

MO Exposure Optics

Innovation for SUSS MicroTec Mask Aligner

SUSS MicroOptics SA

www.mask-aligner.info

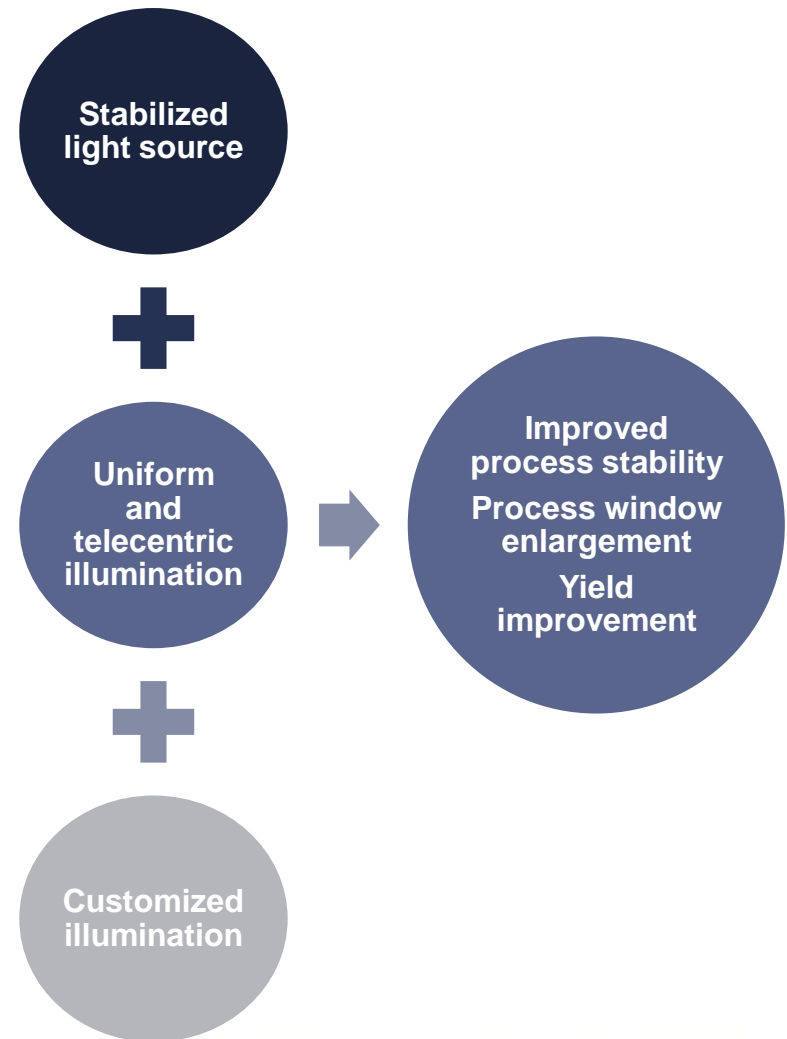
mo-info@suss.ch

+41-32-7205104

MO Exposure Optics: At a Glance

Technology Enhancement

- + New patented illumination system for all SUSS MicroTec Mask Aligners
- + Based on two micro-optical integrators made of fused silica
- + Possibility to upgrade the installed base of SUSS MicroTec mask aligners
- + Major step forward in process window enlargement and yield improvement
- + Resolution and proximity gap enhancement

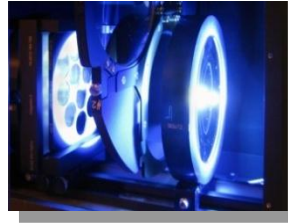


Innovation for Mask Aligner Lithography

Customer Benefit

MO Exposure Optics

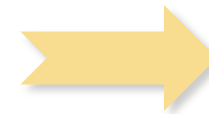
- + Stable light source
- + Excellent uniformity
- + Uniform angular spectrum
- + Telecentric illumination



- + Reduced maintenance
- + Improved CD uniformity
- + Larger process window
- + Higher yield in production

Customized Illumination

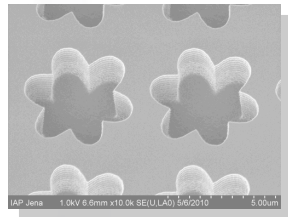
- + Change from HR* to LGO** in < 1 minute
- + Library of Illumination Filters (IFP)
- + Customized illumination to further reduce diffraction effects



- + Flexible illumination
- + Diffraction reduction
- + Correct line ends and edges

Source-Mask Optimization

- + Optical Proximity Correction (OPC)
- + MO Pinhole Talbot Lithography (MOPTL)
- + Complete solution including customized illumination, OPC design and photomask
- + Onsite litho consulting and training



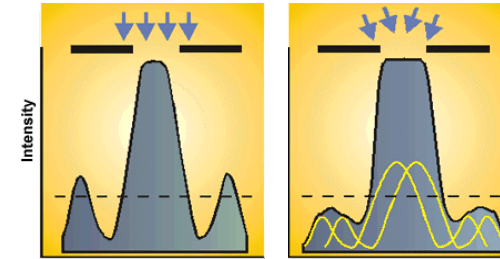
- + Optimize critical litho process
- + Increase depth of focus (DoF)
- + Resolution enhancement
- + Sub-micron large-gap proximity

New Illumination Concept

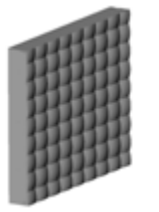


Diffraction Reduction

+ Defines illumination settings by Illumination Filter Plate (IFP)
„Angle defining element“

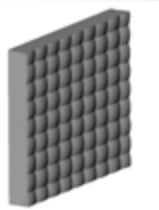


SUSS Diffraction Reduction Optics



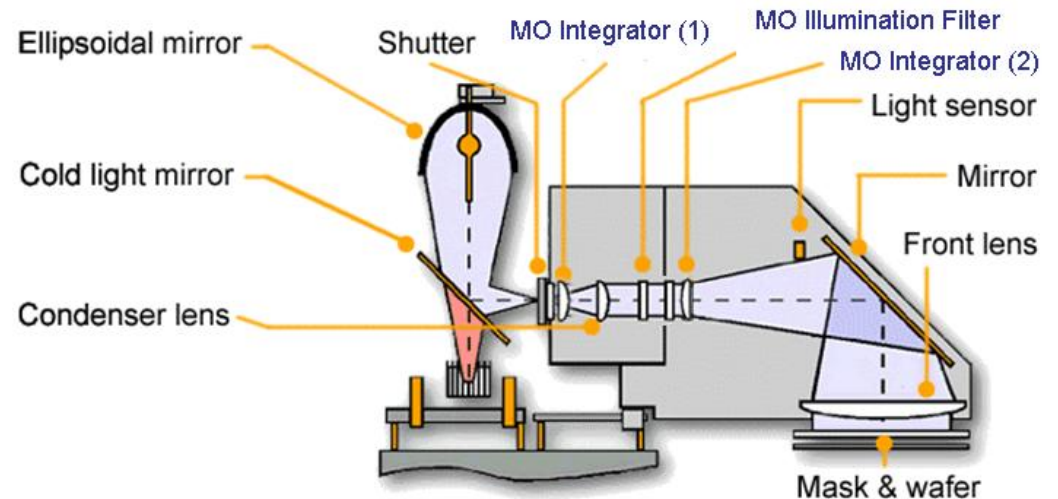
MO Integrator (1)

+ Decouples illumination from lamp position



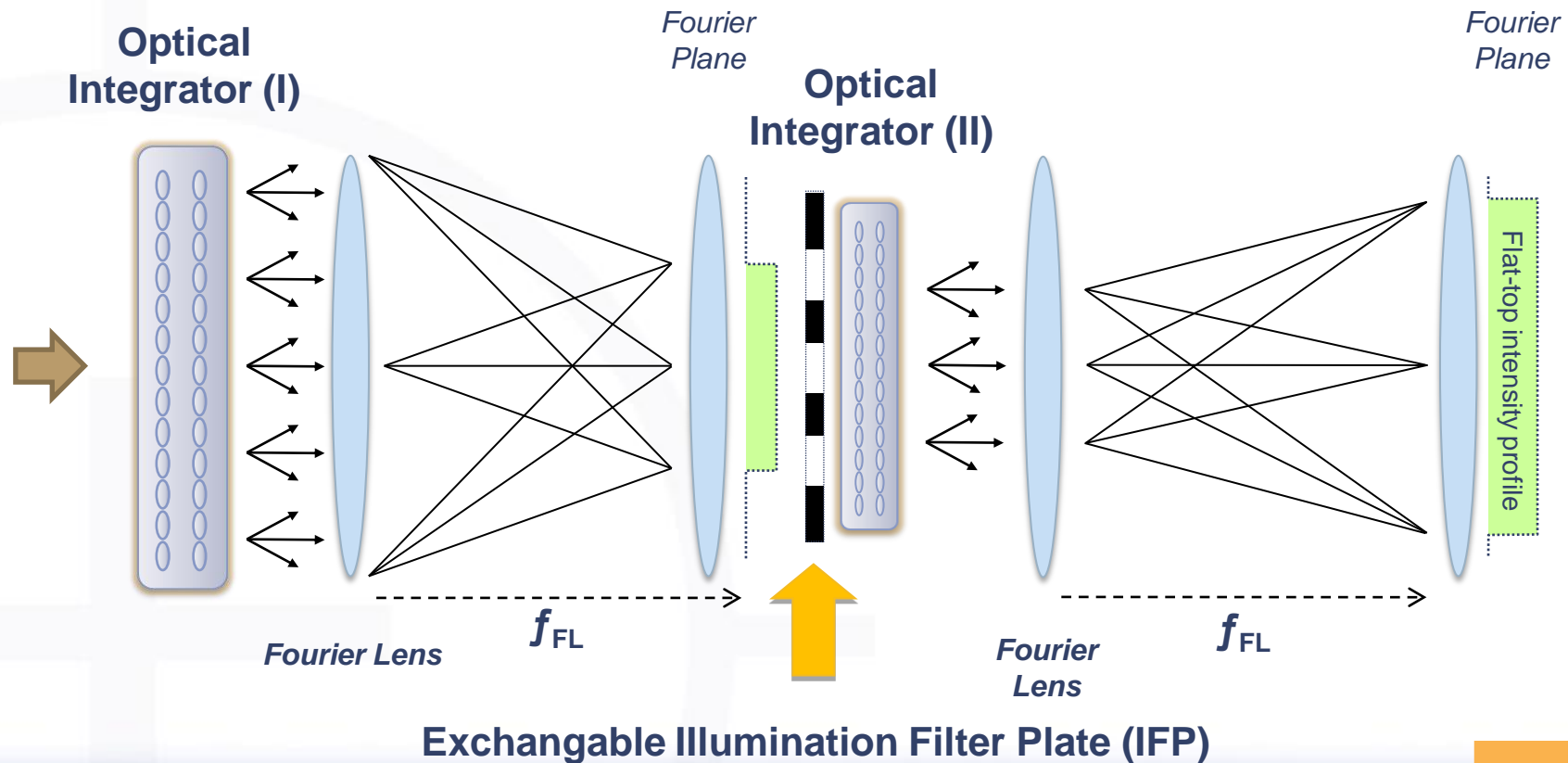
MO Integrator (2)

+ Ensures uniform illumination of mask field



Technology Backbone: Microlens Integrators

- + Uniform light distribution
- + Uniform angular spectrum



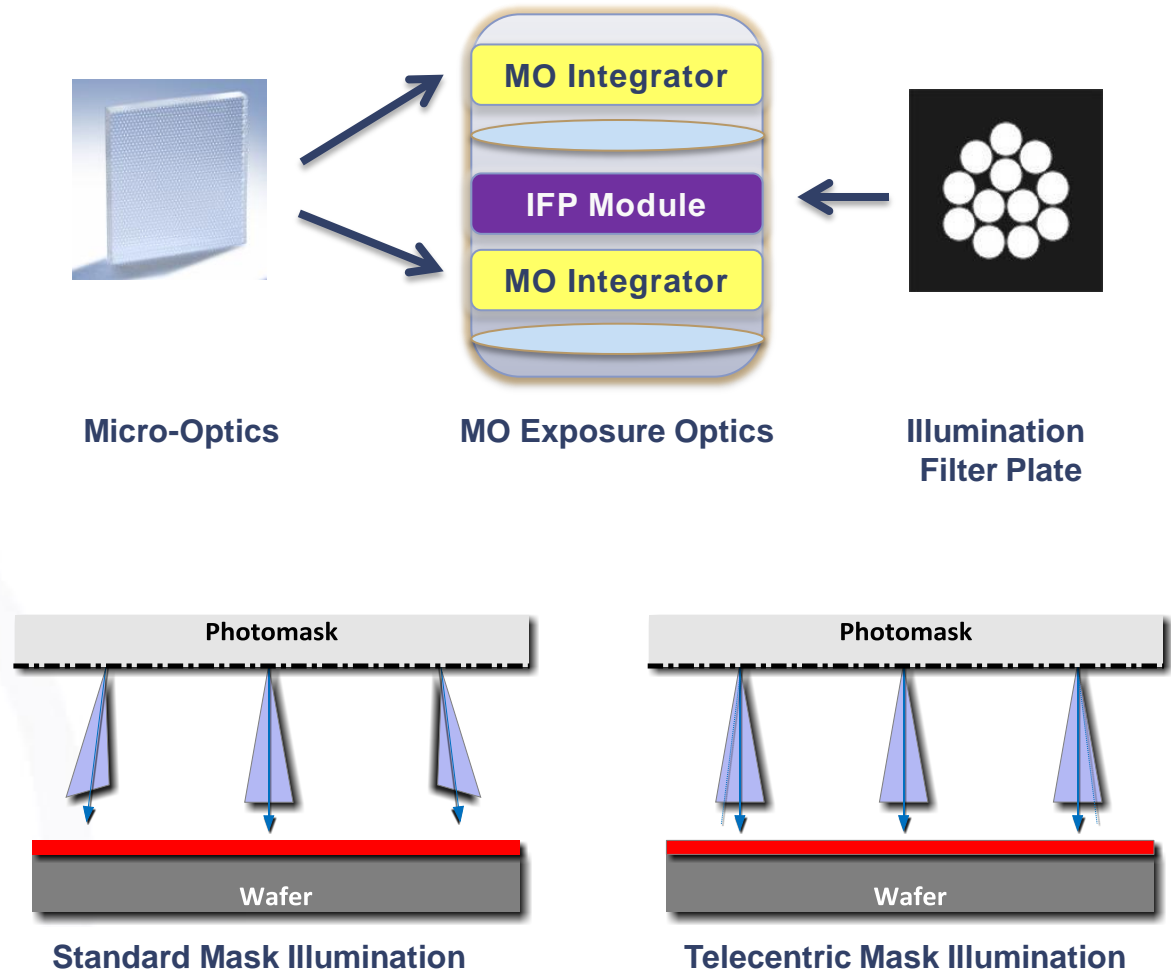
MO Exposure Optics: Stabilize the Mask Aligner

Features

- + Stable Light Source
- + Excellent Uniformity
- + Telecentric Illumination

Benefits

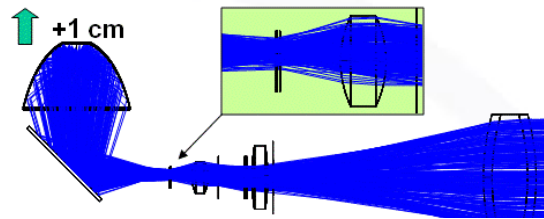
- + Reduced Maintenance
- + Improved CD Uniformity
- + Larger Process Window
- + Higher Yield



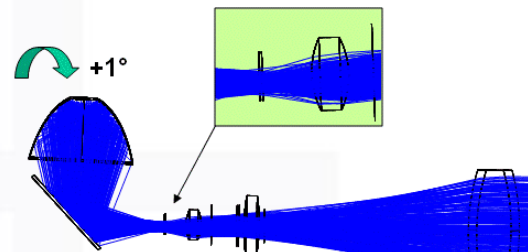
Better Uniformity – Independent of Lamp Position

Excellent Light Uniformity

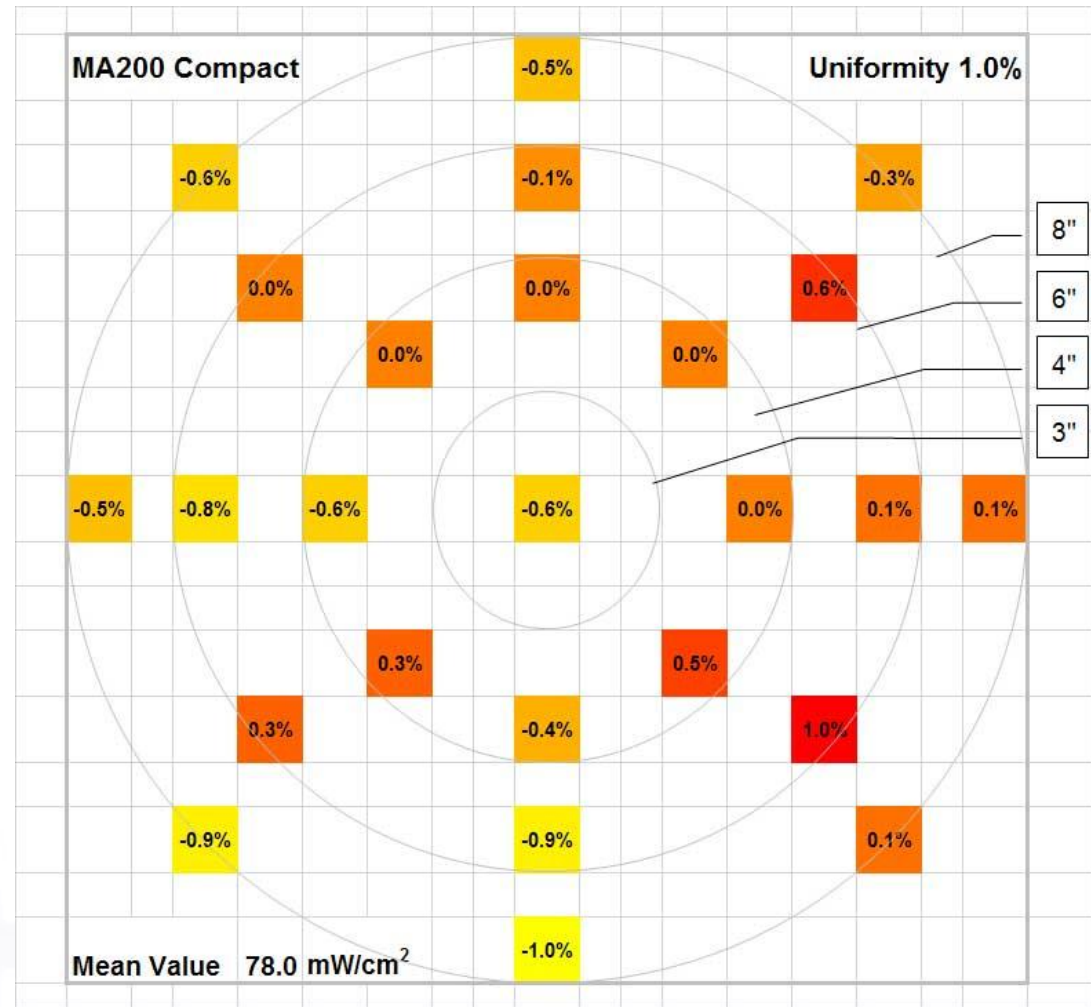
- + Independent from lamp misalignment and degradation of lamp electrode during lifetime cycle



Lamp Position: Uncritical



Lamp Tilt: Uncritical



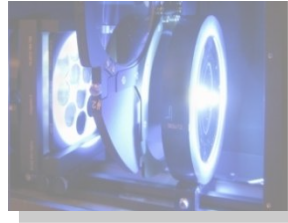
Deviation from mean value in [%] for Ø200mm in MA200 Compact

Innovation for Mask Aligner Lithography

Customer Benefit

MO Exposure Optics

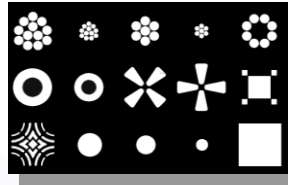
- + Stable light source
- + Excellent uniformity
- + Uniform angular spectrum
- + Telecentric illumination



- + Reduced maintenance
- + Improved CD uniformity
- + Larger process window
- + Higher yield in production

Customized Illumination

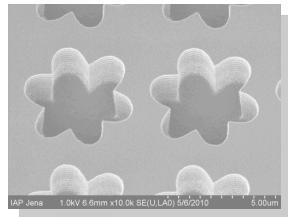
- + Change from HR* to LGO** in < 1 minute
- + Library of Illumination Filters (IFP)
- + Customized illumination to further reduce diffraction effects



- + Flexible illumination
- + Diffraction reduction
- + Correct line ends and edges

Source-Mask Optimization

- + Optical Proximity Correction (OPC)
- + MO Pinhole Talbot Lithography (MOPTL)
- + Complete solution including customized illumination, OPC design and photomask
- + Onsite litho consulting and training



- + Optimize critical litho process
- + Increase depth of focus (DoF)
- + Resolution enhancement
- + Sub-micron large-gap proximity

*HR: SUSS high-resolution illumination optics

**LGO: SUSS large-gap illumination optics

Customized Illumination: Optimize Diffraction

Features

- + Change from HR to LGO in less than 1 minute
- + Library of illumination filter plates (IFP)
- + Customized illumination

Benefits

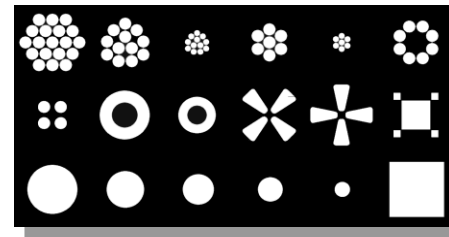
- + Flexible illumination
- + Diffraction reduction
- + Resolution enhancement technology (RET)
- + Optimized lithography process



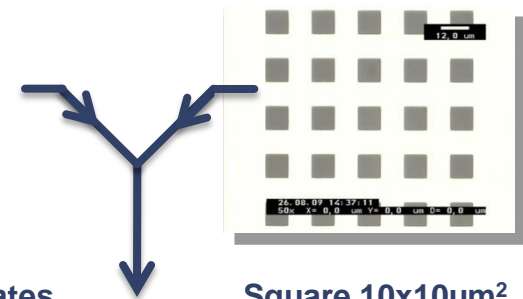
HR: High Resolution



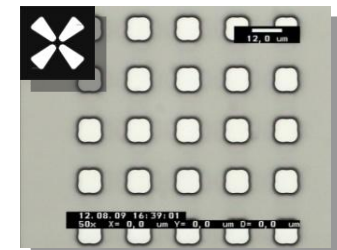
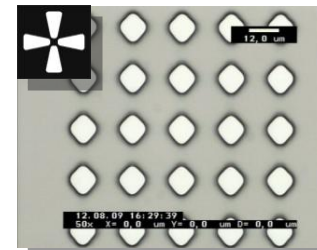
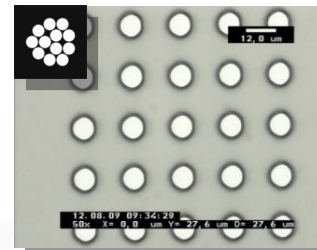
LGO: Large Gap



Library of Illumination Filter Plates



Square 10x10µm²



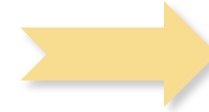
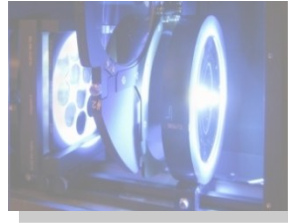
1.2µm thick resist (AZ 4110), 100µm Proximity Gap, SUSS MA8

Innovation for Mask Aligner Lithography

Customer Benefit

MO Exposure Optics

- + Stable light source
- + Excellent uniformity
- + Uniform angular spectrum
- + Telecentric illumination



- + Reduced maintenance
- + Improved CD uniformity
- + Larger process window
- + Higher yield in production

Customized Illumination

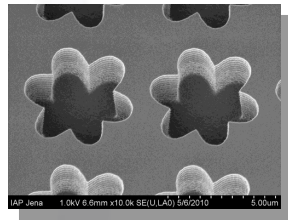
- + Change from HR* to LGO** in < 1 minute
- + Library of Illumination Filters (IFP)
- + Customized illumination to further reduce diffraction effects



- + Flexible illumination
- + Diffraction reduction
- + Correct line ends and edges

Source-Mask Optimization

- + Optical Proximity Correction (OPC)
- + MO Pinhole Talbot Lithography (MOPTL)
- + Complete solution including customized illumination, OPC design and photomask
- + Onsite litho consulting and training



- + Optimize critical litho process
- + Increase depth of focus (DoF)
- + Resolution enhancement
- + Sub-micron large-gap proximity

Source-Mask Optimization (SMO)

Features

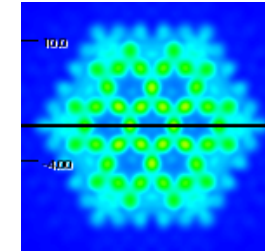
- + Source-Mask Optimization (SMO)
- + Resolution enhancement (RET)

Benefits

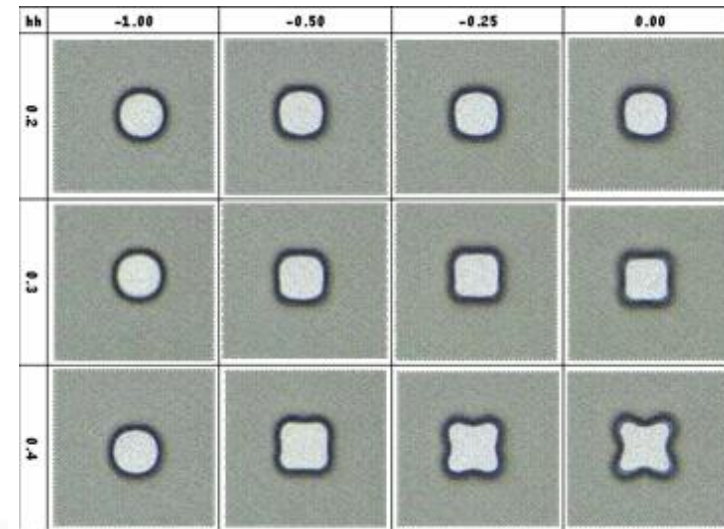
- + Optimization of critical process steps
- + Complete solution including design, mask and training at customer's site



IFP defines angular spectrum

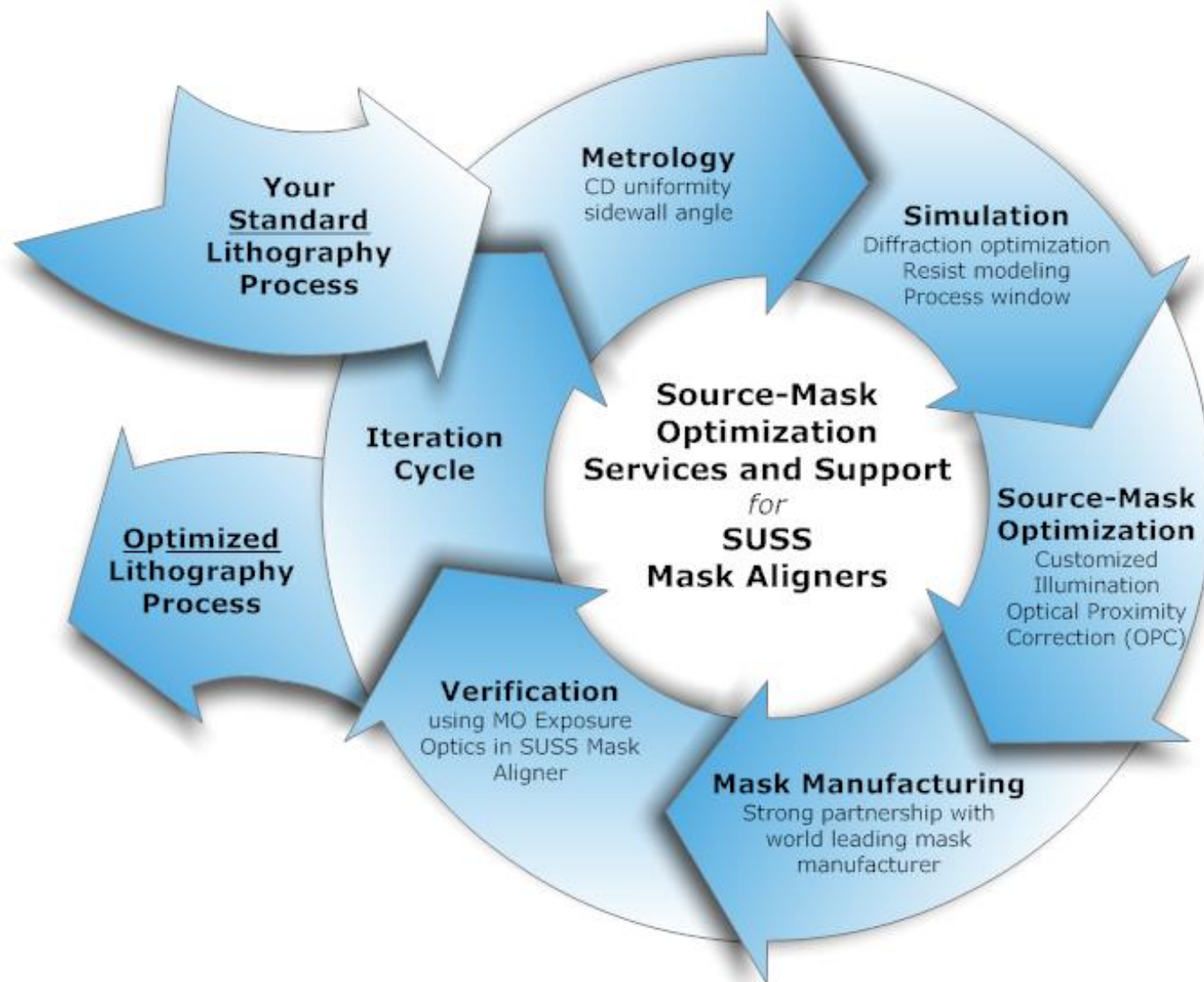


Aerial image (simulation)



Example for Optical Proximity Correction: Vias 10 μ m x 10 μ m
Proximity Gap 50 μ m, Photoresist AZ4110, 1.2 μ m thick

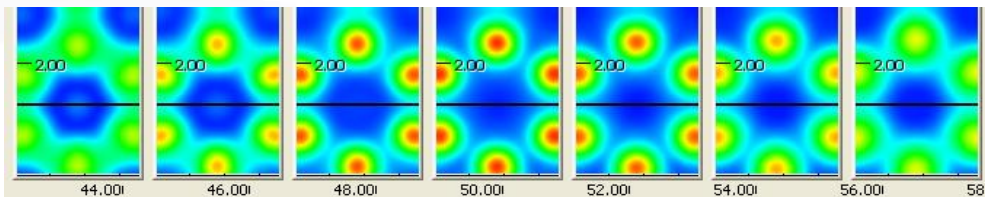
Our Service and Support – Your Benefit



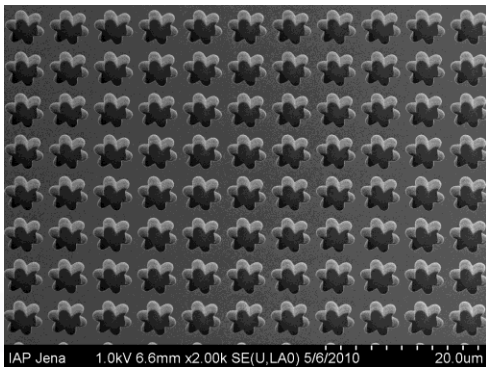
Strong Partnerships in Research

+ Research Projects

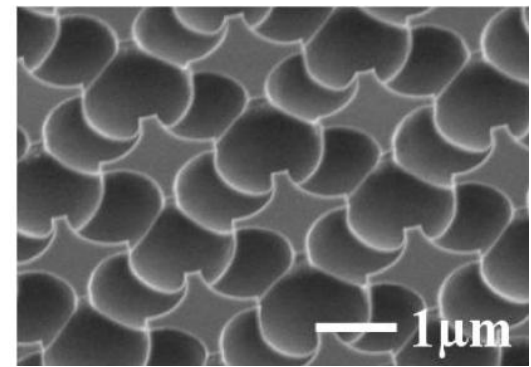
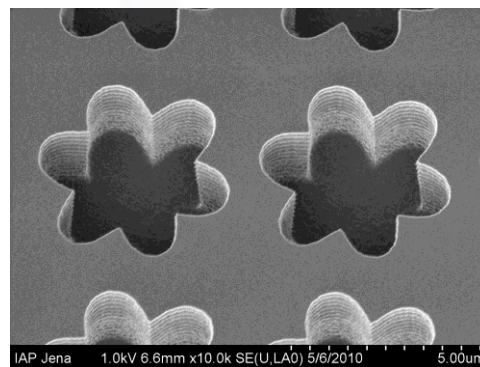
- MALS Bay. Forschungsstiftung
- FISMA EU SEAL-Net



Simulation (Layout Lab, GenISys)



MO Talbot Lithography (FhG-IOF)



MO Grey-Level Lithography (FhG-IOF)



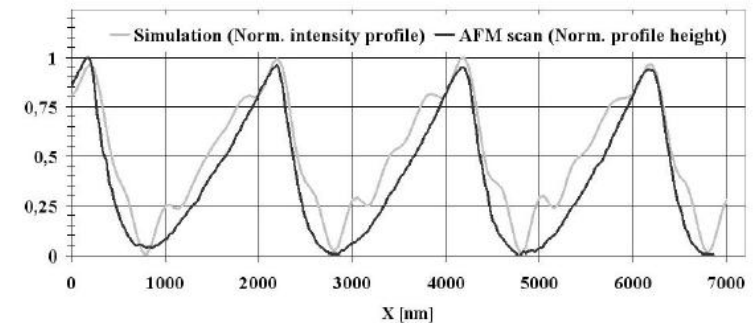
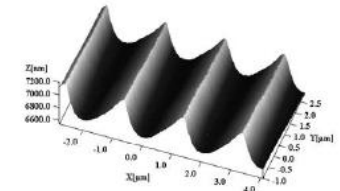
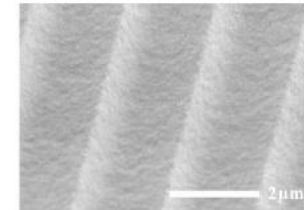
Printing Periodic Structures in Large Proximity Gap

+ Solutions

- MO Pinhole Talbot Lithography (MOPTL)
- MO Grey-Level Lithography (MOGL)

+ Features

- Very large proximity gap ($>30\mu\text{m}$)
- Sub-micron resolution
- 3D Structuring, Gratings
- Photonic Crystals on Sapphire
- Microstructuring of Solar Cells

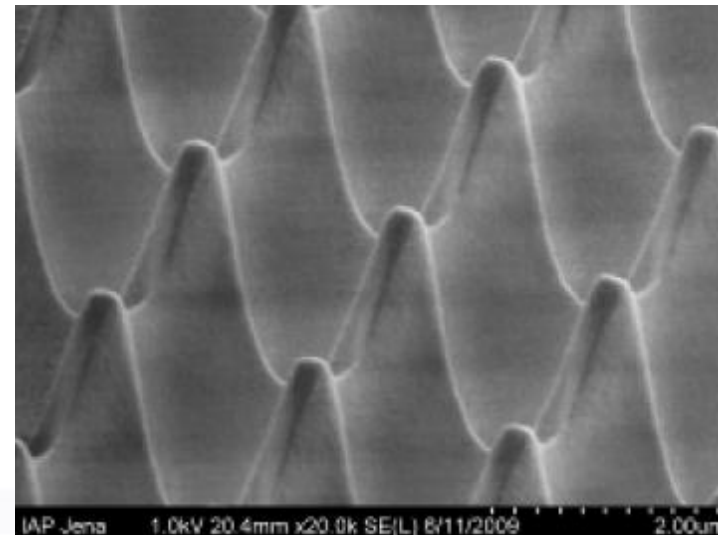
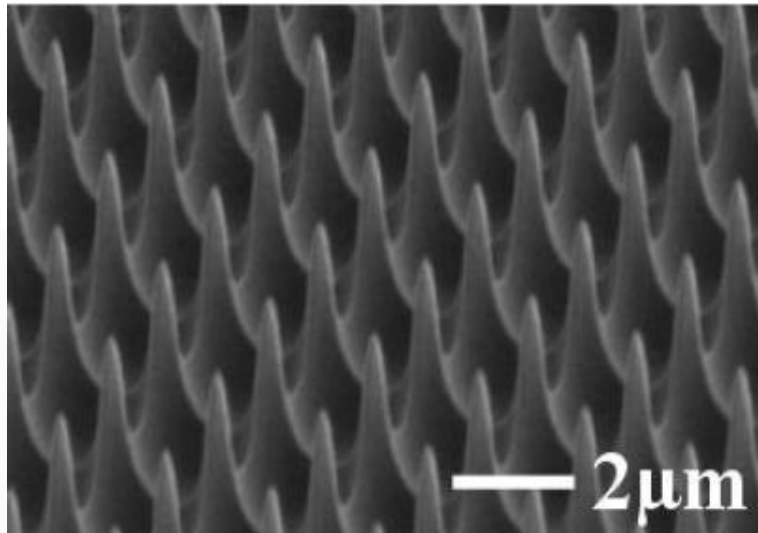


Blazed Grating (FhG-IOF)

Microstructuring

Mask Aligner, MO Exposure Optics

- + Customized Illumination
- + Half-tone photomask
- + Proximity Lithography, Gap $10\mu\text{m}$
- + Half-tone photomask (dot-size 450nm , E-Beam)

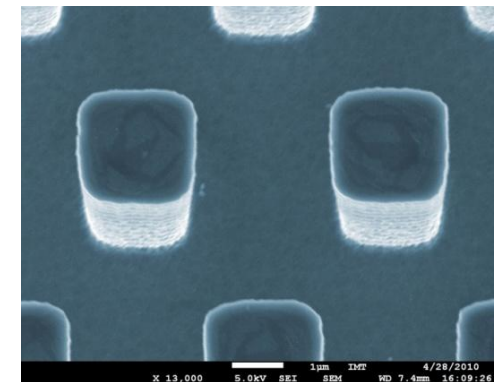
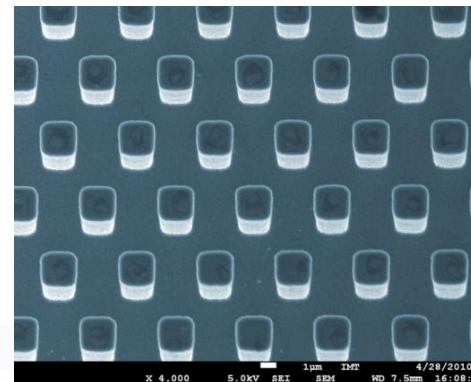
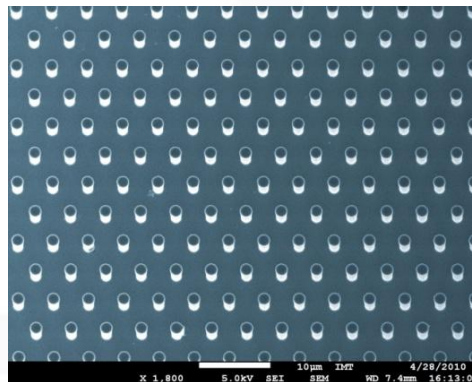
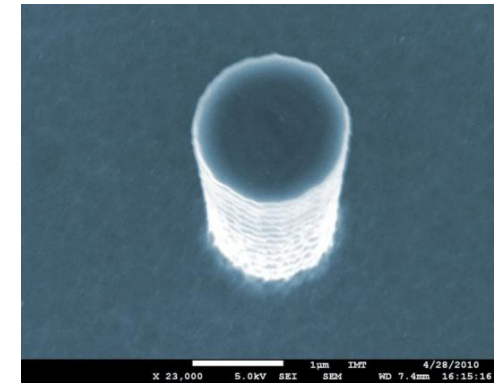
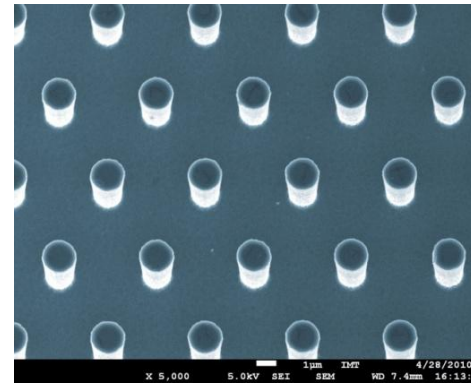


Experimental results from MO Grey-Level Lithography (FhG-IOF)

Large-Gap Proximity Printing of Periodic Structures

Experimental Results

- + Pattern 5 μm pitch
- + Proximity Gap 102 μm
- + Resist 2 μm AZ1518
- + Etching RIE in Silicon
- + Mask Aligner MA8
- + MO Exposure Optics



MO Exposure Optics for All SUSS Mask Aligners



MA6, MA8



MJB4



LithoPack 300



MA/BA8 Gen3



**MA200Compact,
MA100e, MA150e**



MA300 Gen2

Our Solutions Set Standards

SUSS MicroOptics SA

Rue Jaquet-Droz 7

CH-2000 Neuchâtel

Switzerland

Tel +41-32-720-5104

Fax +41-32-720-5713

mo-info@suss.ch

www.mask-aligner.info