



FEI FIB/SEM Failure Analysis

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FIB Capabilities



V-400 backside FIB
Circuit edit
Back- and front-side edits
45 nm capability



Dual-beam Helios
G4 and 450
Imaging and circuit edit
Cross-sections – slice and view
45 nm capability



Magellan SEM
Imaging
0.9nm resolution @<1kv

V-400 FIBs

CE

Nano-Chemix

- W deposition
- SiO₂ deposition
- Cl₂ etch
- XeF₂ etch
- H₂O etch

Gas Injection Systems

- XeF₂ IEE etch
- Dx etch
- De etch

Specifications

- Ion column
Tomahawk – Ga LMIS
- Acceleration Voltage: 0.5 – 30 kV
- Beam current: 1.1pA – 65 nA
- Image resolution: 4.5 nm
- Stage:
 - x,y motion: 100 mm
 - tilt: -10 – 60
 - rotation: 360

Features

- IR imaging
- Stageless navigation
- S-mill
- Drift compensation
- CAD layover
- Charge neutralizer

Concerns:

- FA capability below 45 nm
- Standard baseline process definition
- Improved navigation – laser interferometric stage?
- Improved IR imaging – magnification range – larger FOV
- Dx process development
- Improved secondary ion detection
- Interaction and possible technical applications with applications lab
- Communication about new capabilities

Dual-Beam Helios (G4 and 450)

FIB

CE capability:

Multi-Chem

- Pt deposition
- C deposition
- Dx etch
- De etch
- XeF_2 etch
- H_2O etch

Gas Injection Systems

- XeF_2 IEE etch
- Oxide dep

Specifications:

- Ion column
Phoenix – Ga LMIS
- Acceleration Voltage: 0.5 – 30 kV
- Beam current: 1.0 pA – 65 nA
- Image resolution: 3.0 nm
- 5-axes motorized x-y-z-rotate-tilt stage
with piezo control of all axes
travel along the x and y-axis is 150 mm
tilt range is –10 to 60 degrees

SEM

Imaging capability:

- Cross-sections
- Slice and view
- STEM
- MAPS

Specifications:

- Ultra-High Resolution
 - < 0.7nm @ <1kV
- 5-axes motorized x-y-z-rotate-tilt stage with piezo control of all axes
 - travel along the x and y-axis is 100 mm
 - tilt range is –10 to 60 degrees

Concerns:

- G4 not meeting specs
- Standard baseline process definition
- Interaction and possible technical applications with applications lab
- Communication about new capabilities
- Possible technical collaborations

Magellan SEM

- Ultra-High Resolution electron optics (magnetic immersion lens and ultra-high brightness Elstar emitter)
- UC technology for beam energy spread below 0.2 eV
- Beam deceleration for low-kV work
- Cryo-cleaner and plasma cleaner
- Detectors: in-lens SE and BSE
- Resolution: 0.9nm @<1kV
0.8nm @>5kV
- Sample biasing
- 5-axes motorized x-y-z-rotate-tilt stage with piezo control of all axes
- Travel along the x and y-axis is 100 mm
- Tilt range is –10 to 60 degrees

Concerns:

- This has been one of our biggest issues – cannot dependably use the MAPS software
- Plans for high-frequency nanoprobe?
- UC alignment issues

Additional Concerns

- What is Thermo-Fischer's next generation FA tool?
- Smallest feature size capable for FA?
- Are new sources on the Thermo-Fischer roadmap?
- Delayering capability over large areas
- Upgrades without network connections
- UI should include Universal settings as opposed to individual settings