



## CLM+™ Full Wafer DualBeam™

### Automated TEM Sample Prep and 3D Metrology for Semiconductor Manufacturing Support Laboratories

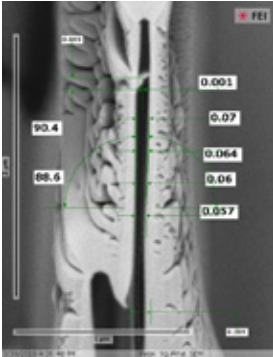
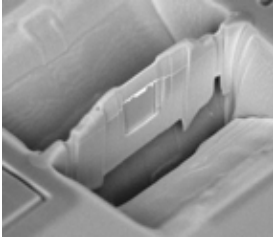
“Time is money.” Nowhere is this more true than in advanced semiconductor manufacturing. Anything that accelerates the process -- and maintains or improves yield -- adds value. The CLM+™ operates on both sides of this value equation. Today’s increasing need for high resolution images of devices for process control and failure analysis is driving the need for TEM imaging. FEI’s CLM+ is uniquely suited for producing critical TEM lamellae for ex-situ liftout and imaging. The Sidewinder ion column allows high throughput lamella creation, while its low voltage performance ensures a clean, damage-free milled surface for accurate TEM imaging and EDS analysis. Unsurpassed cut placement assures the desired target features are accurately captured. The CLM’s ability to monitor the performance of even the most advanced processes, by directly measuring three dimensional structures, permits manufacturers to improve yield in every phase of the process life cycle, from initial development through ramp and into high volume production. CLM+ provides this information through fully automated analysis at multiple sites on whole wafers in a fraction of the time required by conventional techniques. This accelerates the development process, allowing manufacturers to be first to market with high-margin products, first to volume with reduced unit costs, and fast to recover from costly yield excursions.

#### Rapid TEM Lamella Preparation

Today’s demanding semiconductor manufacturing processes increasingly require TEM analysis for CD control, defect analysis, process monitoring and more. The CLM-3D is capable of automatically producing lamella as thin as 70 nm for subsequent ex-situ extraction and TEM imaging. The system accepts wafer maps or defect location information (KLARF) from inspection tools. For defects, an automated or semi-automated process can be employed. Semi-automation allows for human location verification. After verification, the sites are marked and the lamellas produced automatically using automated recipes developed by FEI’s expert applications team.

#### Key Benefits

- Rapid, accurate lamella preparation for ex-situ TEM analysis
- Fast, accurate cross-sectional analysis for qualification and characterization of manufacturing processes
- Answers in minutes to support rapid decision making
- High throughput enables denser sampling for increased statistical significance and more confident decisions
- Faster time-to-market, faster ramp to volume, faster recovery from yield excursions
- Faster development, specification and qualification of etch, thin film, and copper processes



The CLM+ can automatically prepare site specific lamella as thin as 70 nm for subsequent examination in a S/TEM.

### Automated DualBeam™ Metrology

The CLM-3D's crisp SEM imaging with rapid FIB cross section milling provide fast accurate measurements of subsurface structures. The IC3D software allows completely automated operation, managing the entire measurement process from wafer loading to data return. In a typical sequence the system automatically aligns the wafer, navigates to the designated measurement site and refines alignment with machine vision.

The measurement process then deposits a protective metal layer, mills the cross section and images at high magnification. The system then automatically measures critical dimensions using the entire high resolution image. By quickly providing critical feedback from several samples, the CLM+ delivers real time process characterization or validation using a significant sample set.

### Sidewinder™ Ion Column

The Sidewinder™ ion column provides outstanding performance across a broad range of operating voltages and beam currents. At higher voltages, it achieves an optimal trade-off between beam current for milling speed and beam diameter for milling precision, helping to insure that valuable defect or process information is not destroyed during the cross-sectioning operation. Its ability to maintain a small beam diameter at low voltages enables a final low-energy, grazing-incidence clean-up of milled surfaces to remove surface damage. A full range of beam chemistry options supports accelerated milling, selective milling, deposition and enhanced imaging with both ion and electron beams.

## Specifications

### Electron Source

- Schottky thermal field emitter, over one year lifetime

### Ion Source

- Gallium liquid metal, 1000 hours

### SEM Resolution

- Optimal WD
  - 2.2 nm @ 2 kV
  - 3.8 nm @ 1 kV

### SEM Acceleration

- 500 V to 2000 V

### FIB Resolution

- Optimal WD
  - 7.0 nm @ 30 kV, secondary electron image

### Stage

- 4 axis motorized (X, Y, Z, R) 300 mm piezo driven XY motion

### Max sample size

- 300 mm wafer full travel

### User Interface

- Windows GUI with integrated controls for SEM, FIB, and GIS; simultaneous patterning and imaging modes

### Options

- Hardware
  - Beam chemistry
  - Configurable deposition and etch chemistries via electron and ion columns
- Software
  - IWatch™
  - IC3D™ offline workstation
  - Defect Navigation
  - RAPID™

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