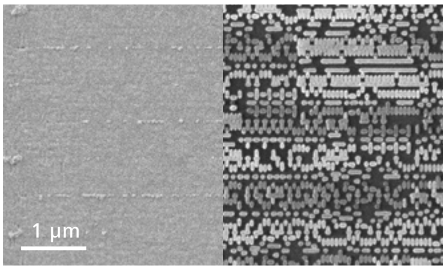
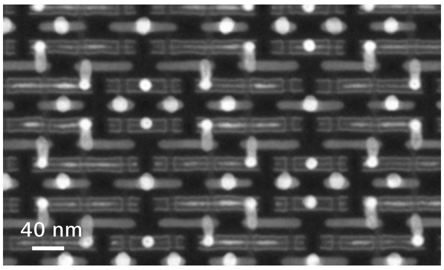
Perform versatile, high-resolution semiconductor imaging and characterization.

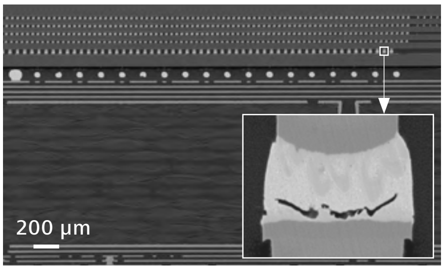
ZEISS GeminiSEM FE-SEM Family



Simultaneous imaging with secondary electrons to obtain topographic and voltage contrast on a 14 nm logic device at contact layer.



High resolution imaging and material contrast of 5 nm FEOL structures taken with Rapid BSD detector.



Extreme field of view imaging of 2.5D package interconnects. Inset: close up of 2.5D package cross section shows grain structure and solder crack in 20 µm microbump.

As semiconductor devices become smaller, faster, and more complex, IC designers have adopted 3D architectures with high interconnect density and implemented novel materials. The development, characterization, and failure analysis of these nanoscale devices require advanced instrumentation and techniques for imaging and analysis. ZEISS GeminiSEM field-emission scanning electron microscopes (FE-SEM) are optimized to meet these challenges.

Shrinking feature sizes and beam sensitive materials drive requirements for excellent SEM performance at the low acceleration voltages and currents used during device characterization and fault isolation. This provides surface sensitive imaging and superior contrast to differentiate device layers of similar compositions and nanoscale thicknesses, while ensuring the device and its defects are not damaged or electrically altered by the electron beam.

ZEISS FE-SEMs deliver superior imaging at the low kV beam energies required for passive voltage contrast and nanoprobing techniques. Industry-leading resolutions and magnifications are achieved at low-kV energies due to the absence of immersion magnetic fields or stage bias.

High-resolution Imaging, Analytics and Sample Flexibility

ZEISS GeminiSEM family delivers the performance required to characterize advanced node semiconductor devices.

The versatile GeminiSEM platform allows for easy integration of nanoprobing and AFM for advanced electrical characterization, as well as analytical techniques such as EDS and transmission Kikuchi diffraction (TKD) for material characterization. Large field-of view, large-area inspection, and reverse engineering applications are achieved at high resolution with distortion-free imaging, enabled by the linear optics in the Gemini column and automated through the ZEN platform.

Key Applications

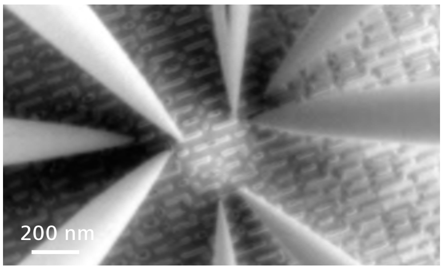
- Construction analysis and benchmarking
- Material and failure analysis
- Electrical fault isolation
- Passive voltage contrast
- Advanced electrical characterization
- EBIC/EBAC and nanoprobing

ZEISS

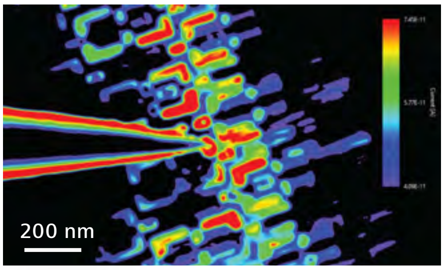
Seeing beyond

GeminiSEM Platform Benefits for Nanoprobing

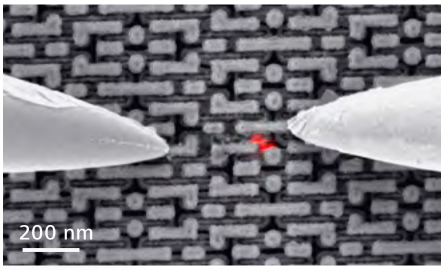
- Immersion free optics – no perturbation during electronic property measurements
- Low voltage high resolution performance for beam sensitive advanced node devices
- Most stable beam current in the industry for high-precision electrical property measurements
- Large field of view without distortion to analyze large circuitry, connected blocks and monitor probe landing
- Proven stability and performance for *3 nm technology node*



Probes landing on a 7 nm SRAM array in SEM-based nanoprober.



EBIC analysis of an SRAM array, highlighting p+/n-well and n+/p-well junctions in the probe area.



EBIRCH analysis highlighting an over-stressed fin in a multi-fin device.

Technical Specifications

	ZEISS GeminiSEM 560	ZEISS GeminiSEM 460	ZEISS GeminiSEM 360
Resolution*	0.4 nm @ 30 kV (STEM)	0.6 nm @ 30 kV (STEM)	0.6 nm @ 30 kV (STEM)
	0.5 nm @ 15 kV	0.7 nm @ 15 kV	0.7 nm @ 15 kV
	0.7 nm @ 1 kV TD	1.0 nm @ 1 kV / 500 V TD	1.0 nm @ 1 kV TD
	0.8 nm @ 1 kV	1.1 nm @ 1 kV / 500 V	1.2 nm @ 1 kV
	1.0 nm @ 500 V	1.5 nm @ 200 V	—
Analytical Resolution	—	2.0 nm @ 15 kV, 5 nA, WD 8.5 mm	—
Inlens BSE Resolution	1.0 nm @ 1 kV	1.2 nm @ 1 kV	1.2 nm @ 1 kV
Resolution in NanoVP mode (30 Pa)	1.4 nm @ 3 kV	1.4 nm @ 3 kV	1.4 nm @ 3 kV
	1.0 nm @ 15 kV	1.0 nm @ 15 kV	1.0 nm @ 15 kV
Acceleration Voltage		0.02 - 30 kV	
Probe Current	3 pA - 20 nA	3 pA - 40 nA	3 pA - 20 nA
	(100 nA configuration also available)	(100 nA configuration also available)	(100 nA configuration also available)
Maximum field of view in high resolution mode	1.6 mm @ 1 kV and WD = 7 mm	5 mm @ 5 kV and WD = 8.5 mm	5 mm @ 5 kV and WD = 8.5 mm
Maximum field of view in overview mode	5.6 mm @ 15 kV and WD = 8.5 mm		
	130 mm @ max. WD (ca. 50 mm)		
Magnification	1 - 2,000,000	8 - 2,000,000	8 - 2,000,000

* Upon final installation, the resolution is proven in the systems acceptance test at 1 kV and 15 kV in high vacuum.

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