ZEISS Semiconductor Mask Solutions

www.zeiss.com/mask-solutions

Seeing beyond

What Drives Us

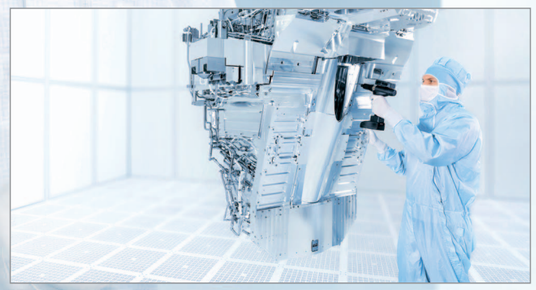
As the pioneer of scientific optics, we continue to challenge the limits of human imagination. With our passion for excellence, we create value for our customers and inspire the world in new ways.

Excellent Service

Great team

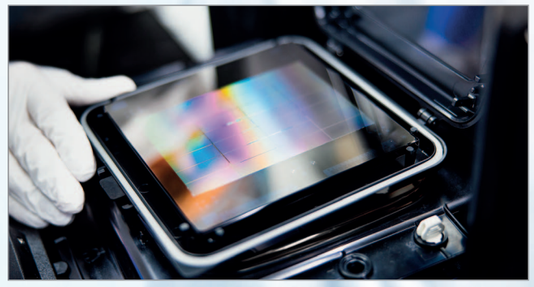
ZEISS is an internationally leading technology enterprise operating in the fields of optics and optoelectronics. For its customers, ZEISS develops, produces and distributes highly innovative solutions for industrial metrology and quality assurance, microscopy solutions for the life sciences and materials research, and medical technology solutions for diagnostics and treatment in ophthalmology and microsurgery.

Comprehensive experience in semiconductors



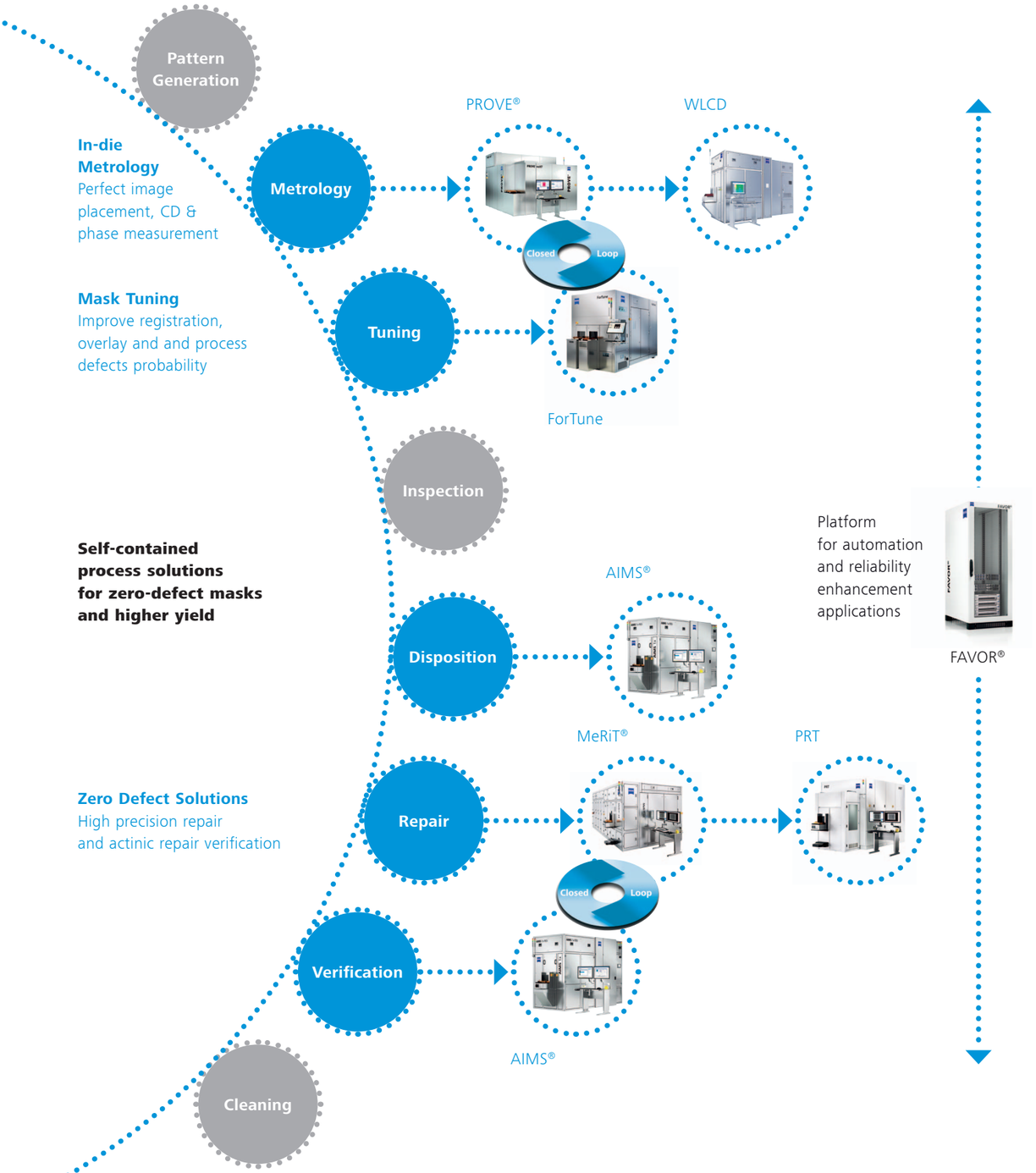
ZEISS is the global technology leader in the manufacture of systems and modules for microchip production. With semiconductor manufacturing optics, photomask systems and process control solutions, ZEISS supplies key technologies for the production of ultra-fine conductor track structures on silicon wafers.

Dedicated to photomask technology



The ZEISS Semiconductor Mask Solutions provides unique solutions for the mask making industry to manufacture zero-defect photomasks. Our solutions cover EUV and DUV masks as well. Please find an overview of the available solutions in the following pages.

ZEISS Perfect Mask Solutions



Mask Qualification

ZEISS AIMS – Aerial Image Measurement for DUV and EUV

AIMS® – The industry standard for defect review and repair verification!

AIMS® (Aerial Image Measurement System) is a unique mask qualification system for defect review, printability analysis, and repair verification of todays and future generation photomasks.

The product portfolio supports ArF immersion, KrF and EUV lithography. By measuring and analyzing the aerial image of the photomask under the same optical conditions as in the wafer printing process the ZEISS AIMS technology provides reliable characterization of mask defects with respect to their real effect in the lithographic process. Based on the AIMS® 1x platform ZEISS offers the WLCD 2G application providing the capability to measure the CD in aerial image capturing OPC, MEEF and mask 3D effects. It addresses the CD metrology challenges of advanced lithography nodes with high MEEF pattern having an increased risk to fail in wafer printing.

For reviewing defects on EUV masks, ZEISS offers the next generation of its AIMS® EUV. With its high precision stage for defect location accuracy and the employment of an EUV plasma Source, AIMS® EUV meets the industry production requirements for manufacturing defect-free EUV photomasks.

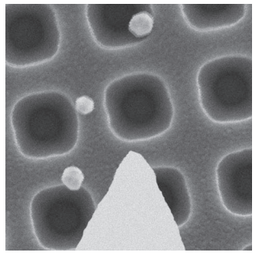
Learn more: www.zeiss.com/mask-qualification

Mask Repair

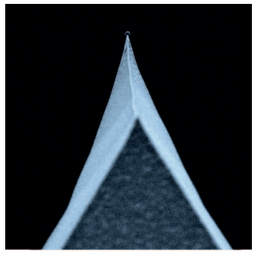
ZEISS PRT – Fast Particle Removal on Photomasks

PRT – Control your repair process!

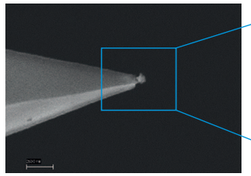
Review SEM, material analysis and repair in one tool – that is the Particle Removal Tool (PRT). It removes even the smallest particle from photomasks, blanks and EUV pellicles.
The system picks particles out of very small features such as EUV contact holes. The real-time imaging capability gives the user real-time feedback and the ability to fully control the removal process.
PRT measures the particle material with EDX, enabling to identify and eliminate the root cause.



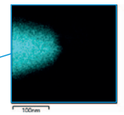
Removal of particle from contact hole



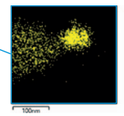
PRT allows for separated analysis…



Tip carrying a particle



…of tip material and…



…particle material

Particle Removal → Removes extreme small particles using real time imaging

Material Analysis → Particle is measured with EDX allowing for material analysis

Root Cause Identification → Material analysis enables to identify and eliminate root cause

Mask Repair

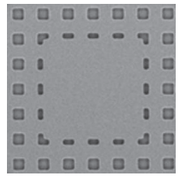
ZEISS MeRiT – E-beam based Mask Repair Technology

MeRiT® – Elevating your repair performance!

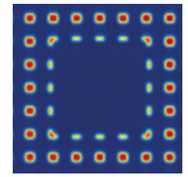
MeRiT® enables the repair of all kind of photomask defects with the highest precision. Based on e-beam technology the system covers opaque and clear defect repair in one platform. MeRiT® achieves superior resolution and accuracy for repair, while the repair process causes no unwanted transmission loss and no contamination. The system is able to repair all mask materials including EUV photomasks.

Learn more: www.zeiss.com/mask-repair

Pre-Repair image

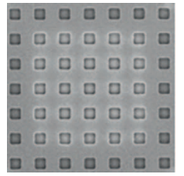


SEM@MeRiT®

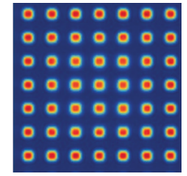


AIMS® EUV image

Post-Repair image



SEM@MeRiT®



AIMS® EUV image

Defect repair → Clear and dark defect repair on DUV and EUV reticles

Review SEM → Fully automated defect imaging and qualification

AutoRepair → Full- and semi-automated removal of defects

Tool Monitoring → Equipment health monitoring and FDC interface

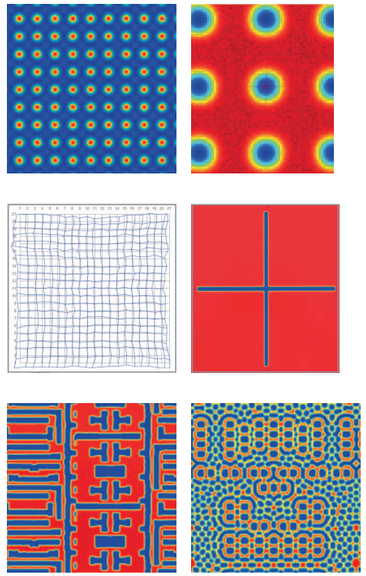
Mask Metrology

ZEISS PROVE – A high precision pattern placement metrology tool

PROVE® – You can correct what you can measure!

The photomask registration and overlay metrology system ZEISS PROVE measures image placement with sub-nanometer repeatability and accuracy.
The key component of ZEISS PROVE is the diffraction limited, high resolution imaging optics operating at 193 nm – corresponding to at-wavelength metrology for the majority of current and future photomask applications.
The high precision stage is actively controlled in all six degrees of freedom. The only moving part in the metrology system is the stage.

Learn more: www.zeiss.com/mask-metrology



Pattern Generator Calibration → PROVE® calibrates and corrects the pattern placement of writing tools (E-Beam & Laser)

Mask Process Control → Registration is an integral part of any standard mask qualification process

In-die Metrology → PROVE® provides detailed registration information of production features

Mask Tuning

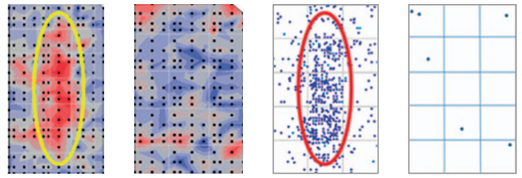
ZEISS ForTune – Intra-Field solutions of High Lateral Resolution

ForTune – Exceeding the boundries of lithography!

ForTune helps IC manufactures in several ways to meet tightest specification in terms of wafer Critical Dimension Uniformity (CDU), mask registration or On-Product Overlay (OPO). The CD correction process (CDC application) improves intrafield CDU, which reduces process defects on wafers significantly. The RegC® application will either improve mask registration or wafer On-Product Overlay. For EUV masks a new system has been developed which allows RegC® application on EUV mask (70 nm TaB backside coating).

Learn more: www.zeiss.com/mask-tuning

Improved CDU leads to significant defect reduction on wafer



Pre CDU *Post CDU* *Pre Defects* *Post Defects*

Registration correction application → ForTune improves On-Product Overlay (OPO) by 0.2-0.5 nm on top of scanner correction

CDU improvement application → ForTune reduce CDU 3 Sigma down to 0.2 nm resulting in process defects reduction

Digital Solutions

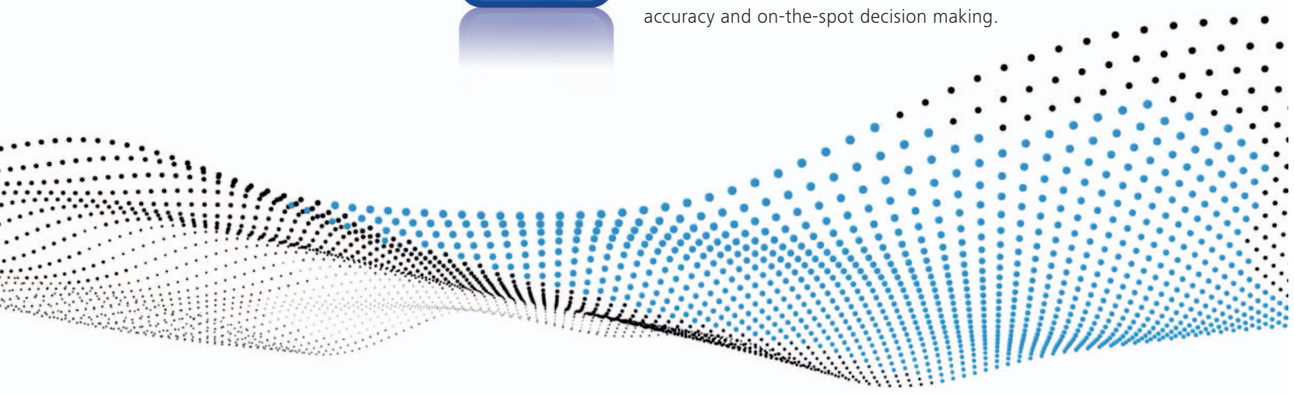
Every ZEISS mask solution can be enhanced by a prevailing software application. All applications run on the new generation FAVOR® 3.0, one of the most modern platforms for realizing HPC requirements and the creation of a centralized and homogenized ecosystem.

AIMS® AutoAnalysis (AAA) allowing for fully automated analysis of aerial images, data flow and information processing. The image processing and evaluation runs in parallel to the AIMS® measurements therefore eliminating time consuming, post measurement analysis. AutoAnalysis shortens cycle time and increases reliability ensuring your quality targets are met. The application is available for DUV AIMS® Systems as well as for AIMS® EUV.

MeRiT® AutoAnalysis (MAA) automatically analyzes the repair images captured by MeRiT®, which means manual measurements are no longer necessary to a very large extent. Using MAA saves time and costs.

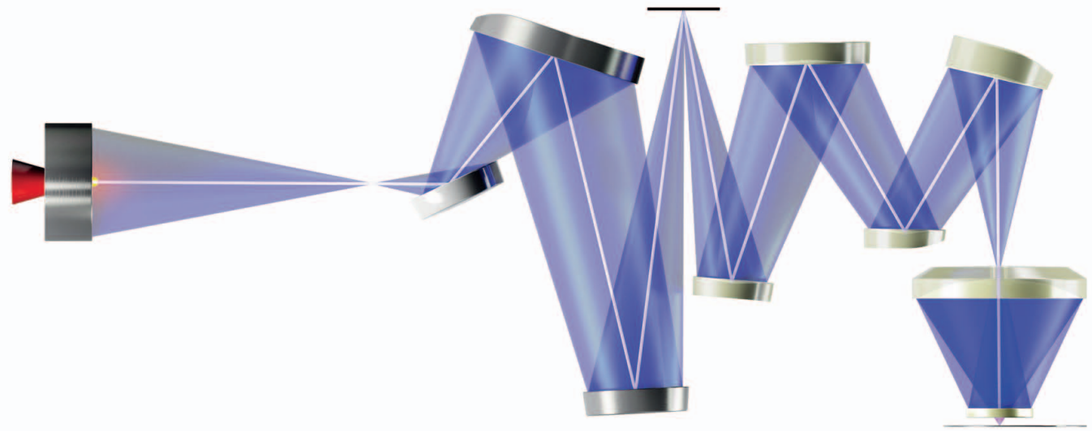
The **Advanced Repair Center** (ARC) is a powerful software solution facilitating effective data management and process flow optimization for the entire defect handling process. Repair enhancement features provide tools to improve repair success. ARC allows you to significantly reduce mask returns and cycling time.

The **ForTune Tuning Module** (FTM) enhances the performance of the ForTune Mask Tuning System. It facilitates recipe creation as well as extensive data analysis and simulations prior to the process. This module's versatile job handling capabilities ensure high process efficiency, superior prediction accuracy and on-the-spot decision making.



EUV Mask Solutions

ZEISS solutions supporting the EUV mask infrastructure



Ready for EUV!

Extreme ultraviolet (EUV) lithography today is deployed to high-volume chip manufacturing. EUV masks are significantly more complex than their predecessors in DUV lithography. Their manufacturing complexity and value is increasing accordingly. This also means that the economic pressure not to lose masks during the manufacturing process is soaring. In the following we present the broad range of solutions ZEISS is offering to ensure defect-free manufacturing of EUV Masks.

AIMS® EUV

A key enabler is the actinic mask qualification system AIMS® EUV, which fully addresses the industry requirements for EUV defectivity review. The AIMS® EUV platform is capable to provide a full understanding of the EUV imaging process and allows for mask qualification applications based on the employment of proven aerial image technology.
Automation in image analysis and data processing can be enhanced employing the AIMS® EUV AutoAnalysis software package.

MeRiT® LE

MeRiT® LE is particularly focusing on EUV repairs. It features a decreased minimum repair size and improved edge placement accuracy to address the increased number and complexity of pattern defects on high-end photomasks.

PRT

The Particle Removal System removes even the smallest particle from photomasks, blanks and EUV pellicles. The system picks particles out of very small features such as EUV contact holes.

ForTune EUV

ForTune EUV optimizes EUV masks by improving the wafer overlay based on mask registration or wafer intra-field overlay input. The newly developed system enables mask tuning for EUV masks with standard mask backside coating (e.g. 70 nm TaB) by femtosecond-laser processing.

PROVE® neXT

The latest PROVE® generation enables the measurement of EUV mask with superior repeatability and accuracy. With its best in class resolution it is the tool of choice to localize EUV – Blank defects with highest precision. Powerful and fast DB – mode measurement schemes support extensive sampling as needed for the calibration of state of the art multibeam writers.

Learn more under
www.zeiss.com/mask-solutions

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