Pico-Second Laser and Broad Argon Beam Tools For Characterization Of Advanced Packages And Devices

Vincent Richard[a] and M. Hassel Shearer[b]
[a]GATAN FRANCE - ROPER SCIENTIFIC, Evry (FR)
[b]GATAN Inc. Pleasanton (USA)

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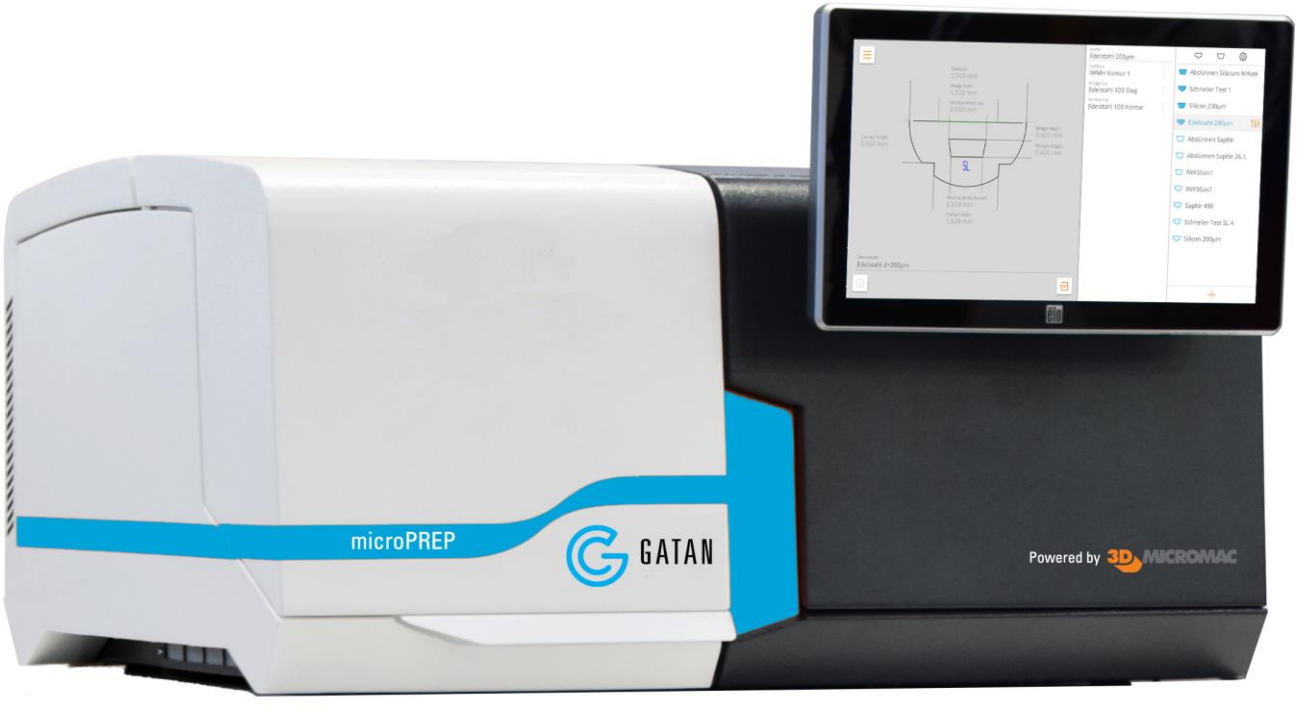
microPREP™ with the Ilion™ II system


microPREP
GATAN
Powered by 3D MICROMAC

Where Did this Product Come From?

Joint effort between Gatan-3D-Micromac and Fraunhofer-Halle

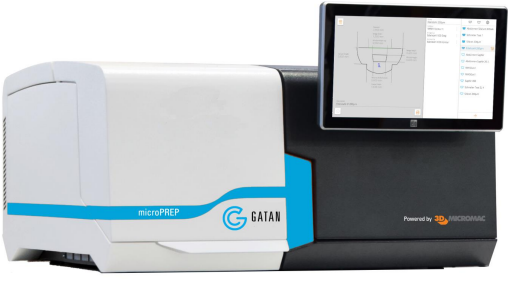
3D-Micromac AG
Technologie-Campus 8
09126 Chemnitz, Germany

http://3d-micromac.com

Overview

Picosecond laser ablation sample preparation tool to rapidly remove material for electron and x-ray microscopy. Complements or replaces mechanical, focused and broad ion beam (FIB and BIB) tools.

- Table top system that operates with compressed air
- Cross section packages as large as 110 x 110 x 4 mm
- Simple interface to adjust laser power level
- Diode pumped solid state laser (Wave length: 532 nm)



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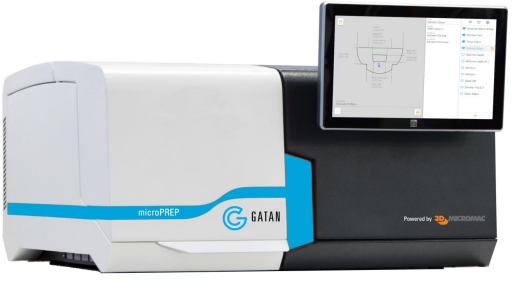
Large Area and Volume Capabilities

Box cuts

- Excavate large volumes
  3.0 x 0.3 x 0.3 mm (L x W x D) in <25 min

Line cuts

- Cross-section large samples
  25 x 1.5 mm (L x D) in 15 – 25 min



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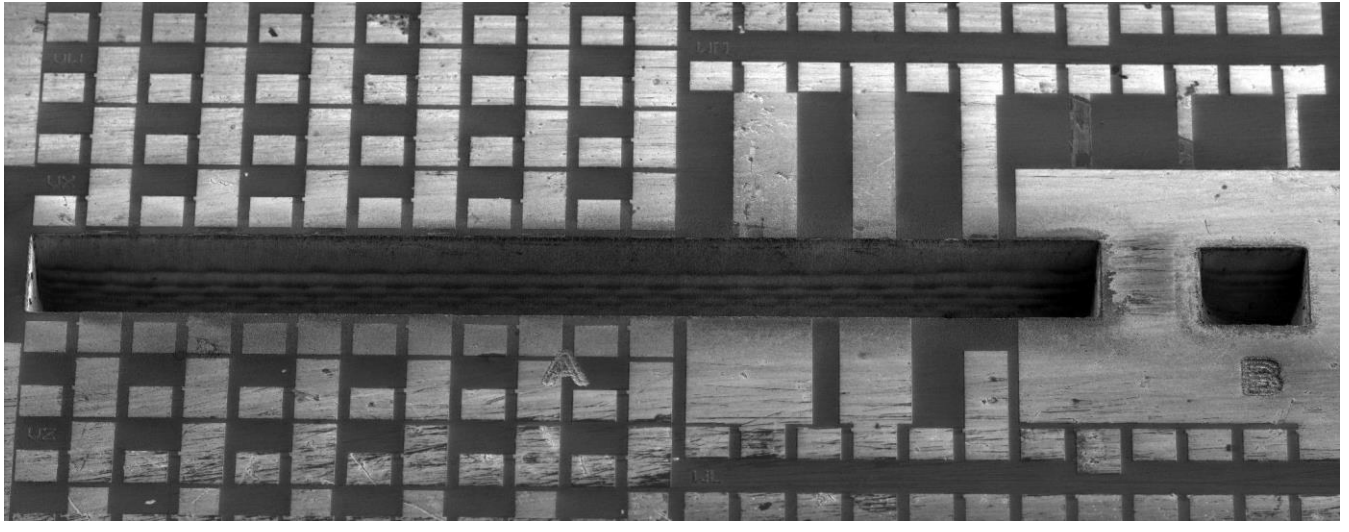

Quickly Trench Large Areas – Silicon with TSV's

Sample	Size (mm)	microPREP (actual)	Ga FIB (calc.)
#70	0.3 x 0.3 x 0.3	3 min, 40 s	17.5 days
#69	3.0 x 0.3 x 0.3	23 min, 40 s	0.5 years

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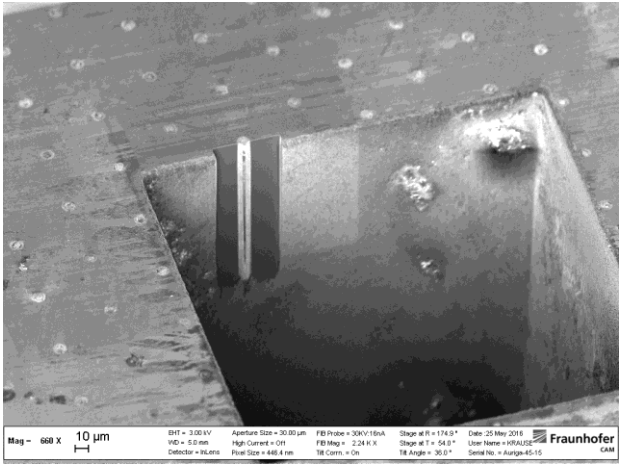
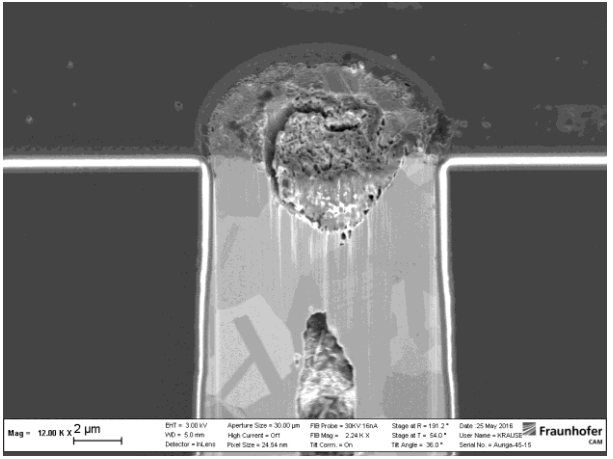
Post microPREP + Ga FIB





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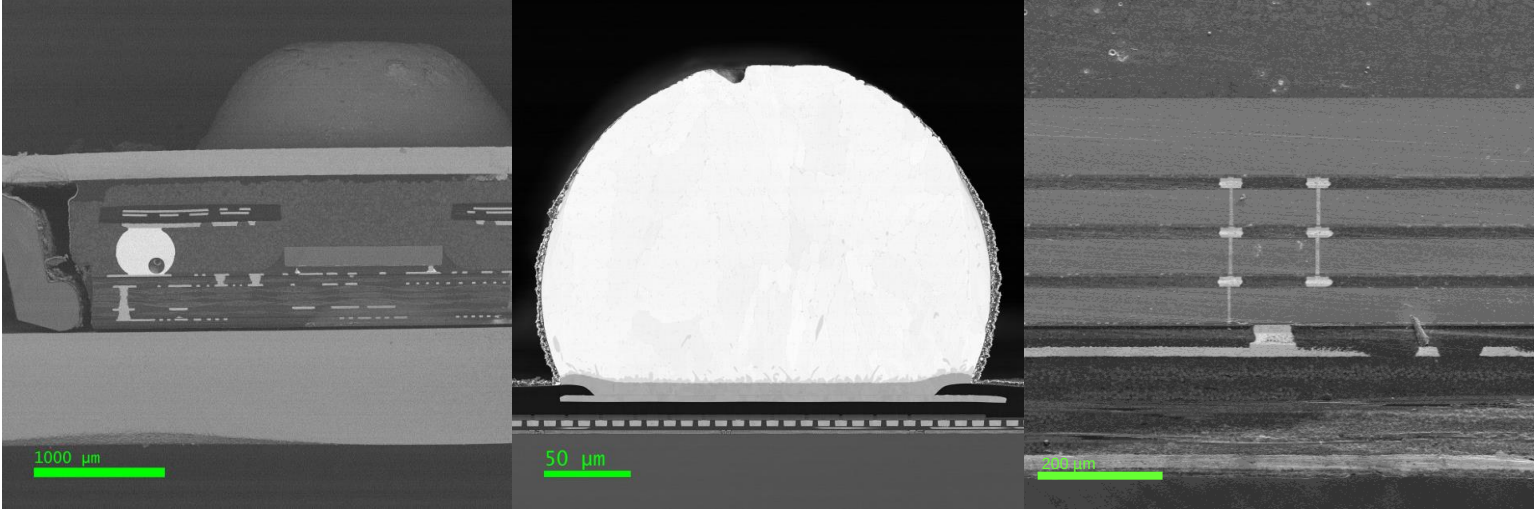

Solutions for Dissecting Advanced Packages

- Deliver near perfect surface for high-resolution, analytical analysis for root cause determination
- Cross-section stacked devices and advanced packages
- Prepare large ROI within minutes

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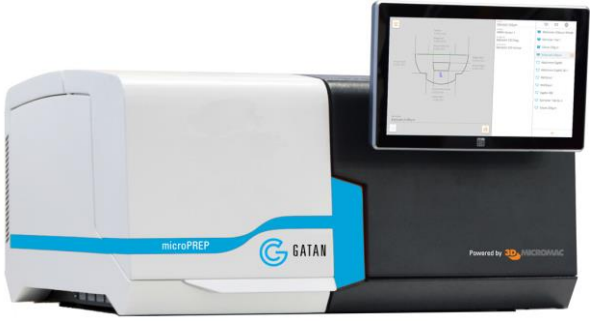
Workflow for Sectioning Stacked Chips

microPREP

- Slice entirely through package
- Time = **15 min**

Ilion II

- Cross-section polish
- Time = **1 h**



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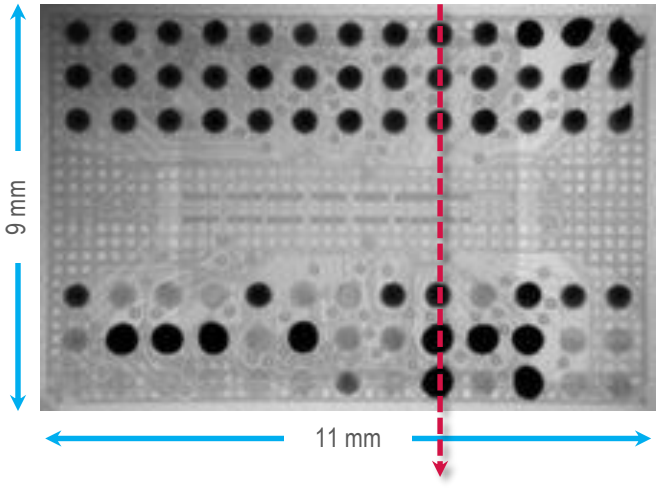
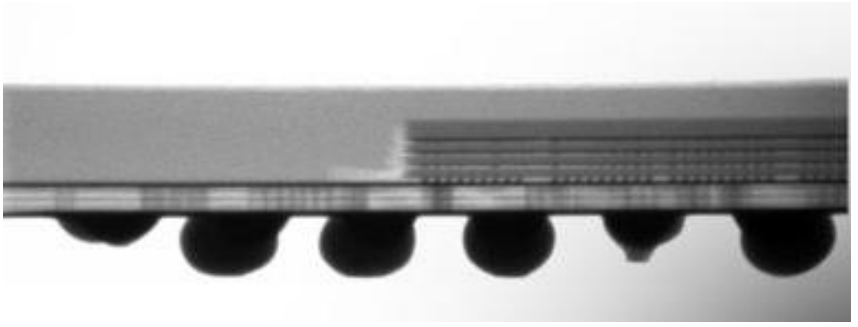
Top view of multi-layer device



X-ray image of ROI



Cross-Section Stacked Chip

- Cut through large, 4-layer stack (9 x 1.1 mm (L x D)) within 15 min

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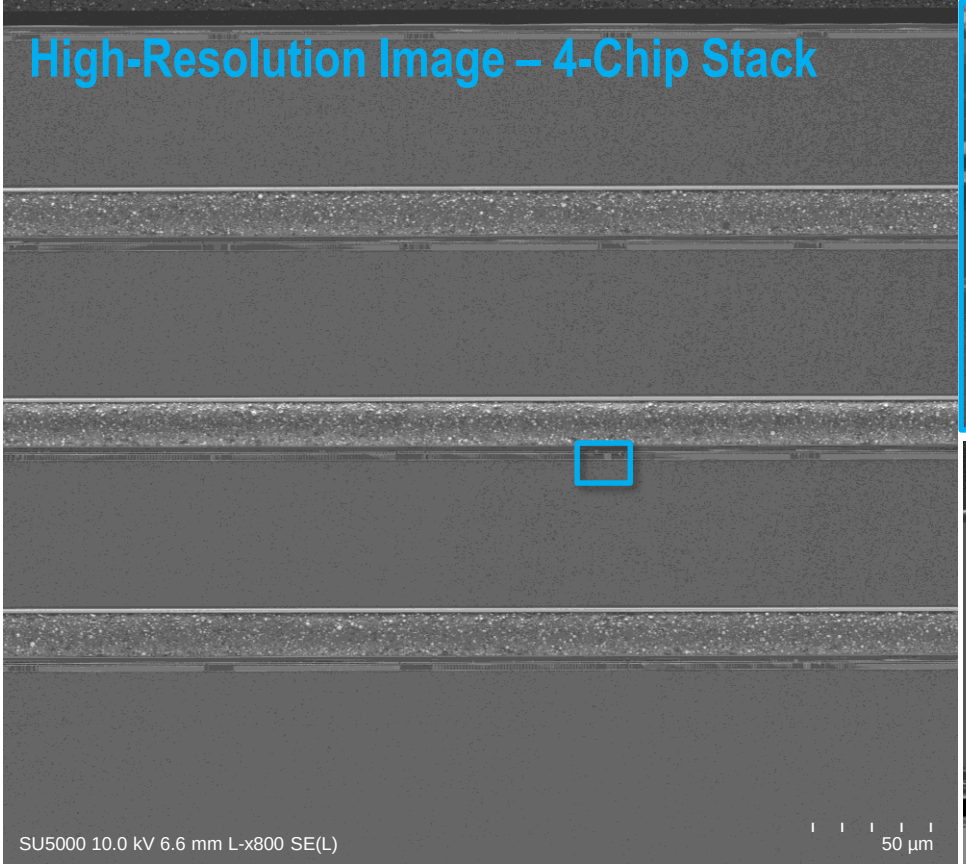
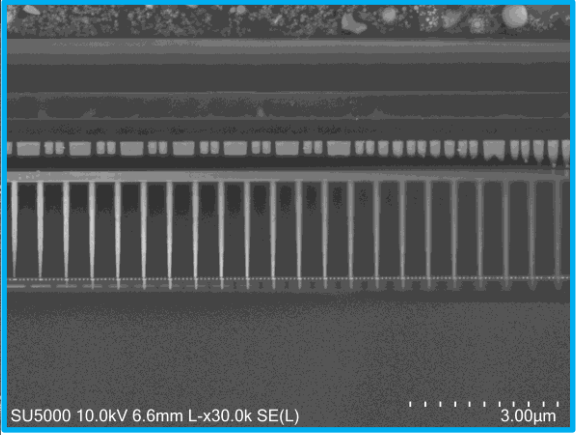
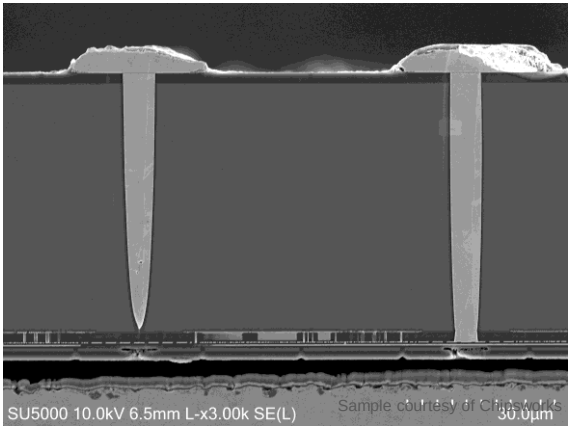
Sample courtesy of Chipsworks

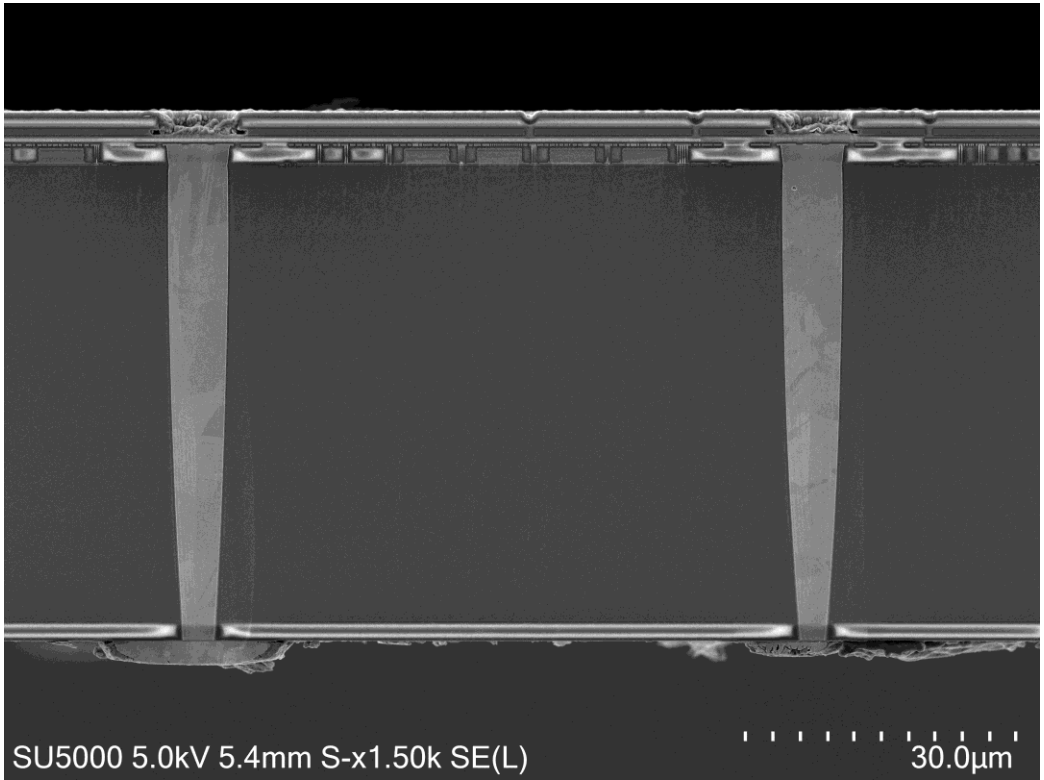
High-Resolution Image – 4-Chip Stack

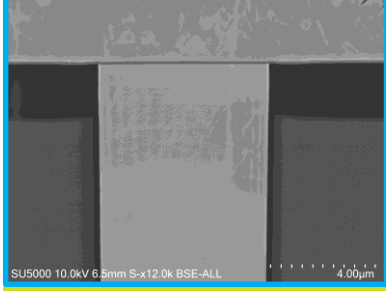


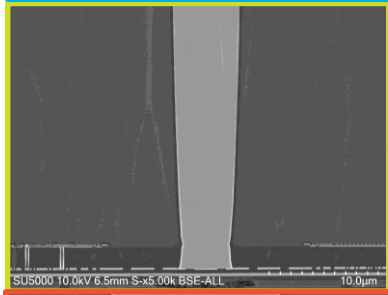


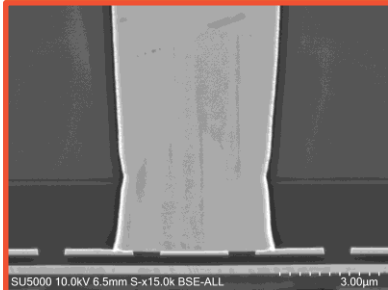


Visualize Large Features – TSV









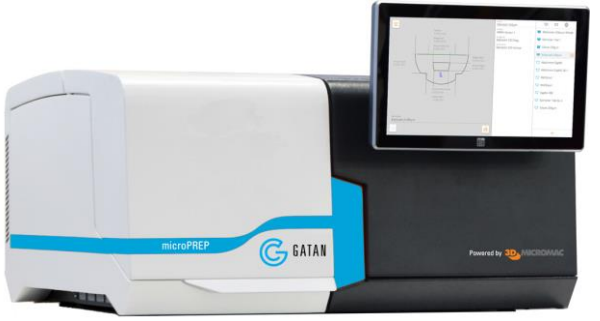
Workflow for Sectioning Ball Bonds and Package

microPREP

- Slice entirely through package
- Time = **7 min**

Ilion II

- Cross-section polish
- Time = **1 h**



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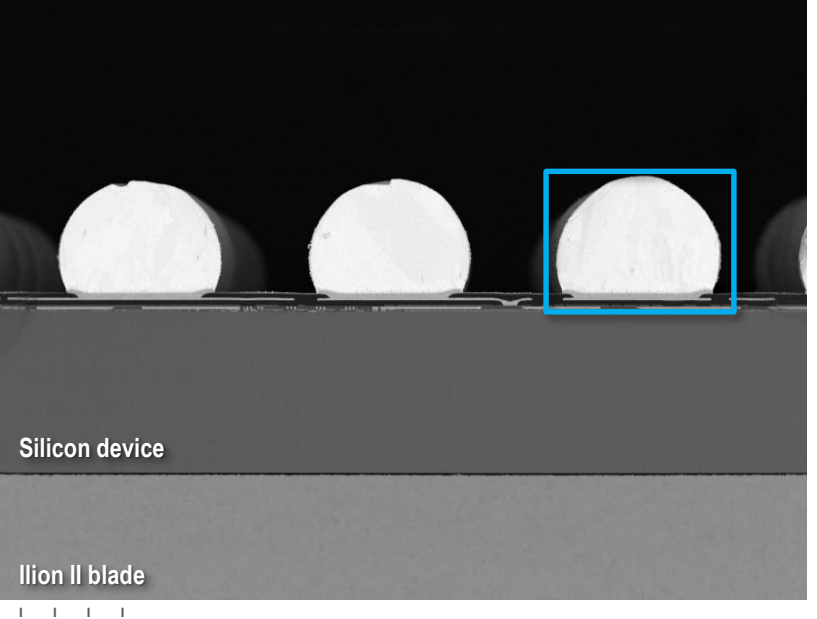

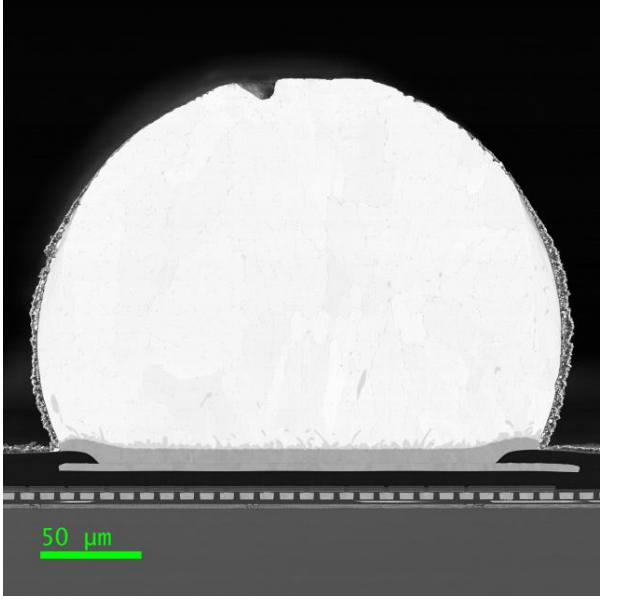

Cross-Section Ball Bonds

- Cut through three ball bonds plus complete silicon device and package (11 x 0.5 mm (L x D)) within 7 min
- Post Ilion II polish within 1 h

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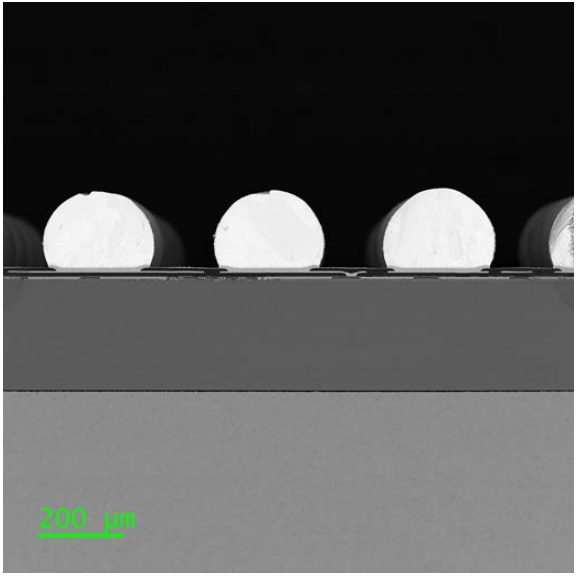
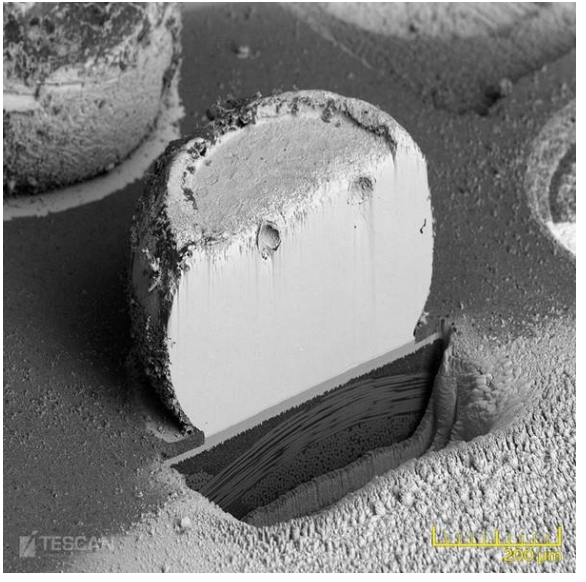


microPREP (7 min) + Ilion II (1 hr) result ROI 16 times larger than P-FIB



Cross-section of a solder ball with a diameter of 400 µm completed in 4 hr using Xe Plasma FIB and Rocking Stage for a curtaining-free surface.

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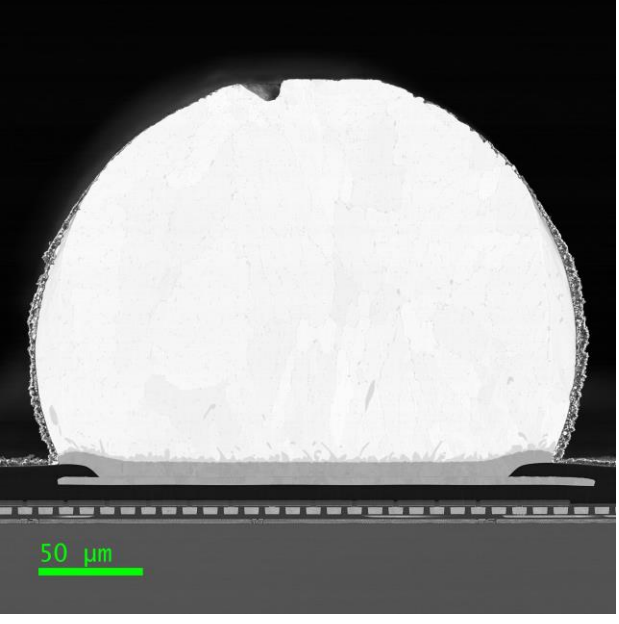
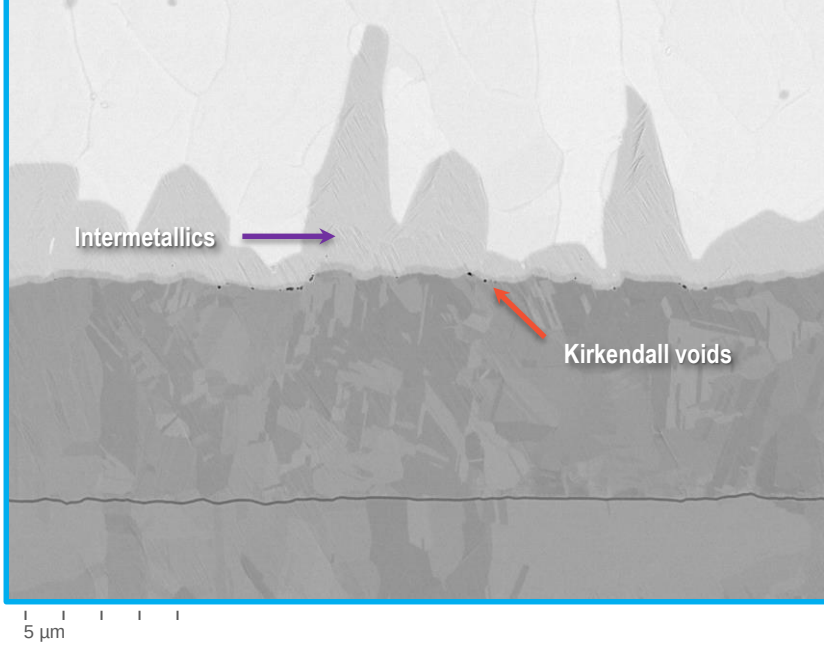
Comparison microPREP + Ilion vs. Plasma FIB





High-Resolution Detail at the Interface

- Kirkendall voids indicate defect formation caused by different diffusion rates
- Presence of intermetallic compounds may point toward wire bond failures in device

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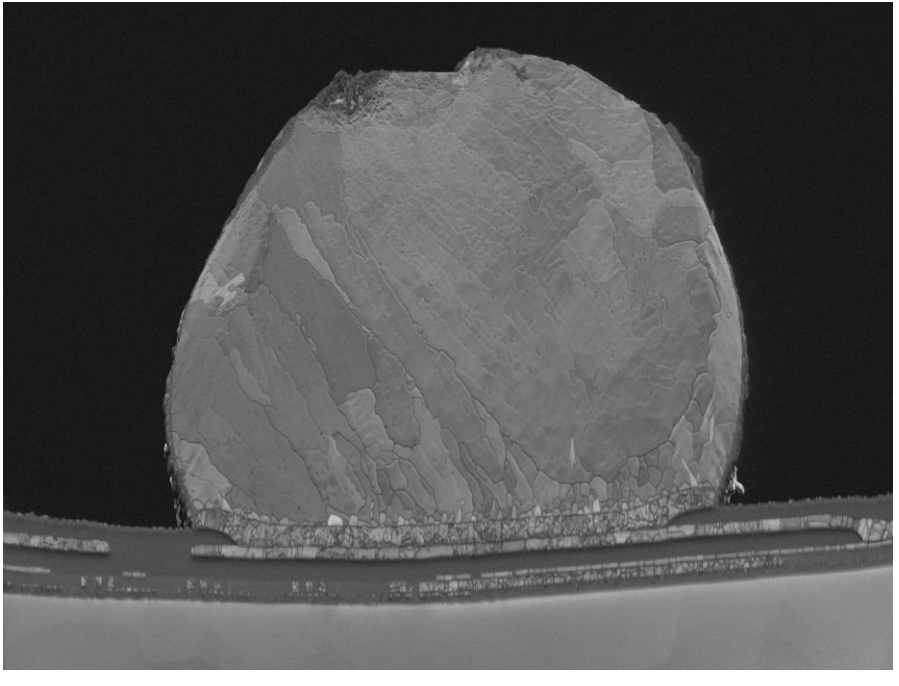
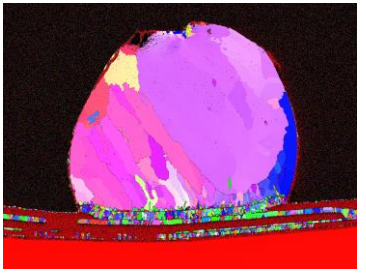
Band Contrast Image



IPF X



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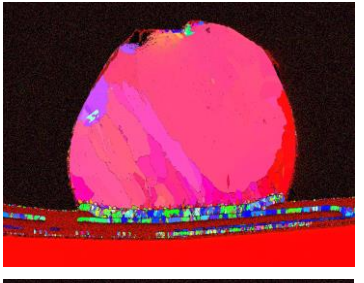

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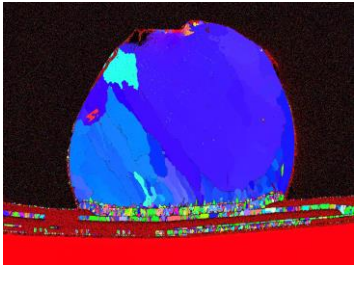
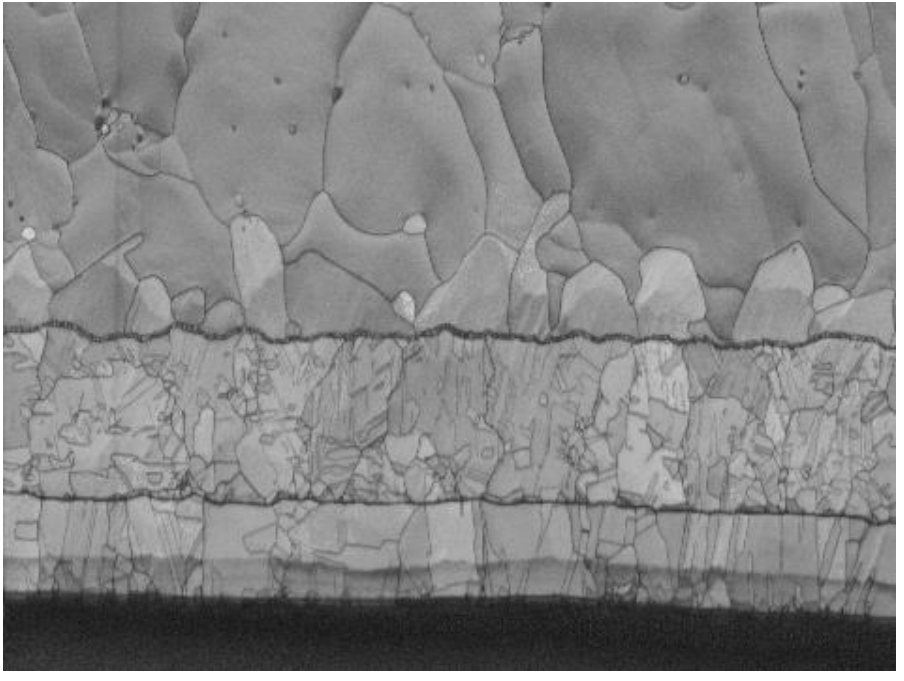


EBSD MAPS of Ball Bond

Band Contrast Image



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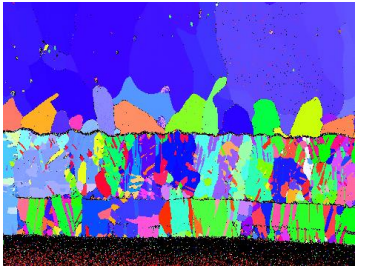

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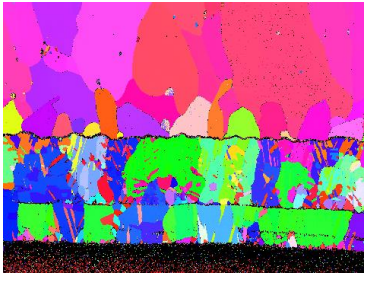
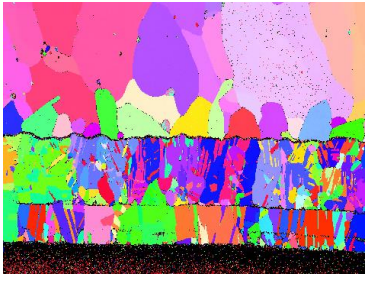
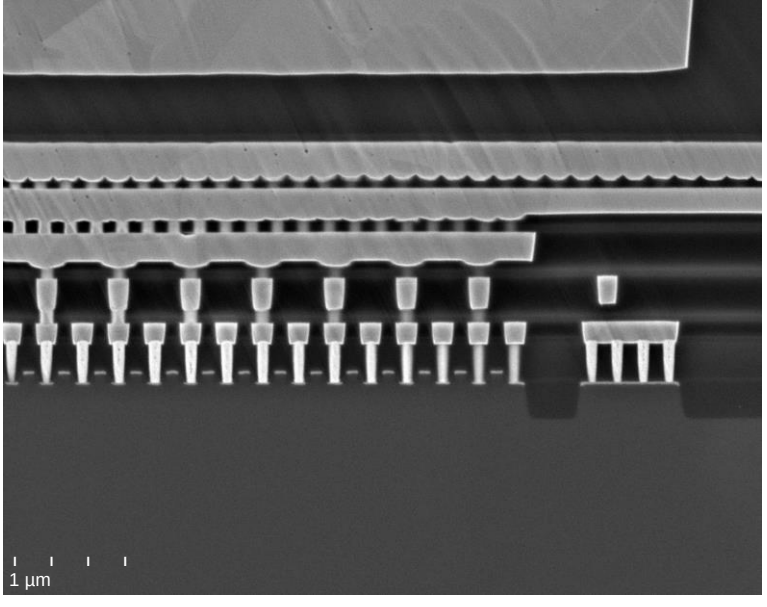


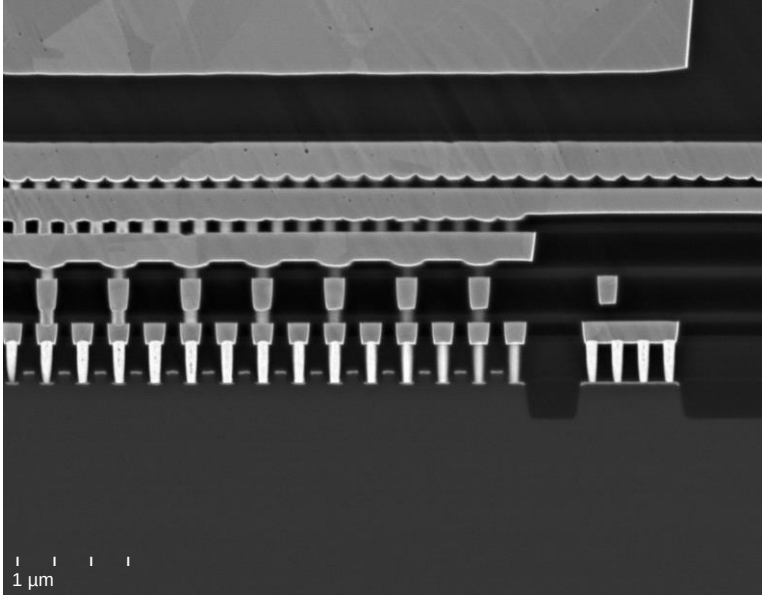
IPF Z



EBSD of Ball Bond/UBM Interface



Secondary Electron



Backscattered Electron

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Transistors Below the Ball Bond/UBM Layer

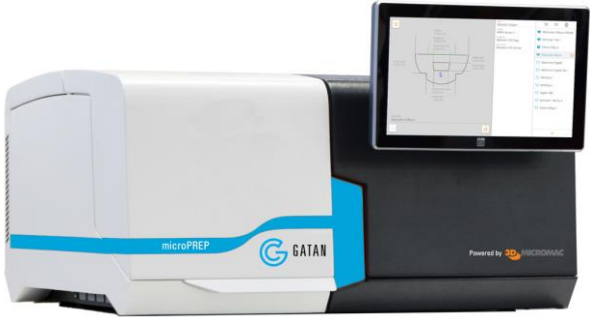
Workflow for Sectioning Home Button

microPREP

- Slice entirely through package
- Time = **45 min**

Ilion II

- Cross-section polish
- Time = **1 h**



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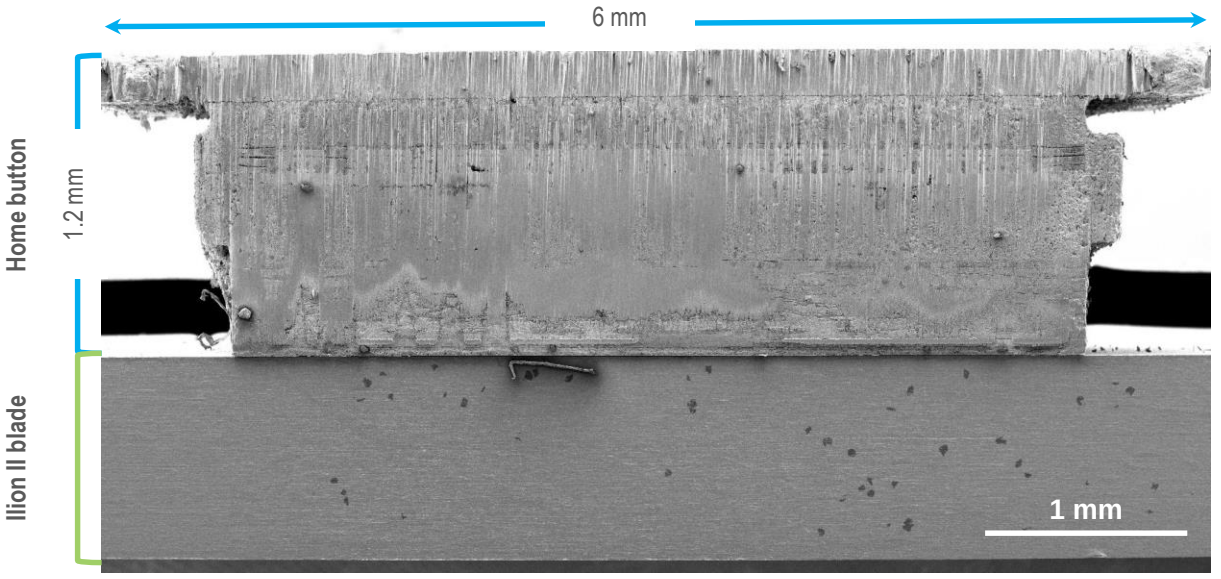

Cross-Section Home Button in 45 min

- Shows initial cross-section made by the microPREP
- Follow-up with broad ion beam tool to polish

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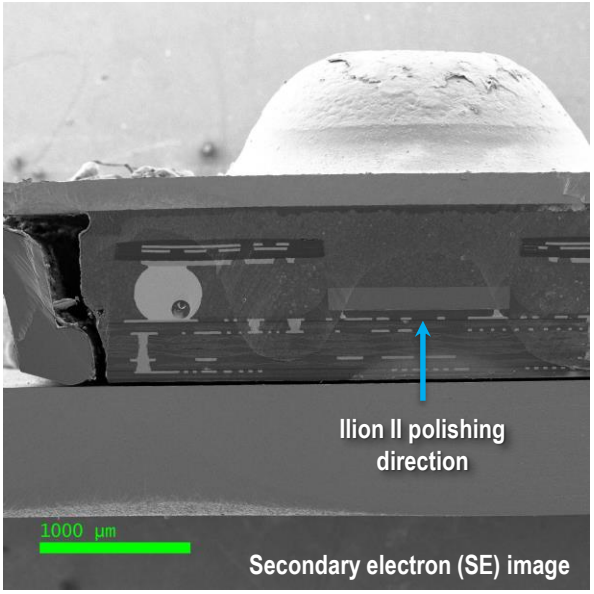
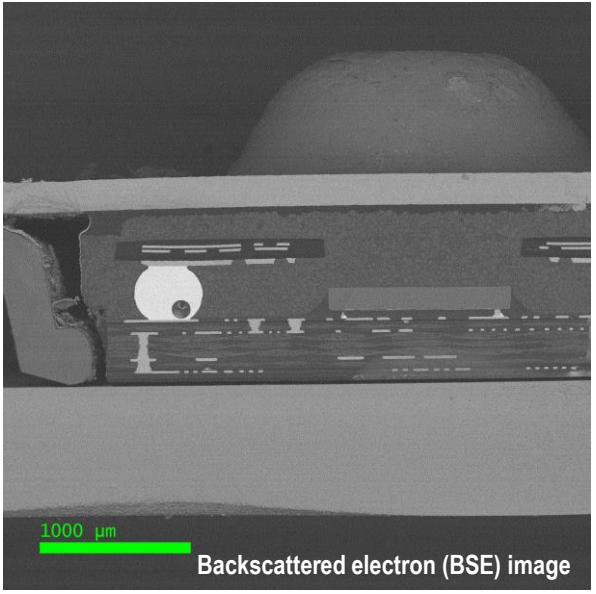
Home button post laser ablation





Overview of Home Button

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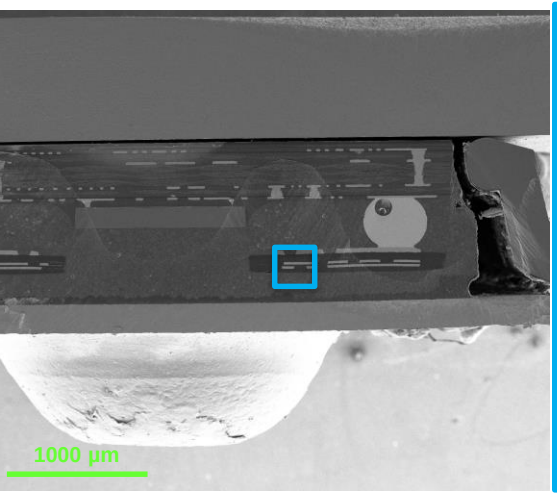
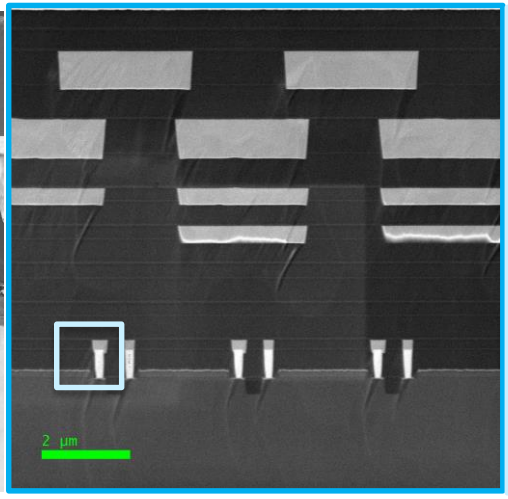
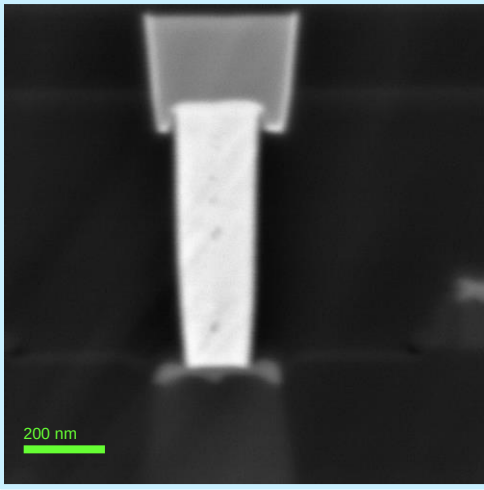
Home button post laser ablation and broad ion beam polishing







Post Ilion Polish

Home button post laser ablation and broad ion beam polishing

Summary

Solutions for Dissecting Advanced Packages

- Deliver near perfect surface for high-resolution, analytical analysis for root cause determination
- Cross-section stacked devices and advanced packages
- Prepare large ROI within minutes

microPREP opens opportunities to expand the size, volume and speed of preparing samples for

- XRM samples
- Atom probe tips
- High volume TEM prep

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Thank You

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