

Uncover **voltage contrast**

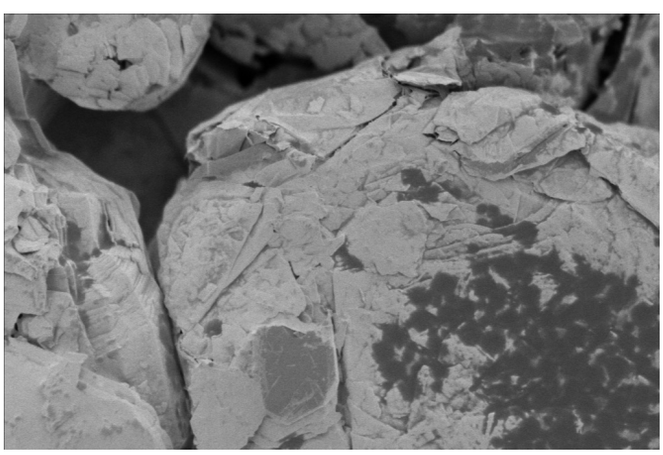
Ultra-low voltage detector on ZEISS GeminiSEM

zeiss.com/ulv

Seeing **beyond**

When aiming to characterize advanced materials and semiconductor samples, the **ultra-low voltage (ULV) detector** on ZEISS GeminiSEM enables you to reveal subtle differences in electrostatic potential and material composition. No matter whether you are working in a failure analysis lab, in academia, or in semiconductor industry you can easily perform gentle imaging on delicate samples at ultra-low voltages even below 200 V.

The **ultra-low voltage detector**, available for all ZEISS GeminiSEMs, lets you map differences in electronic potential. Collect information beyond topography and conventional material contrast from your samples. Gain access to voltage-sensitive, near-surface information from your specimen.



Graphite anode of a battery with two binders. GeminiSEM, 100 eV, ULV detector.

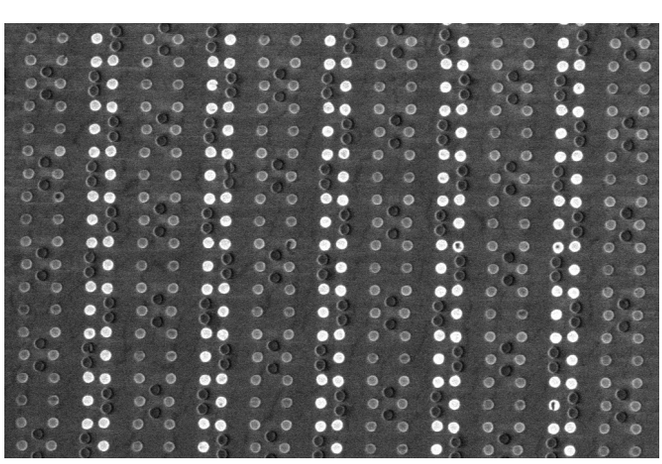
ULV images at 200 V and below

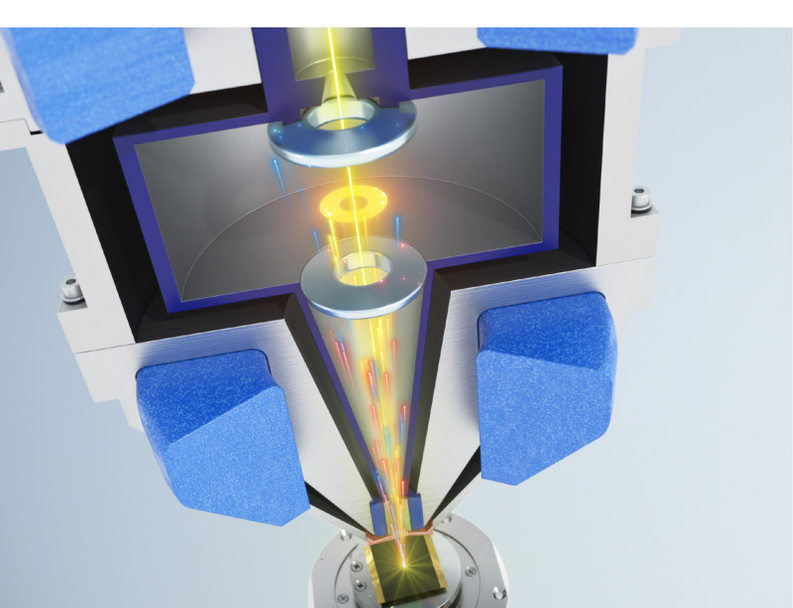
Obtain clearer images with lower signal-to-noise reliably. Achieve high resolution of 1 nm at 200 V due to improved detector sensitivity. And benefit from retaining useful image quality, even at ultra-low voltage.

Enhanced material and voltage contrast

Reveal stronger voltage and doping contrast. Separate phases in complex samples easily. Get excellent results for segmentation and analysis.

SRAM device, PVC imaging of vias and transistor-related structures. GeminiSEM, 300 eV, ULV.

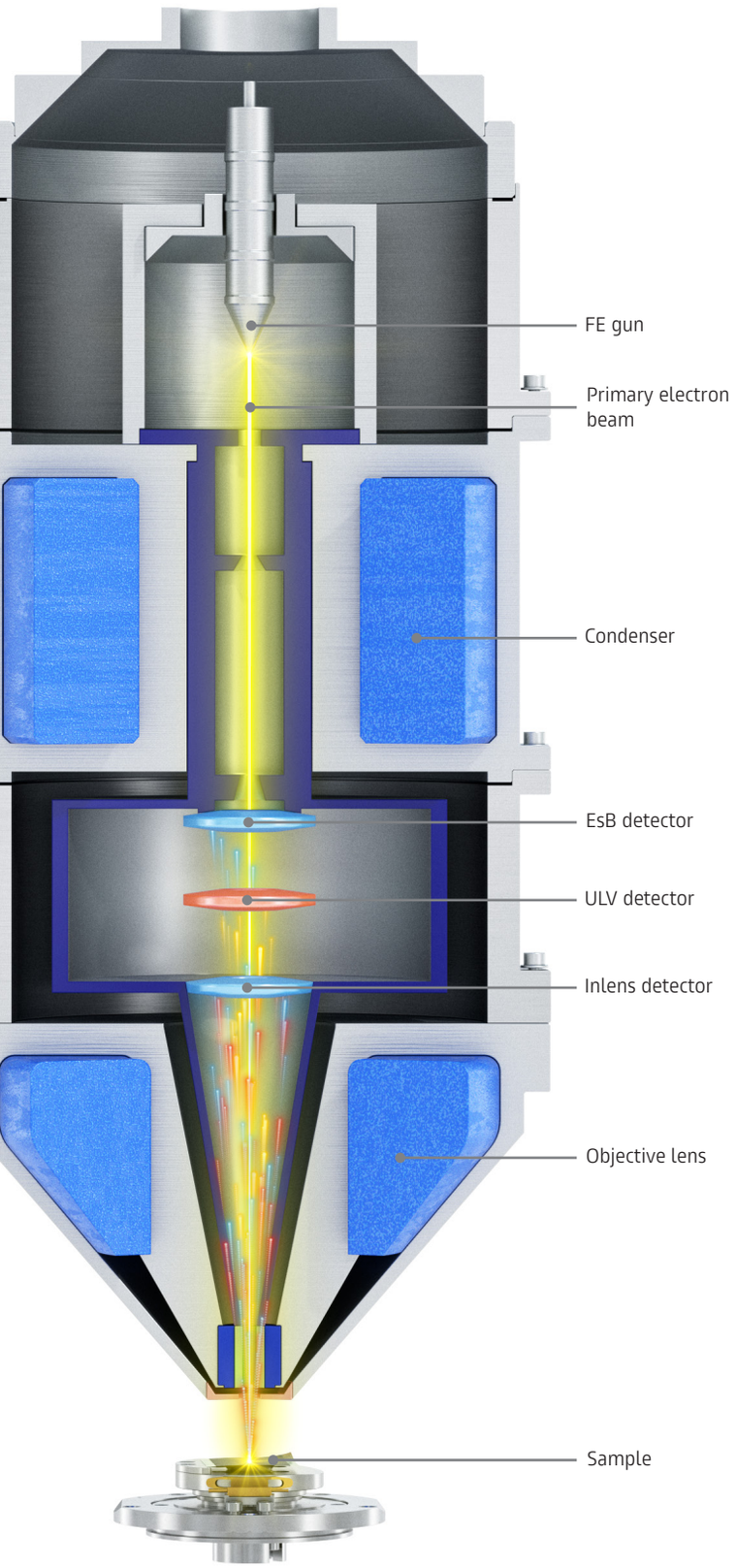




Collect all information in a single workflow

Capture information on differences in voltage or doping. Reveal features beyond conventional in-column detection and compare Inlens, ULV, and EsB (energy selective backscatter) images in one workflow. You will benefit from the ability to discern all data on topography, electrical potential, and composition simultaneously.

Technology insight



Column cross-section of a GeminiSEM with ultra-low voltage detector.
Scattered electrons: low energy SEs yellow, SEs red, backscattered electrons blue.

Reveal subtle differences of your sample

The ULV detector on ZEISS GeminiSEM efficiently captures low-energy secondary electrons (SE) that respond to local surface potential and near-surface material differences. As an in-column detector it sits between Inlens and EsB detector. Together, these three channels provide topography, voltage, and material contrast, and energy-filtered backscatter information in only one workflow.

How passive voltage contrast becomes visible

- Different conductive and non-conductive regions can develop different local surface potentials. These local surface potentials shift the emitted secondary-electron energy distribution.
- Low-energy secondary electrons respond strongly to that shift. As a result, the ULV detects the shift more sensitively than conventional in-column detection.
- As a result, composites of non-conductive and conductive materials are imaged with strong contrast and enable a comprehensive characterization of the samples' properties easily.

Applicational benefits

- Enhanced passive voltage contrast
- Improved material discrimination
- Better low-voltage image quality
- High efficiency at ultra-low voltages, far below 500 V
- Enables segmentation and phase analysis
- Delivers information complementary to data from Inlens and EsB imaging

Technical specifications

Detection System*	ZEISS GeminiSEM 360, 460, 560
In-column detection system*	Detection system equipped for parallel detection and signal processing of multiple detector channels: • Four detector channels and one TV input as standard • Parallel detection, processing, and display of up to four channels possible • Upgrade to up to 16 detector channels and up to three TV inputs possible • Any two signal detector inputs can be mixed for enhanced image information
Configurations	Inlens SE
	Inlens SE, EsB
	Inlens SE, EsB, and ULV
Inlens SE detection as standard	Column-mounted scintillator detector with optically coupled photomultiplier for high-efficiency surface-sensitive imaging.
EsB detector option	Column-mounted, high-efficiency scintillator detector with an optically coupled photomultiplier for detecting energy- and angle-selective backscattered electrons. Filtering grid adjustable from 0 V to – 1.5 kV for energy filtering. The Inlens SE and EsB detectors can be used in parallel.
ULV detector option	Column-mounted, high-efficiency scintillator detector with an optically coupled photomultiplier for detecting low-energy SE, enabling voltage contrast. Increased efficiency for ultra-low-voltage applications <500 V.
ULV detector resolution	1.0 nm at 200 V

* Additional detection options are available e.g., SE, BSD, VPSE, CL, STEM. Retrofit possible – for more information, please contact your local sales and service representative.

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