Супербыстрые сканирующие электронные микроскопы MultiSEM 505, MultiSEM506, рабочие станции 3D-метрологии и инспекции 3D Metrology and Inspection Workstation

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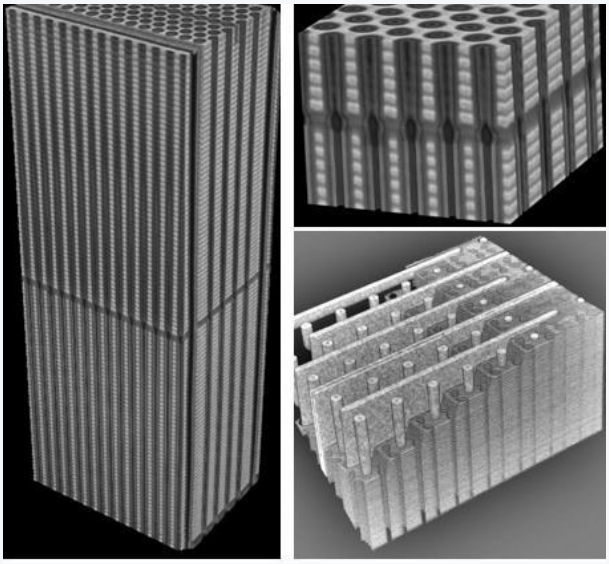
ZEISS 3D METROLOGY AND INSPECTION WORKSTATION

Making complex structures intelligently visible

Future-proof microchip development

(Un)imaginably small and precise



3D Metrology and Inspection Workstation for Semiconductor Manufacturing

Metrology and process control

Moore's law continues: The number of transistors on a microchip is growing continuously. They are becoming ever more compact and powerful. If you no longer want to analyze memory chips in nanofine 2D structures, but in spatial 3D structures, then this places particularly high demands on process control. This applies both to the production of NAND gates, as used in SSD hard disks, but also to the production of memory chips with DRAM technology, which are mostly used as working memory. This also increases the challenges for metrology (measurement technology) and validation in semiconductor manufacturing processes.

3D analysis from ZEISS

Metrology Workstation

Previous 2D imaging and analysis techniques are no longer sufficient for today's complex and small microchips. ZEISS empowers chipmakers worldwide with process control systems such as 3D Metrology and Inspection Workstation, which combines high-resolution 3D imaging technology with live imaging and the highest throughput data-driven analysis platform. For 3D high-throughput analysis and sample preparation. For process development and failure analysis. For the validation of state-of-the-art semiconductor memory manufacturing processes with 3D Metrology and Inspection Workstation.

Unique in the world

- **0,9 nm**

SEM resolution at the coincidence point at 15 kiloelectron volts (keV)

- **1,8 nm**

SEM resolution at the coincidence point at 1 kiloelectron volts (keV)

- **1 nA - 100 pA**

SEM beam current

- **300 mm**

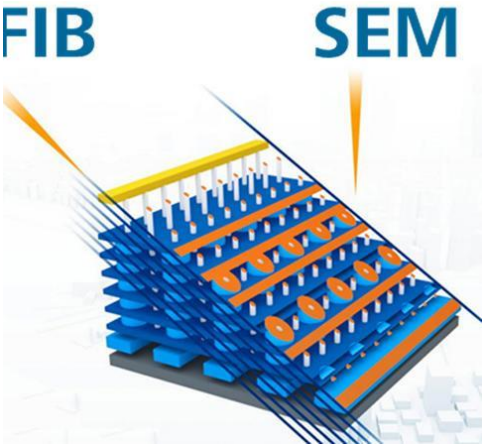
Sample size of the wafers

The scalpel for complex semiconductor structures

The 3D Metrology and Inspection Workstation from ZEISS

The 3D Metrology and Inspection Workstation allows the volume of microchips to be sampled, analyzed and validated with nanometer accuracy using FIB tomography. ZEISS relies on a high-resolution 3D imaging process in combination with an intelligent analysis platform.

Product Highlights



FIB-SEM combination

Randomly exposed wafers are removed from chip production. The Focused Ion Beam (FIB) microscope is the heart – the "scalpel" – of the 3D Metrology and Inspection Workstation. This focused ion beam cuts out random samples at various points on the wafer, whose three-dimensional nanostructures are then precisely examined using a scanning electron microscope (FIB-SEM).

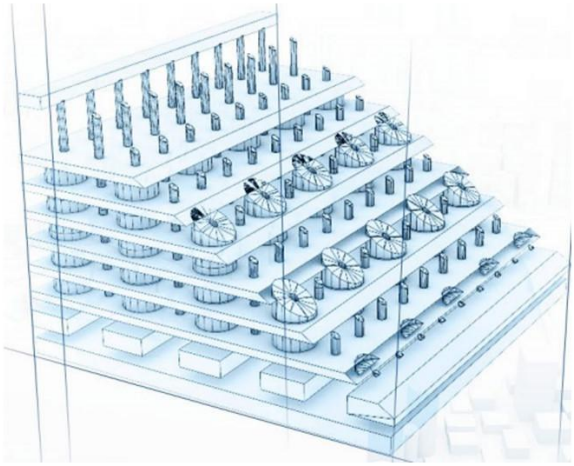
All in one device

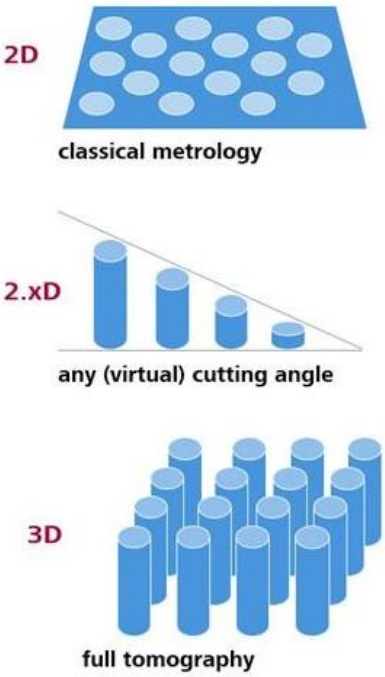
ZEISS brings all the steps of high-resolution 3D analysis under one roof: specimen preparation, structure and defect detection, 3D analysis – all in one device. The modular platform concept and powerful reconstruction and analysis software of this 3D Metrology and Inspection Workstation enable high-throughput process control, structural inspection and failure analysis.

AI helps with analysis and troubleshooting

Artificial intelligence is also used here, as the workstation learns from previous analysis results and thus constantly feeds its own wealth of experience. In other words, high statistical significance can be achieved with few samples. This in turn allows valid conclusions to be drawn about the quality of the entire process chain.

High resolution 3D display





Overcoming complex process challenges

The highest slicing sharpness in its class for a maximum voxel count (3D resolution). With fully automated volume acquisition, in an extremely wide-angle field of view, and intuitive workflow, the workstation provides valuable insights for metrology and defect detection in the manufacturing of 3D memory chips.

Highest resolution and precision

The 3D Metrology and Inspection Workstation succeeds in measuring complete 3D profiles, evaluating structural properties and generating a solid statistical database in the process. Highly complex structures can be inspected from any direction in highest 3D resolution with simultaneous high signal-to-noise ratio. This makes it possible to identify even the smallest defects in structures.

ZEISS Atlas 5

Intelligent, integrated, intuitive

The Atlas 5 platform from ZEISS allows the capacities of the 3D Metrology and Inspection Workstation to be expanded. Market-leading solution for fast and accurate tomography speeds up acquisition by scanning only relevant volumes. In the shortest possible time, the required amount of information is represented by large mosaic tiles, with simultaneous multichannel acquisition. The modular architecture, scripting interface of the workflow engine and scalable hardware architecture make customization possible. The sample-centric, correlative environment provides integrated, cross-technology workflows.

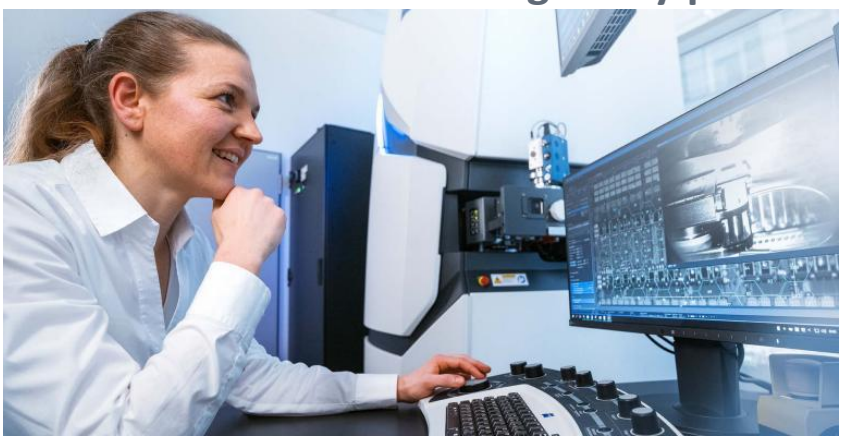
ZEISS MULTISEM

Speed revolution

The world’s fastest scanning electron microscope

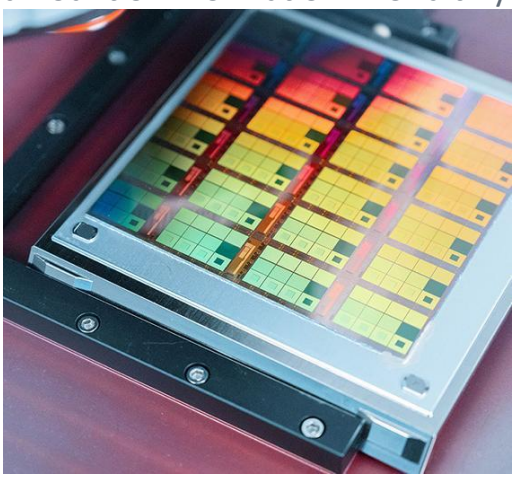
Facts & FiguresProduct Highlights

Unimaginably precise and fast



Unimaginably precise

In one cubic millimeter of the human brain there are tens of thousands of neurons and millions of synapses. Researchers from Harvard have succeeded in imaging these structures thanks to the MultiSEM from ZEISS Semiconductor Manufacturing Technology (SMT): through 225 million composite individual images with a data volume of 1400 terabytes (J. W. Lichtman, Harvard University). Converted, that's about 500 billion pages of text. An unimaginable amount of information – for a tiny fraction of the brain.



Unimaginably fast

The way of visualizing the human brain is not far from the representation of structures of microchip production. It is conceivable and possible thanks to the multi-beam scanning electron microscope from ZEISS MultiSEM for short. One of the most powerful electron microscopes with the world's fastest data acquisition for previously unthinkable research results in biology, materials science and semiconductors. For the fastest extraction of the largest amounts of data. For the next technological breakthrough.

Unique in the world

- **91**

Parallel electron beams simultaneously

- **1.500**

Gigabyte per hour data rate

- **24/7**

Designed for reliable continuous operation – around the clock

- **> 1 bn.**

Pixels in under 1 second acquisition time (per image field and scan)

- **3,5 nm**

Scanning in the nanometer range

High-end technology for the semiconductor industry

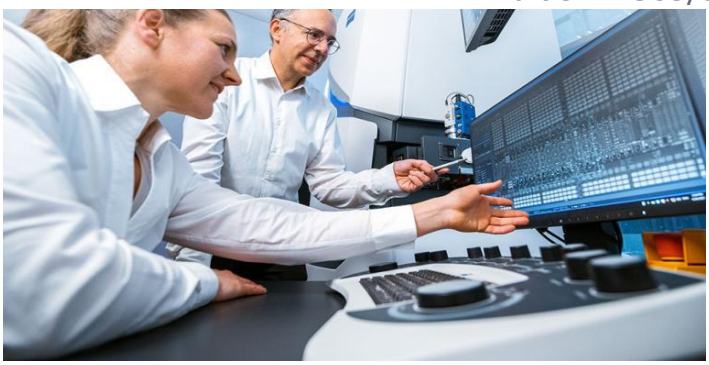
Whether brain research or microchip production: The ZEISS MultiSEM enables unique insights and analyses.

Working in the nanometer range

In industrial laboratories, it's all about precision and speed. Thanks to innovative multi-beam imaging, the MultiSEM works incredibly fast and with high resolution in the nanometer range. It is therefore used to study microchips with structure sizes in the nanometer range.

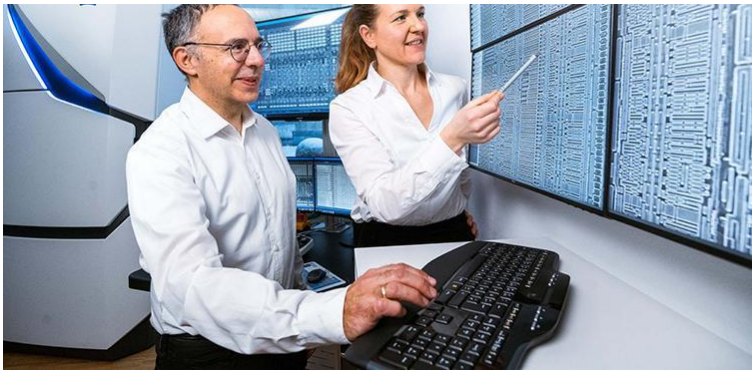
Product Highlights

MultiSEM 505/506 from ZEISS



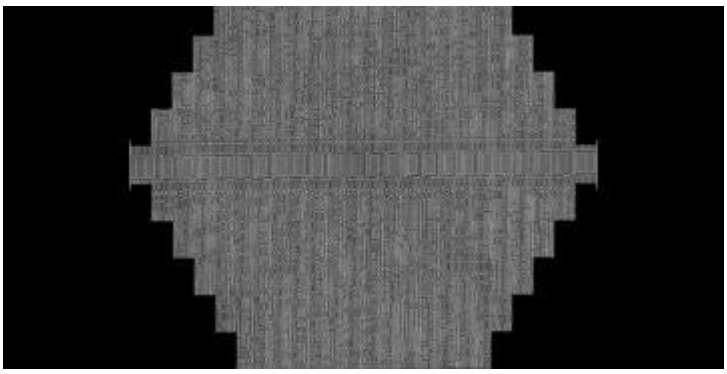
Multi-beam imaging

At the heart of the MultiSEM is multi-beam imaging: 91 parallel electron beams visualize complex 2D structures simultaneously and fully automatically at an incomparably high imaging speed. For an area of one square centimeter, the MultiSEM 506 from ZEISS requires around six hours with a pixel size of 3.5 nanometers. This corresponds to a data rate of about 1.5 terabytes per hour.

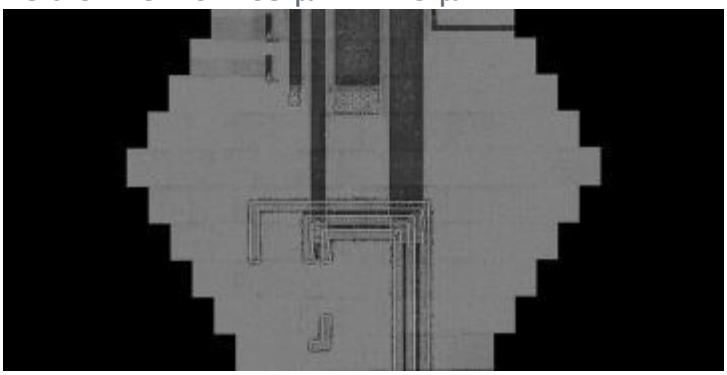


High contrast, low noise and rich in detail
The result is high-contrast images with very low noise thanks to highly efficient detection of secondary electrons. Automated imaging protocols make large-scale, detailed imaging with high nanometer resolution possible. Tiny details become accessible in a macroscopic context.

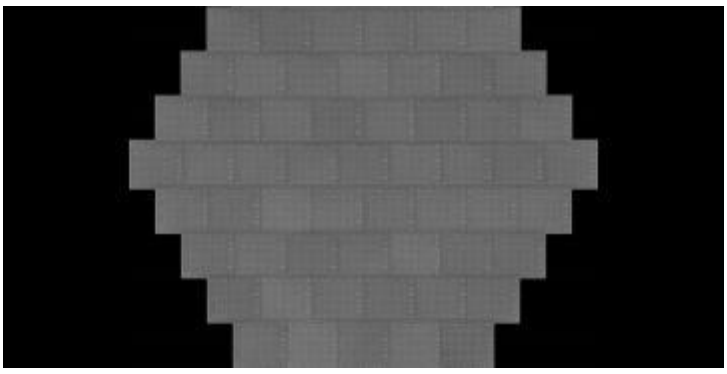
ZEISS MultiSEM in use

- 

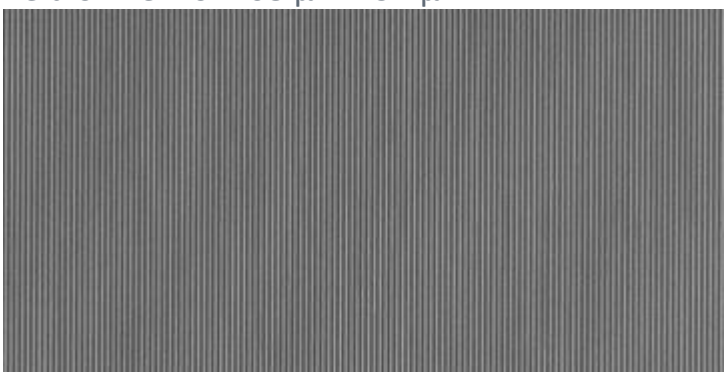
  Graphical processor
  Multi-beam image acquired with the MultiSEM 506 with 4 nm pixel size covering a hexagonal field of view of 165 µm x 143 µm.

- 

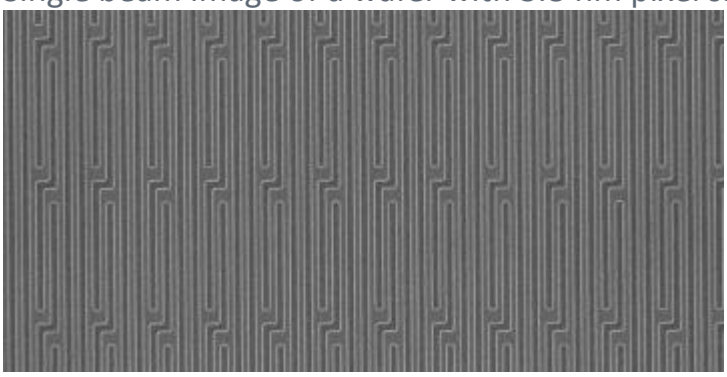
  20 nm gold/palladium particles
  Multi-beam image acquired with the MultiSEM 506 with 4 nm pixel size covering a hexagonal field of view of 165 µm x 143 µm.

- 

Silicon test sample
Multi-beam image acquired with the MultiSEM 505 with 4 nm pixel size covering a hexagonal field of view of 108 µm x 94 µm.

- 

Semiconductor wafer
Single beam image of a wafer with 3.8 nm pixel size.

- 

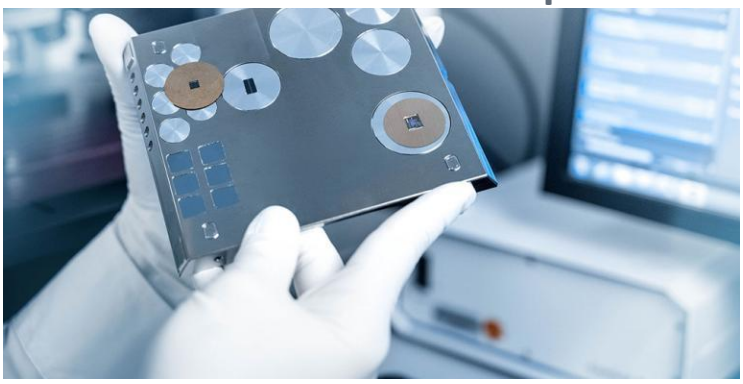
EUV mask
Single beam image of an EUV mask with 3.8 nm pixel size.

ZEN Imaging Software

Intuitive and user-friendly

Added to this is ZEN (ZEISS Efficient Navigation), an intuitive and user-friendly software from ZEISS SMT that can be used to control the MultiSEM. Highly automated software routines ensure easy operation of the user interface, with routine experiments organized in the clear and intelligent data management system. Together with the powerful parallelized image acquisition pipeline, this saves many hours of manual work.

Other potential applications



Reverse engineering of computer chips

Qualification and testing in a short time

Qualify trusted suppliers or detect threats from built-in backdoors: The ZEISS MultiSEM's large-area imaging with nanometer-scale resolution ensures faster data extraction from the exposed inner workings of modern microelectronics. ZEISS SMT can thus make a decisive contribution to the development of so-called "trusted chips" and to improving cyber security.

How the MultiSEM works

Parallel. Fast. Powerful.

ZEISS MultiSEM achieves its high imaging speed through the parallel use of multiple electron beams and the detectors assigned to each. All beams scan the sample surface synchronously. The hexagonally arranged partial images generated in this process are then combined to form the overall image field. The high imaging speed and a parallel server architecture ensure fast data recording. Image acquisition and microscope control are perfectly matched in the MultiSEM system to ensure full performance at all times.

ZEISS MultiSEM 505 and 506

With 61 or 91 beams

ZEISS MultiSEM 505 operates with 61 parallel beams and a data rate of up to one terabyte per hour. 91 electron beams are used in the ZEISS MultiSEM 506, resulting in an even higher data throughput. A larger area is scanned per scan pass. The more powerful version generates up to 1.5 terabytes of data per hour.

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