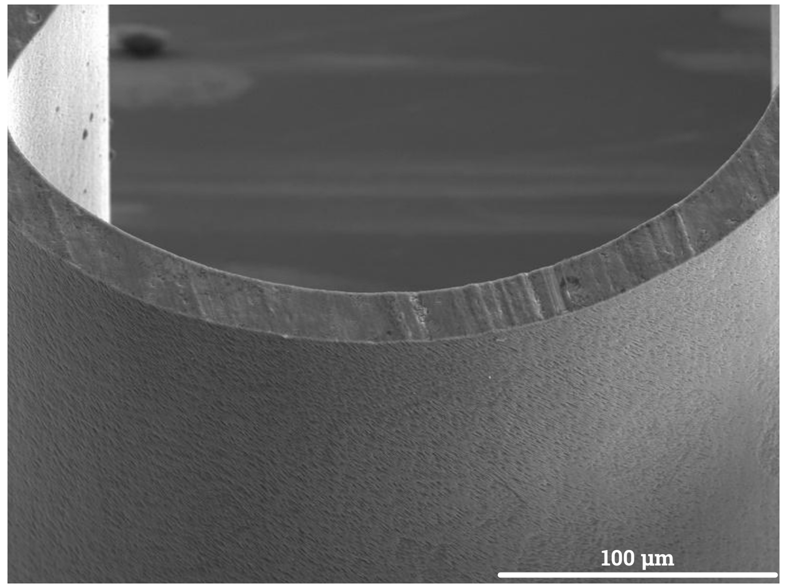


Material: Tungsten Carbide

Processing of a material widely regarded as extremely difficult to machine

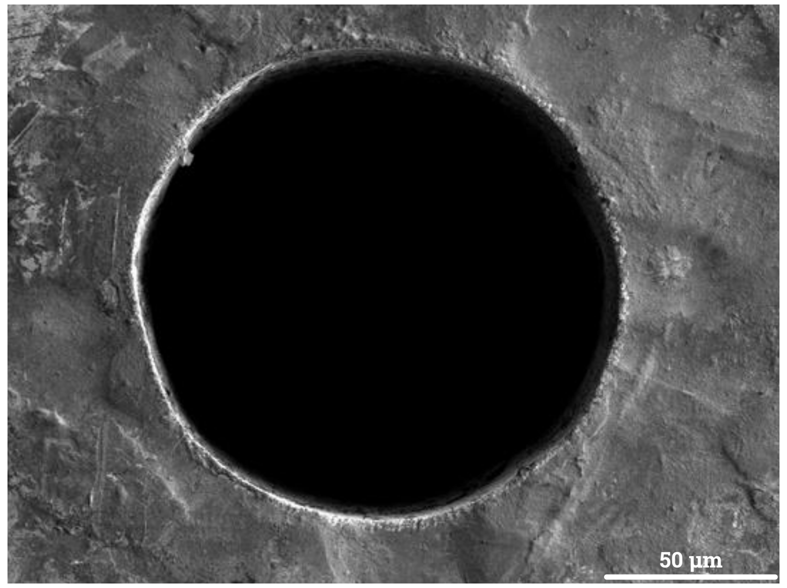


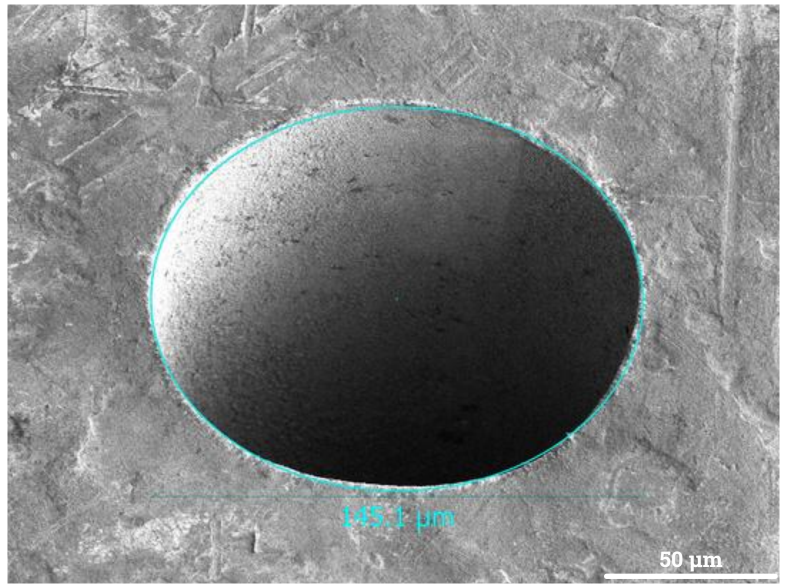


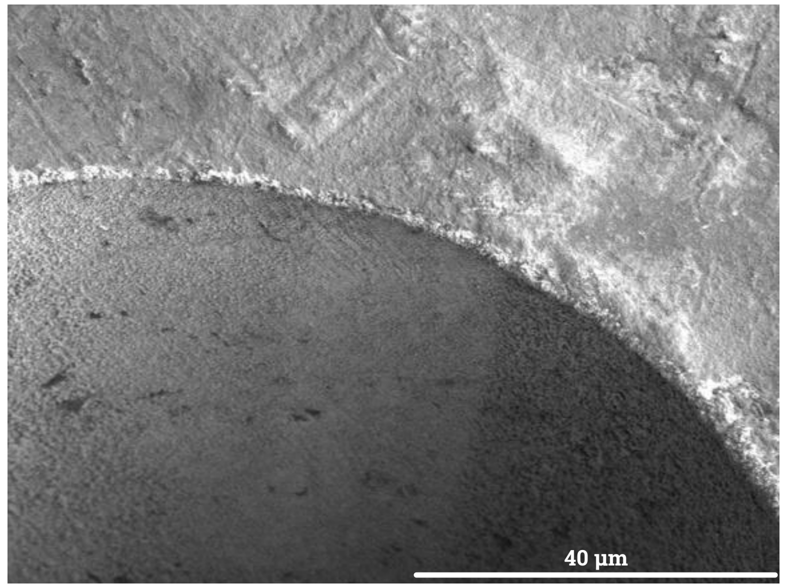


Material: Titanium
Thickness: 400 µm

A structures with walls 10 µm thick







Material: Steel
Diameter: 145 µm
Depth: 1400 µm

Difference in inlet and outlet diameters: <5 µm

UV-laser

A femtosecond laser is an advanced ultrashort-pulse laser that emits light pulses lasting only a few hundred femtoseconds. Such short pulses allow for extremely precise material processing with minimal thermal impact.

1 fs | 10−15 1 ps | 10−12 1 ns | 10−9 1 µs | 10−6 1 ms | 10−3 1 s

- Capability to process any solid material, removing it only where intended (layer-by-layer processing)
- Minimum modification size of ~1 µm
- Processing accuracy <100 nm
- Capability for precision processing of optical materials while preserving surface quality

Production volume

low high

Minimal scale of modification

1 nm 10 nm 100 nm 1 µm 10 µm

100 x 100 x 0.2 mm

Processing speed

low very high

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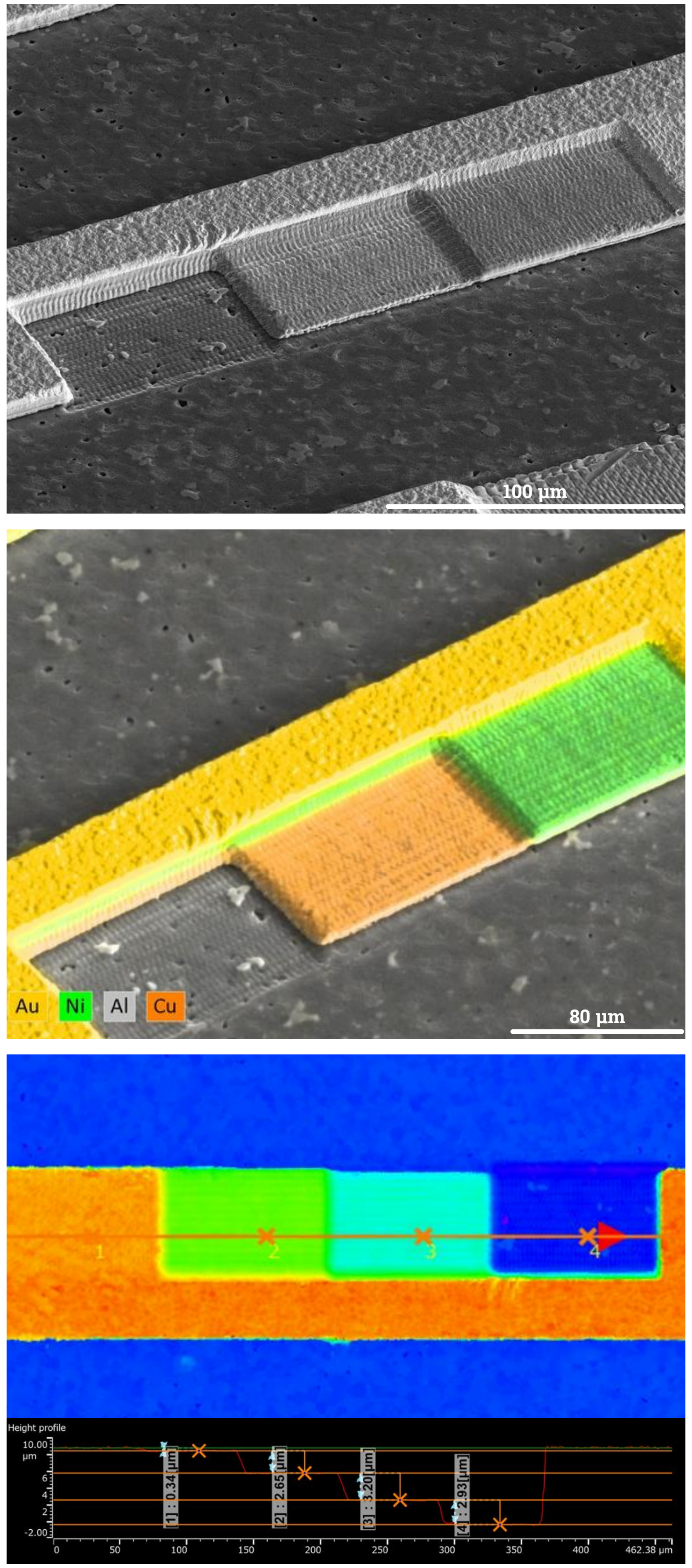
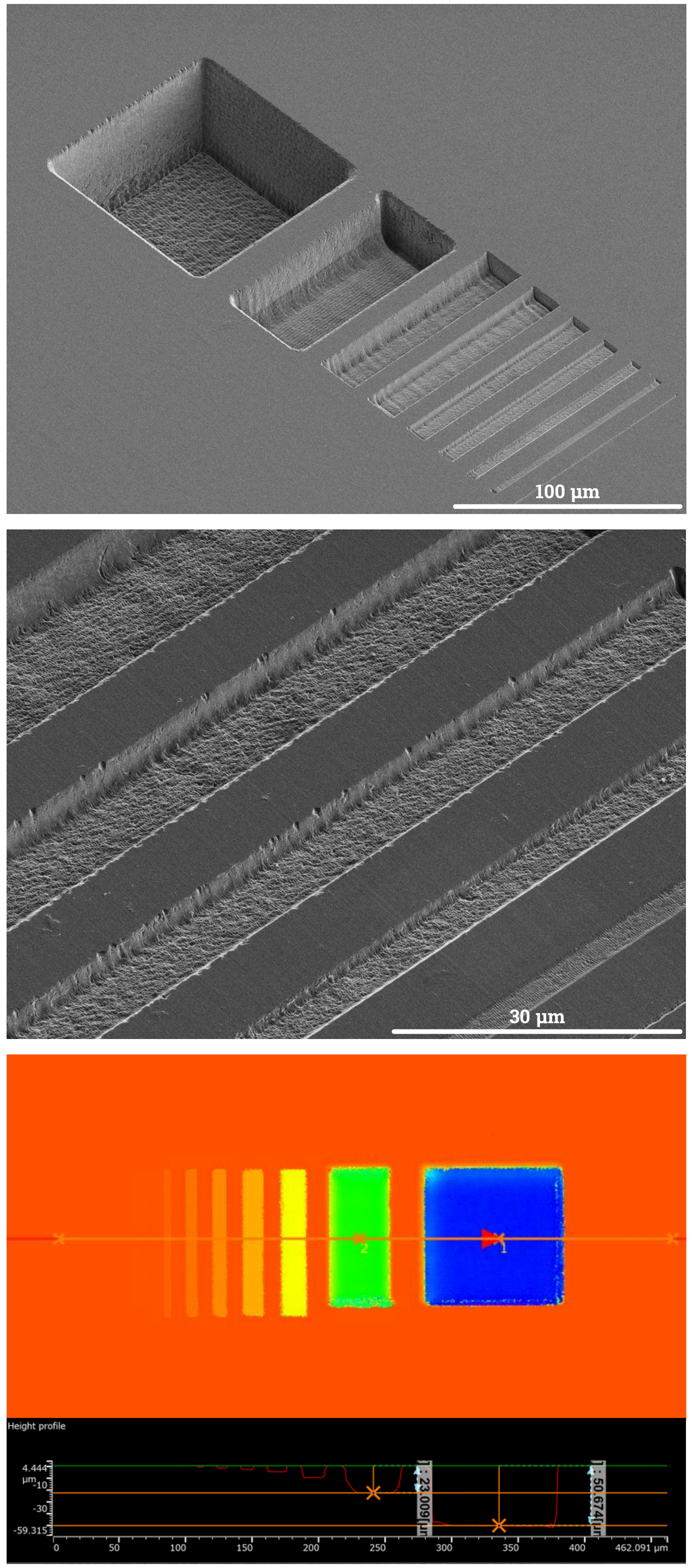


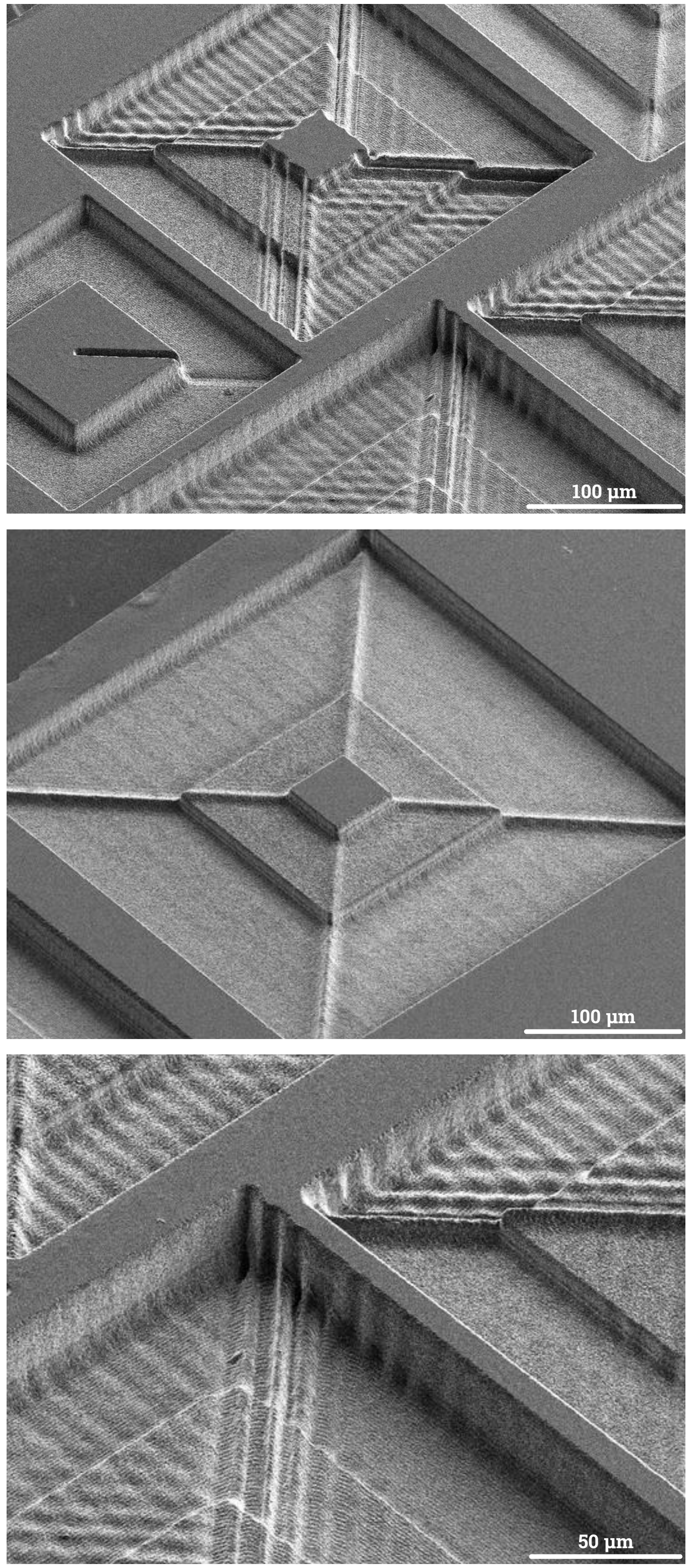
Material: Multilayer metallic structure
Thickness: ~3 µm per layer
Area: 75 x 50 µm

Multilayer metallic path composed of Au | Ni | Cu on an aluminium substrate with performed delayering process



Material: Diamond

Spectrum of sizes of paths and structures made by laser ablation in a diamond substrate

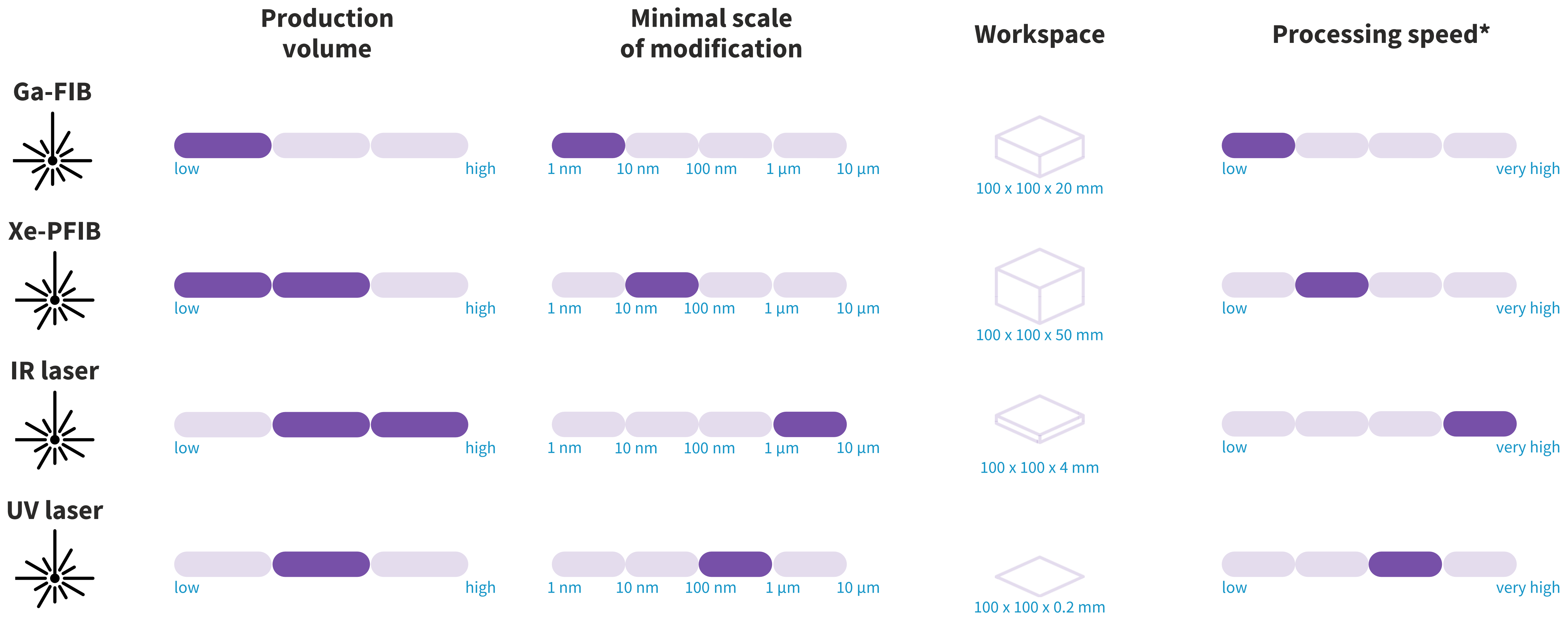


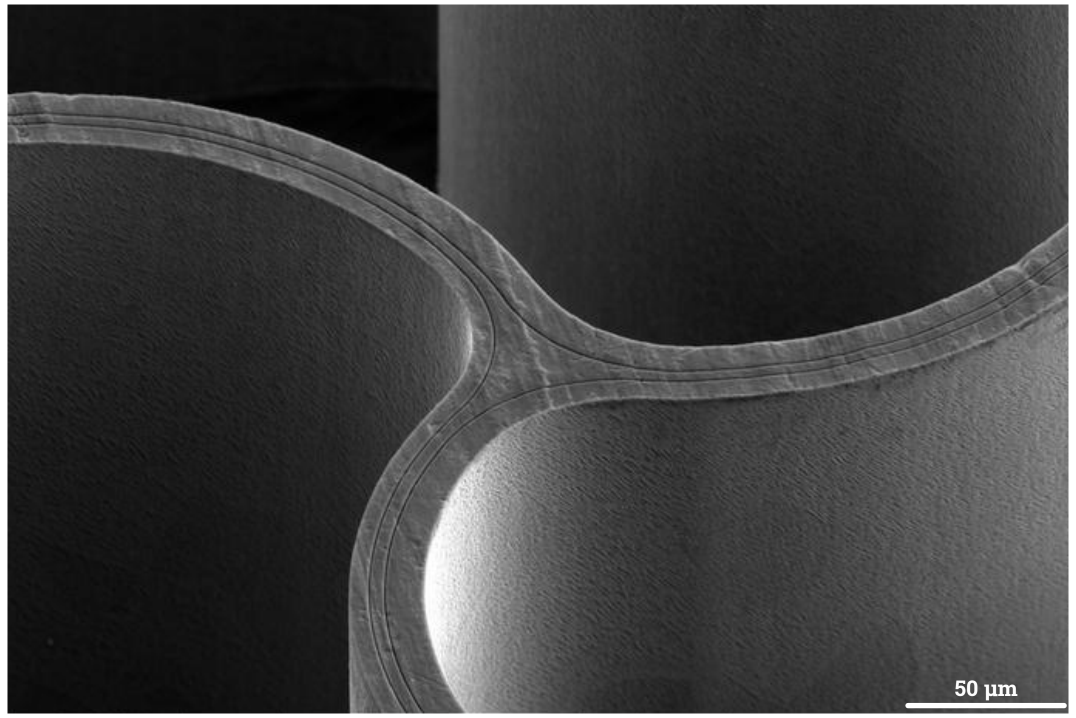
Material: Diamond

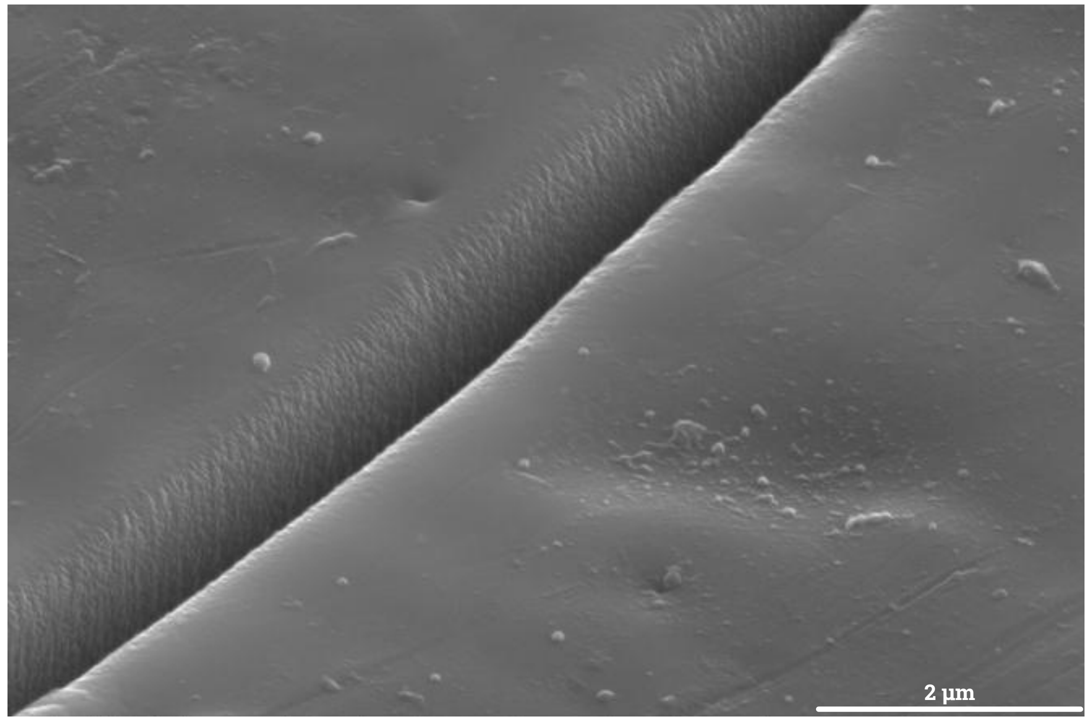
The structure of a stepped pyramid made in a diamond substrate

Combining methods

Our equipment and expertise allow us to combine methods, utilizing both techniques to create more complex and demanding structures with different levels of component accuracy.







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