thermoscientific

Helios G4 PFIB HXe DualBeam

Highest throughput, highest resolution large area deprocessing, sample preparation and characterization for 10 nm devices

Helios G4 PFIB HXe DualBeam provides unique capabilities to enable damage free delayering of 10 nm semiconductor devices, advanced failure analysis of 3D packages in addition to a wide range of other large area FIB processing applications.

The Thermo Scientific™ Helios™ G4 PFIB HXe DualBeam™ is the fourth generation advanced PFIB DualBeam platform for large area sample preparation and analysis in semiconductor failure analysis, process development, process control, and materials characterization labs. The Helios G4 PFIB system combines the unique Elstar™ electron column with UC+ technology for high-resolution, sub 500 eV imaging and end-pointing with the high-performance PFIB2.0 Xenon plasma ion column, for fast, precise, and damage free large area sample cross-sectioning and deprocessing.

In addition to the industry leading SEM and FIB columns, the Helios G4 PFIB DualBeam incorporates a suite of innovative technologies and automation which enable simple and consistent sample preparation on even the most challenging samples.

Flexible and configurable DualBeam platform
Our DualBeam systems are unmatched when it comes to the high-speed creation of precise and consistent cross-sections and the preparation of high quality TEM samples. The Helios G4 PFIB HXe system expands on this leadership and can be configured with high performance options such as the EasyLift™ nanomanipulator, Multichem™ gas delivery system and iFAST™ automation software.

Key benefits

High-performance Elstar electron column with UC+ monochromator technology for nanometer SEM image resolution and surface sensitivity

Perform the highest throughput and quality relevant 3D characterization, cross sectioning, and micromachining using the next-generation 2.5µA Xenon Plasma FIB (PFIB 2.0) Column

Achieve high-productivity, curtain-free preparation of large area cross-sections and highest quality TEM lamella with Auto Rocking Mill

Exceptional low kV ion beam performance enables material sensitivity and low sample preparation damage

Optional MultiChem or GIS gas delivery systems provides the most advanced capabilities for electron and ion beam induced deposition and etching on FIB/SEM systems

Proprietary Dx and DE chemistries for deprocessing of copper metallization in regular and ultra low-k dielectrics. Plasma FIB based chemistries and recipes for milling advanced packaging materials

Optional EasyLift nanomanipulator and QuickFlip enables precise, site-specific preparation of large area lamellae while promoting high user confidence and yield

Five-axis, piezo-driven UHR stage with load lock provides full coverage of 70 mm samples

Backed by our world class knowledge and expertise in advanced failure analysis for DualBeam applications
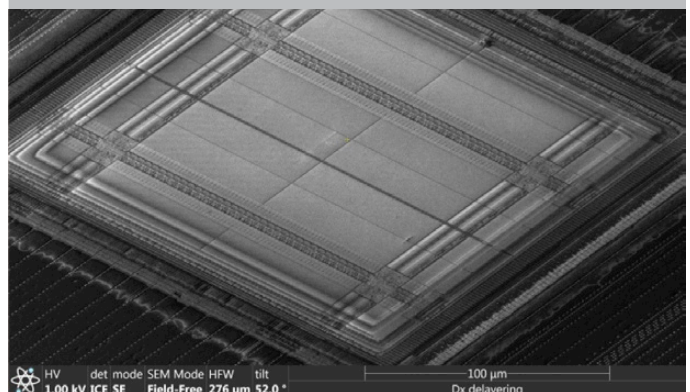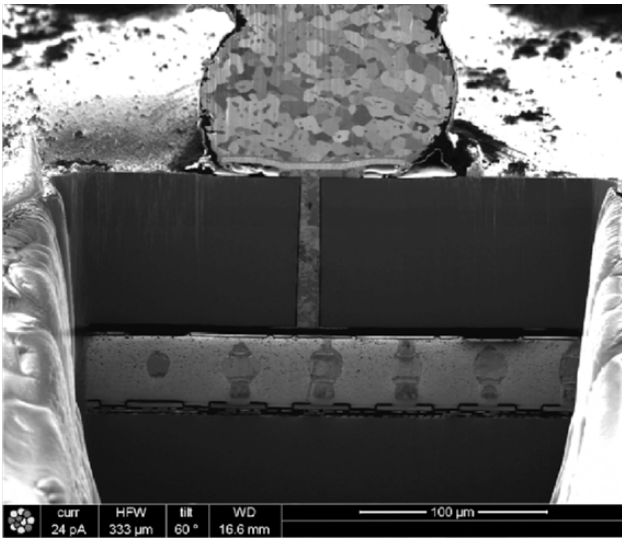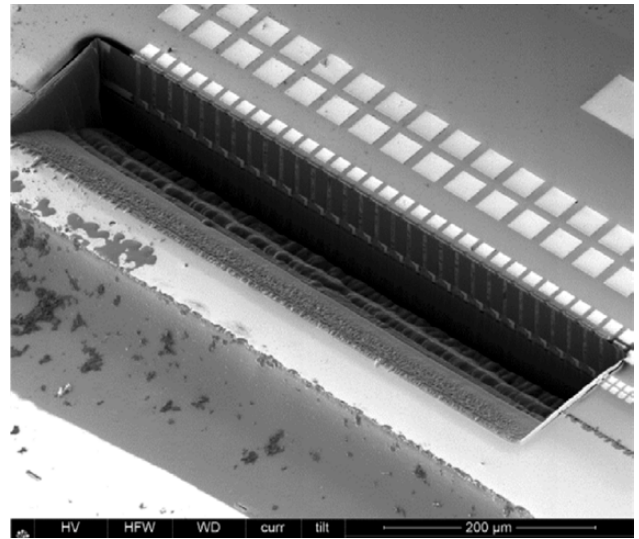
Figure 1. 300um × 300um Cross-section of a 2.5D stack

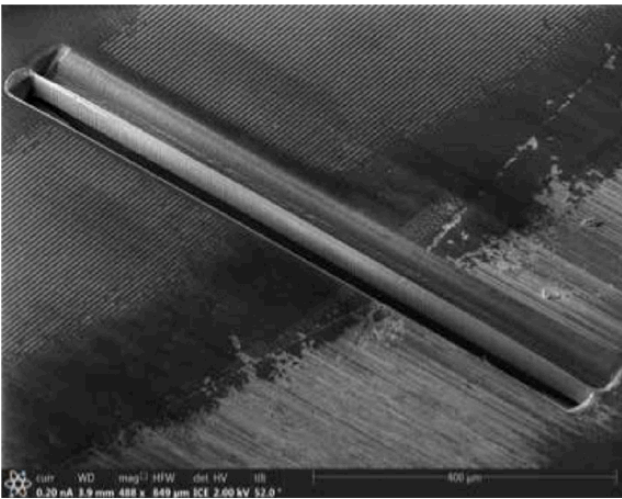

Figure 2. 800um wide cross-section of a 3D IC with Cu TSVs
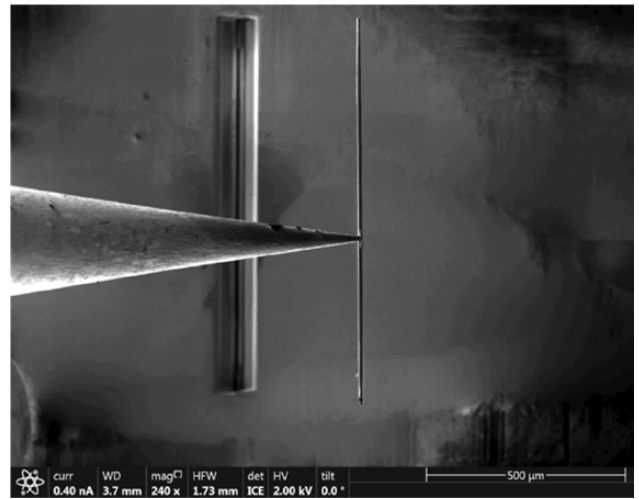

Figure 3. 900um × 14um × 27um large lamella

Figure 4. 900um x 14um × 27um large lamella: liftout with EasyLift™
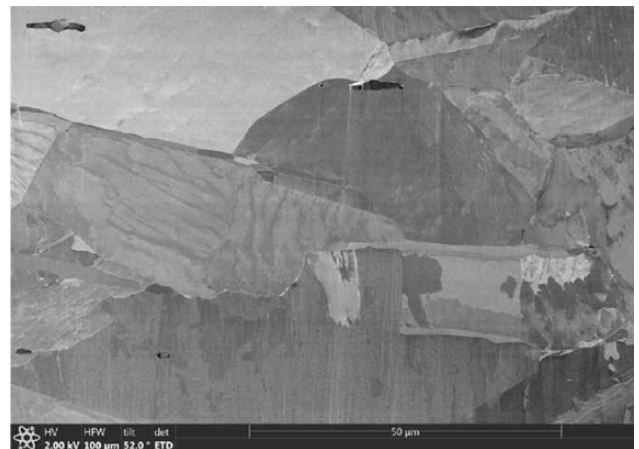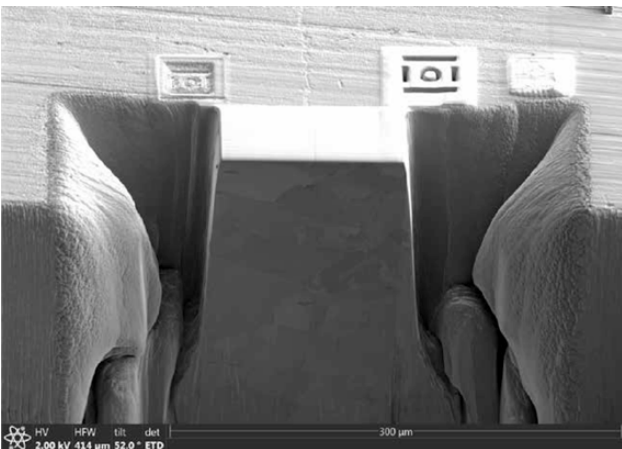

Figure 5. (above and right) Curtain free large area cross-sectioning with Auto Rocking Mill / polish
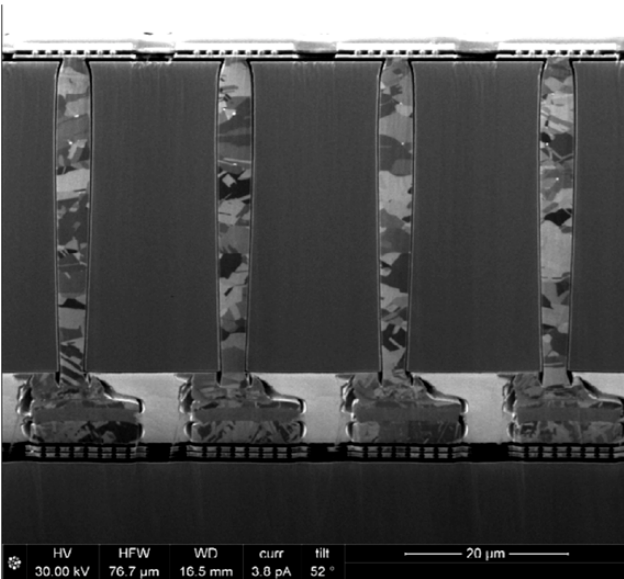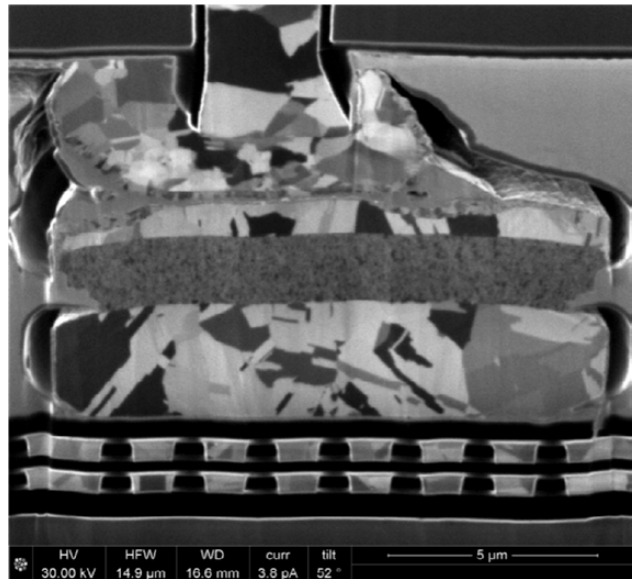
Figure 6. Multi-copper TSV cross-section

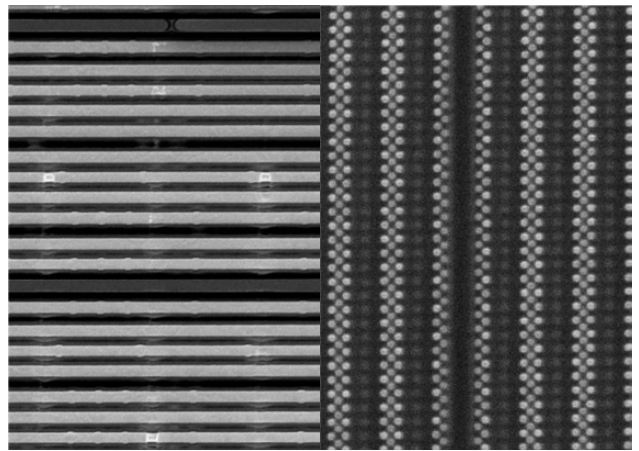Figure 7. Zoomed-in view of Cu TSV and Cu bump contact
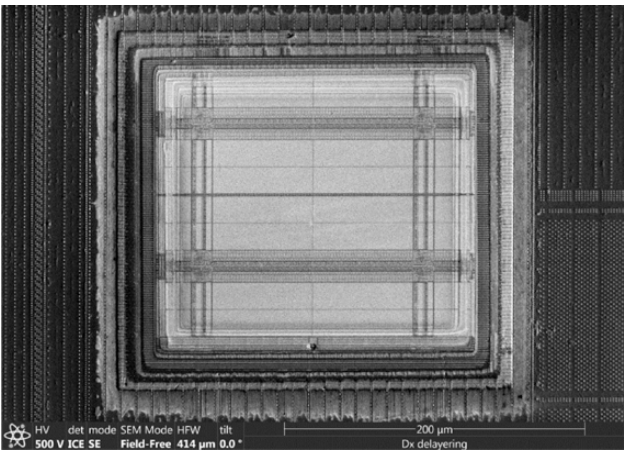

Figure 8. (above and right) Deprocessing with Dx for Passive Voltage Contract (PVC) based image analysis - 200um×200um are 1× node device
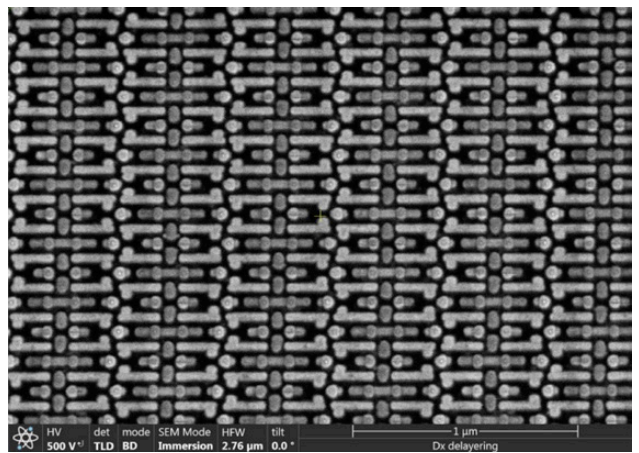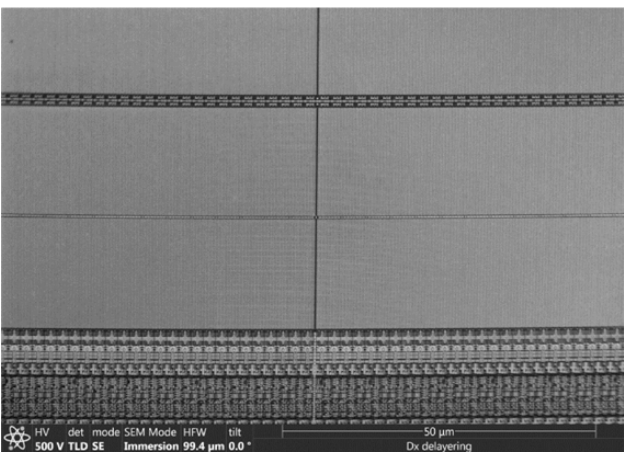

Figure 9. (above and right) Deprocessing with Dx for electrical fault Isolation with SEM based nanoProbing or Atomic Force Probing (AFP)

Target specifications
- Electron source
  - Schottky thermal field emitter, over one year lifetime
  - E-beam current: 0.8 pA up to 100 nA
- Ion source
  - Inductively coupled Xe+ Plasma (ICP), >4000 hours
  - PFIB Beam Current: 1pA to 2.5uA
- Landing Voltage
  - 50 V - 30 kV SEM
  - 2kV - 30 kV PFIB
- SEM resolution (Optimal WD)
  - 0.6 nm @ 2-15 kV
  - 0.7 nm @ 1 kV with beam deceleration
  - 1.0 nm @ 500 V with beam deceleration
  - Coincident WD
  - 0.6 nm @ 15 kV
  - 1.2 nm @ 1 kV
- FIB resolution coincident WD
  - 20 nm @ 30 kV using preferred statistical method
  - 10 nm @ 30 kV using selective edge method
- EDS spatial resolution
  - < 30 nm on thinned samples

Gas delivery
- MultiChem integrated gas delivery system
  - Up to 6 chemistries can be installed
  - Up to 2 external gases can be installed
- GIS gas delivery system
  - Up to 4 independent GIS units can be installed
- *In situ* Chunk or TEM lamella Sample liftout
  - Easylift LT or EX nanomanipulator

Stage and navigation
- 5 axis all piezo motorized eucentric
- 100 mm XY motion
- Automated Loadlock
- NavCam+
- Sample types
  - Wafer pieces, packaged parts
  - TEM grids, whole wafers up to 100 mm
- Maximum sample size
  - 70 mm diameter with full travel

Software
- User interface
  - Windows® 7 GUI with integrated SEM, FIB, GIS, simultaneous patterning and imaging mode
- Auto Rocking Mill, Auto Chunking, Guided TEM prep and Auto Deprocessing

Key options
- MultiChem chemistries
  - Milling/Deprocessing: Dielectric-etch, Polyimide-etch, Dx, DE low-k Dielectric Etch
  - Conductor Deposition: Platinum, Tungsten, Carbon
  - Insulator Dep – IDEP2
- GIS chemistries
  - Milling/Deprocessing: Dielectric-etch, Polyimide-etch, Dx, DE low-k Dielectric Etch
  - Conductor Deposition: Platinum, Tungsten, Carbon
  - Insulator Dep – IDEP3
  - Silicon Trenching Option with Co-axial nozzle for High Speed Trenching & Sample Prep

Application software options
- iFast Developers Kit Professional automation software
- Guided TEM Prep
- Auto Slice&View™ software
- NEXS CAD Navigation, Synopsys Avalon Connectivity

Hardware options
- Dual QuipFlip sample holder shuttle
- STEM3+
- EBSD, EDS analysis
- IR Microscope
- Bulk Silicon Trenching
- Wide Area Bulk Silicon Trenching

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