SÜSS MicroOptics

Lake Neuchâtel, Switzerland

Contents

SÜSS MicroOptics

About Us

SUSS MicroOptics SA was formed in 1999 with the remit to supply its parent **SUSS MicroTec AG** with micro-optical elements for their lithography equipment. As the market for micro-optics grew, **SUSS MicroOptics** expanded to meet the new and diverse requirements, developing its product portfolio and expertise to become one of the leading producers of precision refractive and diffractive micro-optics in the world.

SUSS MicroOptics is recognized by Carl Zeiss SMT GmbH as a Preferred Supplier and first became ISO 9001 certified in 2008. In 2013 it moved to its current premises, complete with state-of-the-art cleanroom, from where it continues to deliver excellence to its international customer base.

SUSS MicroOptics is a wholly owned subsidiary of **SUSS MicroTec SE**, a leading supplier of products and solutions for backend lithography, wafer bonding and photomask processing.

Our Quality Policy

SUSS MicroOptics is committed to providing the highest quality products and services.

We value our customers and aim for the total satisfaction of their needs through enjoyable, efficient and effective interactions.
Our goal is zero defects through preventive actions.
We strive to do the right thing the first time. If a problem does arise, we take immediate action to resolve it in an efficient and effective manner.

Quality is everyone's responsibility.

For more information please visit **suss.com** and **suss-microoptics.com**

Our Certifications

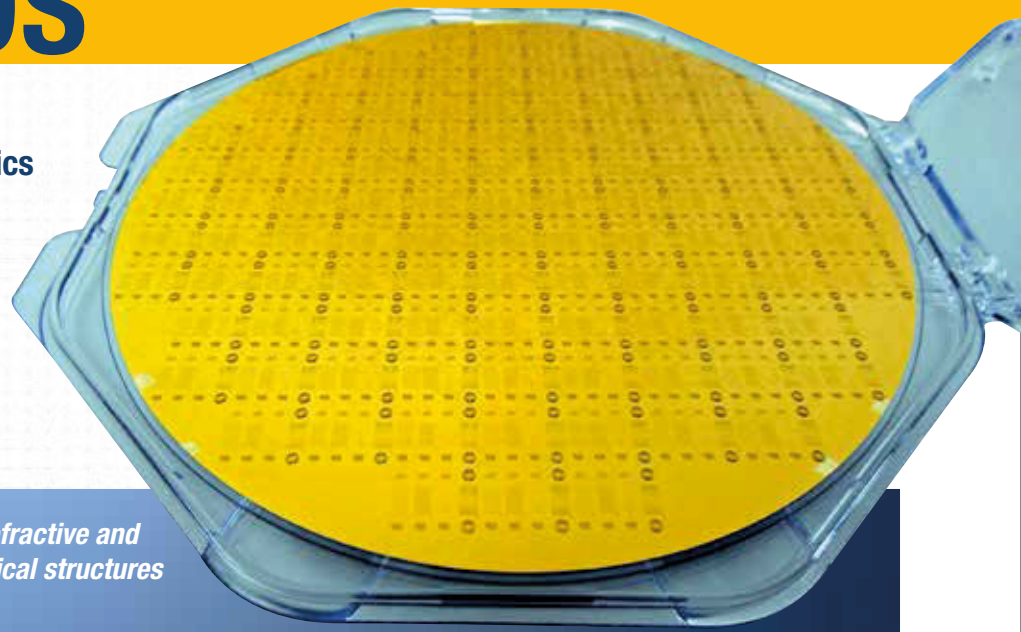
SUSS MicroOptics is certified according to the international standards **ISO 9001:2015** and **IATF 16949:2016** (automotive).

OUR MICRO-OPTICS SET THE STANDARDS

SUSS MICROOPTICS IS COMMITTED TO PROVIDING THE HIGHEST QUALITY COMPONENTS

through leading edge manufacturing techniques. Combined with a unique blend of people skills, its innovative advances in technology make

SUSS MicroOptics a leader in its product offerings.



Silicon wafer with Refractive and Diffractive micro-optical structures

PHOTOLITHOGRAPHY

Thick film photoresists are optimized for mask aligner lithography. **Exposed areas become transparent and guide the exposure light linearly in deeper resist regions**.
After wet-chemical development and drying, the **resist structures are melted** in an oven or on a hotplate at temperatures around 150 °C – 180 °C.

REACTIVE ION-ETCHING

In the next step the micro-optical structures are transferred into the bulk wafer material. **The etching process removes atoms from the resist and wafer surface at different etch rates**. Surface areas covered by resist structures are protected until the covering resist layer is removed.

DESIGN SUPPORT
PROTOTYPING TO VOLUME

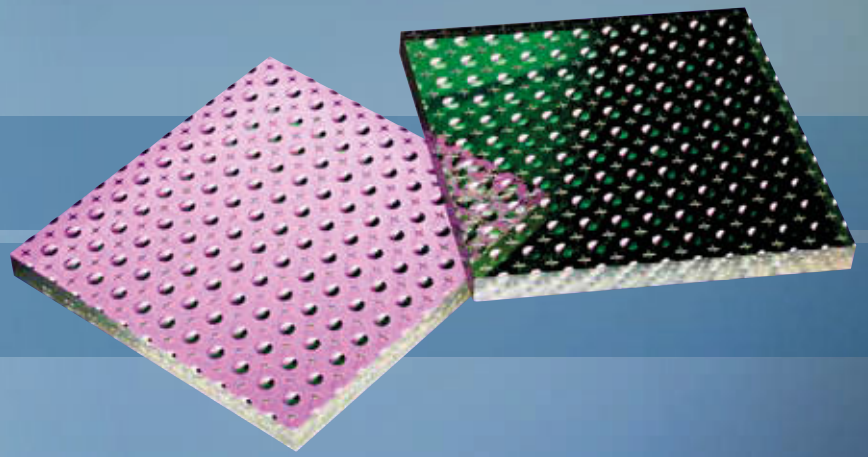
- SIMULATION
- DESIGN REVIEW
- MANUFACTURING REVIEW
- PROPOSAL
- PROTOTYPE MANUFACTURE
- REVIEW & ACCEPTANCE WITH THE CUSTOMER
- PRE-SERIES & VOLUME PRODUCTION

SUSS MicroOptics has currently **class-100, 1000** and **10000 cleanrooms**, along with **fully operational production lines for 6” and 8” wafers.**

Microlens arrays for high coupling efficiency

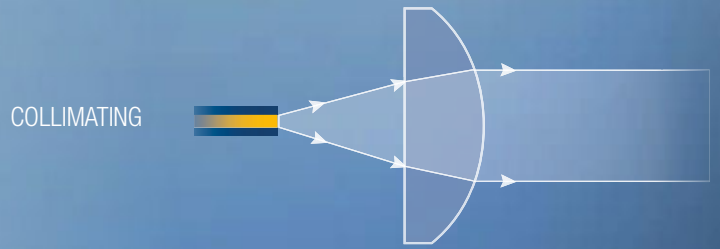
FIBER COUPLERS

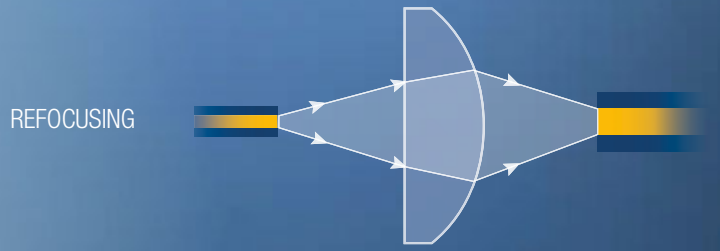
ROADM · WSS · MUX · DEMUX

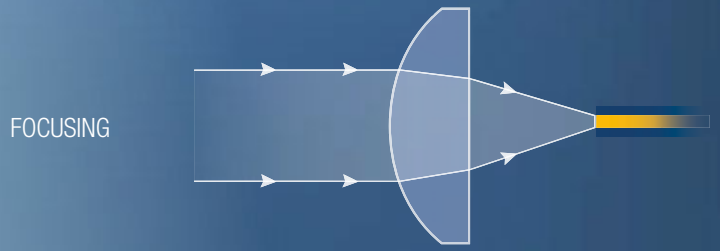


Microlens arrays increase the efficiency for all kinds of telecom and datacom applications. Our semiconductor-based manufacturing technology together with unique metrology processes allows us to deliver elements with outstanding performance.

Materials	Fused silica (various grades), Silicon
NA	Typically 0.1 to 0.6
Mode Field Diameter (MFD)	0.8 µm to 50 µm
Fiber / WG Types	SMF, MMF (FMF & special waveguide modes possible)
Back focal distance	Typically 0 to 300 µm
Pitch	According to customer requirements
Lens type	Circular, cylindrical
Lens profile	Spherical, aspherical (DOE / Fresnel lenses also available)
Arrays	Linear, quadratic, hexagonal, custom
Number of lenses per array	According to customer requirements
AR coating	UV, VIS, NIR - front side, back side, against air or glue







KEY FEATURES

- 1D & 2D Microlens Arrays
- Highest quality and precision
- Bulk material: fused silica, silicon, borofloat
- Wavelength range: DUV (193nm) to IR (5um)
- Lens profiles: spheres, aspheres
- Sub-µm position accuracy

ADDITIONAL FEATURES

- Trenches for glue stops and glue pockets, pupils, pinholes, alignment marks, mounting posts
- Double sided lens arrays with precise front-to-back alignment
- AR-Coating, Metallization, Wafer-Level Packaging
- Wafer thinning

LARGE SELECTION OF STANDARD ARRAYS AVAILABLE OFF-THE-SHELF

- Pitches 127um, 250um, 500µm, 750µm, 1000µm, 1250µm in stock
- Array sizes available up to 120x120 mm²

TAILOR-MADE CUSTOMIZED ARRAYS

Customized microlens arrays along with all important measurement data (ROC, conic, uniformity, coating) can be supplied if requested.

TYPICAL APPLICATIONS

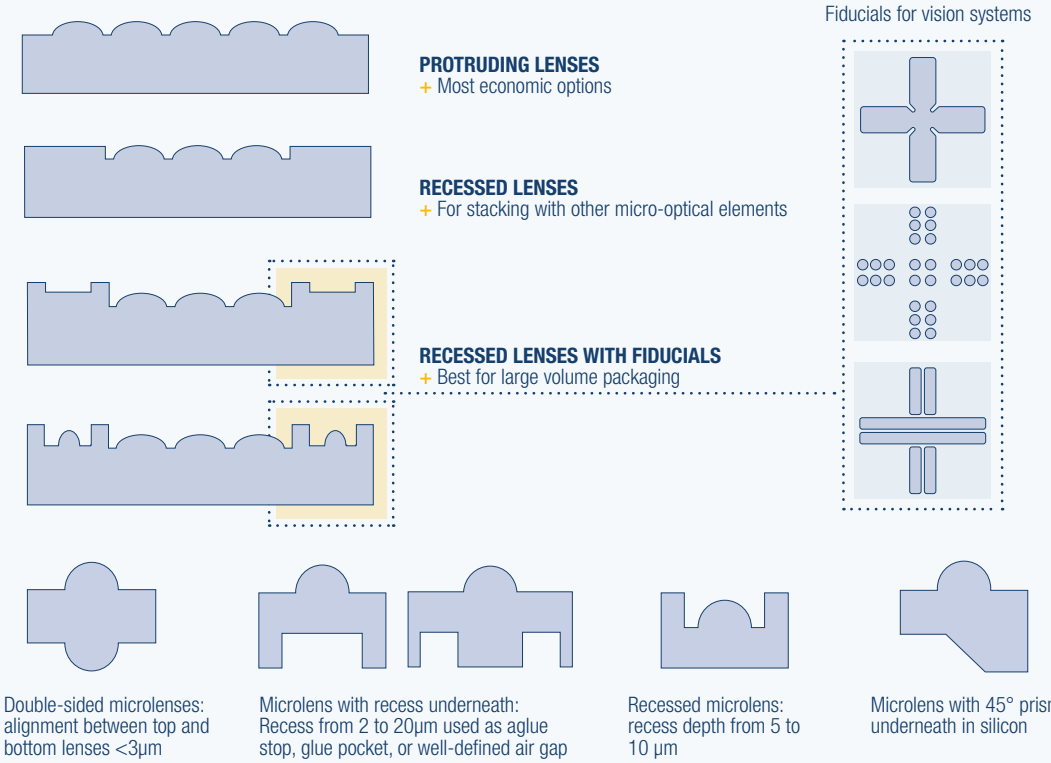
- TELECOM/DATACOM
- 3D SENSING
- MEDICAL

Why SUSS MicroOptics

Packaging

SUSS MicroOptics offers innovative solutions for packaging to ensure the most efficient integration into customers' systems. Packaging options include recessed lenses, cavities, integrated microprisms and fiducial markers.

MICROLENS ARRAYS – FORM FACTOR OPTIONS



… AND ANY COMBINATION OF THE ABOVE!

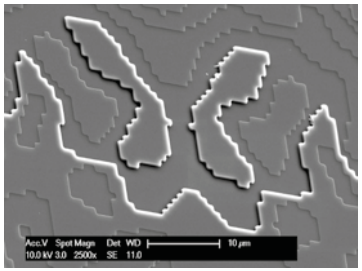
High-end diffractive optical elements

DOEs · DIFFRACTIVE OPTICAL ELEMENTS

SUSS MicroOptics is a premium supplier for high-end diffractive optical elements suitable for very demanding applications like DUV wafer stepper illumination systems, high-power laser beam shaping, vortex lenses for fiber interconnects, random DOE for beam smoothing, metrology, medical devices and masters for imprint or replication.

Materials	Fused silica (various grades) and Silicon
Composition	2 (binary) to 16 levels
Precision	Typically overlay error < 70 nm
Minimum feature size	500 nm to 1 µm depending on step height and/or etch depths
Efficiency	Up to 98 %

Diffractive optical elements (DOEs) can be used instead of microlenses where size or weight in an application is a concern. *They are also excellent beam homogenizers and shapers and – unlike their microlens counterparts – have no shape constraint for the illumination they produce.*



8-LEVEL DIFFRACTIVE OPTICAL ELEMENTS DESIGNED FOR A FRESNEL LENS

Our **wafer-based technology** (6” or 8” wafer scale) allows **large scale manufacturing of diffractive optical elements** for very competitive prices.

In the images beside you can see an example of **8-Level diffractive optical element** (Fresnel Design) for **excimer laser beam shaping** (193 nm).

KEY FEATURES

- Fused Silica, Silicon, Borofloat, CaF2
- 6” or 8“ wafer scale
- Binary, 8-level, 16-level
- 0.5 µm min feature size
- < 70nm overlay accuracy
- Diffraction efficiency up to 98%
- 190nm to 5µm wavelength range

ADDITIONAL FEATURES

- MLAs and DOEs on one element
- Custom designs
- Fiducials, ID marks
- Pedestals & trenches
- AR coatings & metallisation
- Delivery options

TYPICAL APPLICATIONS

- BEAM SHAPING
- PHASE PLATES
- LASER
- HOMOGENIZERS/DIFFUSERS
- 3D SENSING
- SPOT GENERATOR

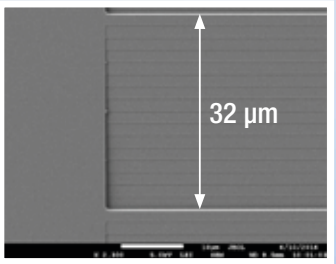
Why SUSS MicroOptics

Design capabilities, custom solutions

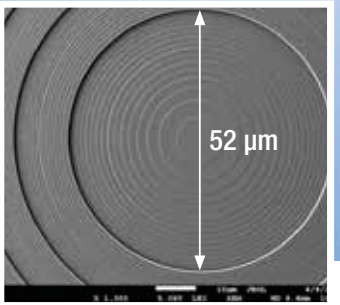
Our optical engineers understand your need to design products that meet or exceed requirements and can be made cost-effectively.
SUSS MicroOptics can help bring your vision to life with our custom lens design solutions both in prototyping and volume production.

> 96% DIFFRACTION EFFICIENCY

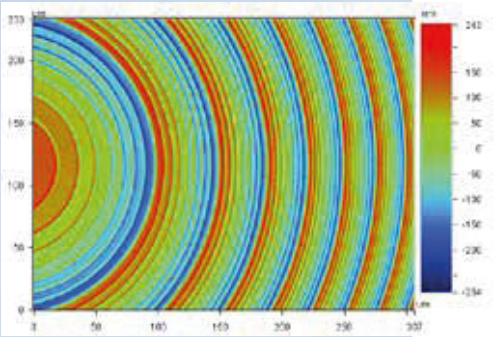
8-LEVEL GRATING



16-LEVEL GRATING



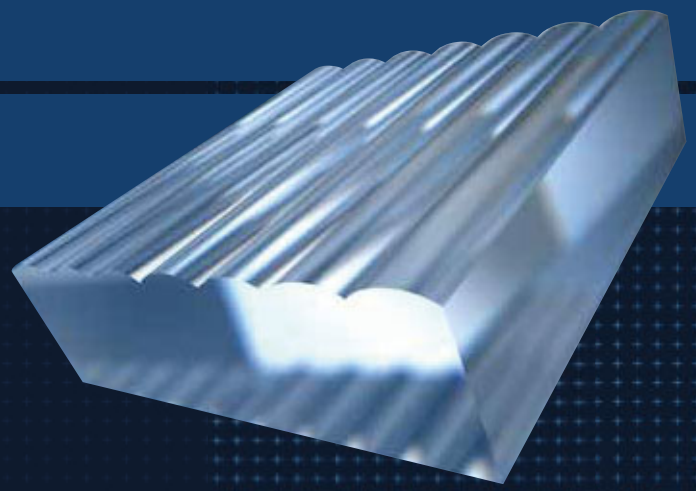
- 16-LEVEL DOE LENSES
- STEPPER TECHNOLOGY
- DOUBLE-SIDE AR COATING



After fabrication, our metrology specialists will validate the compliance of the DOEs with the optical specifications.

Homogenize your light source

BEAM HOMOGENIZERS



Most applications such as **UV curing**, **gluing** and **illumination require a uniform light distribution** in order to achieve the best possible results. With SUSS MicroOptics homogenization components, you will have an easy solution even for very demanding applications.

Materials	Fused silica (various grades) and Silicon
Angular spectrum	Typically < 1 to 20 degrees
Area of illumination	Linear, circular, rectangular, square
Source-workplane distance	Typically 30 to 1000 mm
AR coating	UV, VIS, NIR - front side, back side, to air, to glue
Lens array dimensions	According to customer requirements

KEY FEATURES

- Perfect uniformity in working plane (flat-top profile)
- Flat-top shapes: square, rectangular, circular, line
- Compact design
- Easy to use
- UV grade fused silica: very high power
- Suitable for all light sources (mercury arc lamps, excimer laser, UV LED)
- AR coatings for UV broad band or specific wavelengths available

A LARGE SELECTION OF MODULES AVAILABLE

- Standard off-the-shelf solutions
- Tailor-made specific modules

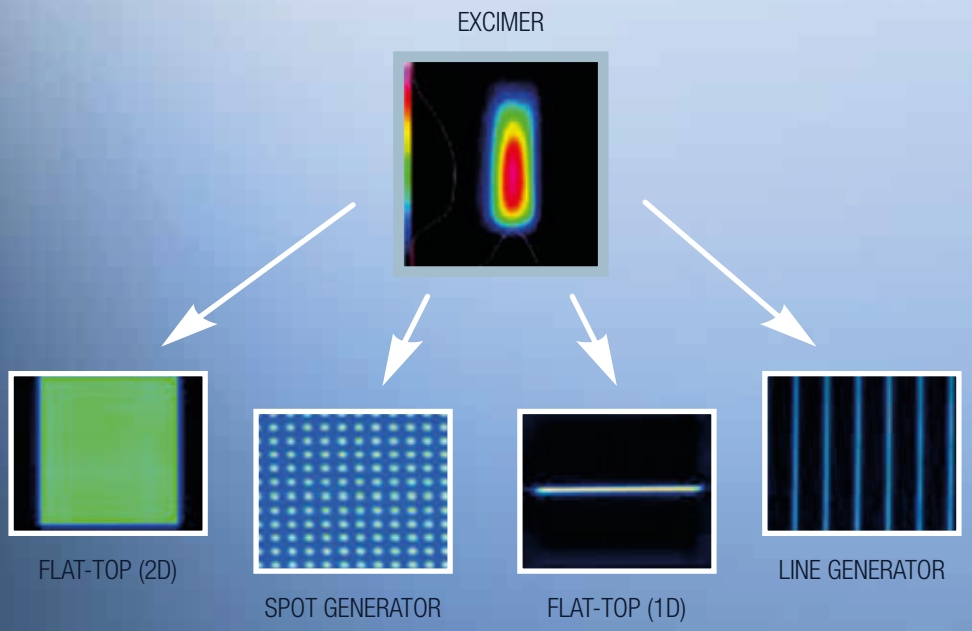
TYPICAL APPLICATIONS

- SEMICONDUCTOR
- LASER MACHINING
- OPTICAL INSTRUMENTS
- DISPLAYS

Why SUSS MicroOptics

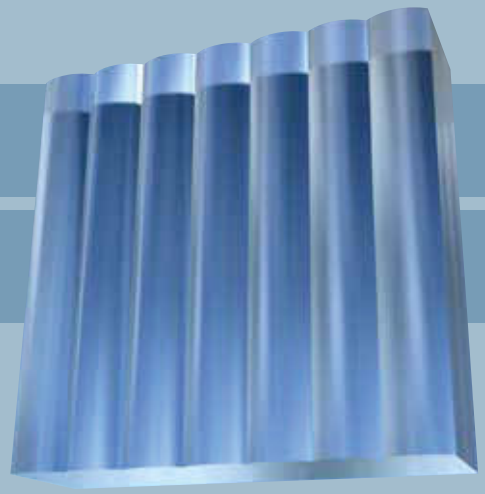
Off-the-shelf products and simulations available

Our micro-optical elements offer near-perfect decoupling of output illumination from the properties of the incoming beam. Generate 2-dimensional rectangular or square areas of uniform illumination, as well as lines and spot patterns with our refractive microlenses, or create the shape of your choice with uniform illumination using a diffractive optical element. We can create any shape you need and do simulation tests of the desired effect.



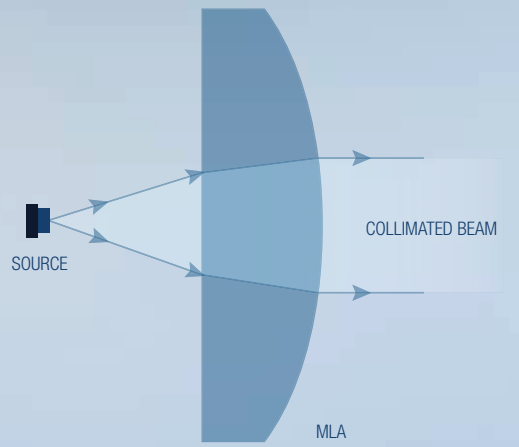
Solutions for diode laser collimation

FAST AND SLOW AXIS COLLIMATORS



Excellent collimation of the laser beam from a diode laser is often crucial for the overall performance of optical systems. SUSS MicroOptics provides a large variety of standard fast and slow axis collimators and cylindrical arrays for collimation of laser diode stacks or bars.

Materials	Fused silica (various grades), Silicon, Borofloat
NA	Typically 0.1 to 0.6
Back focal distance	Typically 0 to 300 µm
Pitch	According to customer requirements
Lens type	Circular, cylindrical - fast axis & slow axis
Lens profile	Spherical, aspherical
Arrays	Quadratic, hexagonal, custom
Number of lenses per array	According to customer requirements
AR coating	UV, VIS, NIR - front side, back side against air or glue
Fiber/ WG types	SMF, MMF (FMF & special waveguide modes possible)
Alignment accuracy	< 3 µm using mask aligner technology



Since the output of a laser diode is highly divergent, collimating optics are necessary. SUSS MicroOptics arrays have a fundamental role in the collimation process.

KEY FEATURES

- 2D Microlens arrays
- Highest quality and precision
- Bulk material: fused silica, silicon, borofloat
- Wavelength range: DUV (193 nm) to IR (5um)
- Lens profile: plano-convex, bi-convex, sphere, asphere
- Additional features: apertures, pinholes, alignment marks
- Circular and square lens shape

LARGE SELECTION OF STANDARD ARRAYS AVAILABLE OFF-THE-SHELF

- Pitches 170 µm, 200 µm, 250 µm, 300 µm, 400 µm, 500 µm, 1000 µm, 1015 µm on stock
- Array sizes available from 1x1 mm² to 120x120 mm²
- Customized lens design and consulting on request

TYPICAL APPLICATIONS

- TELECOM/DATACOM
- LASER MACHINING
- 3D SENSING

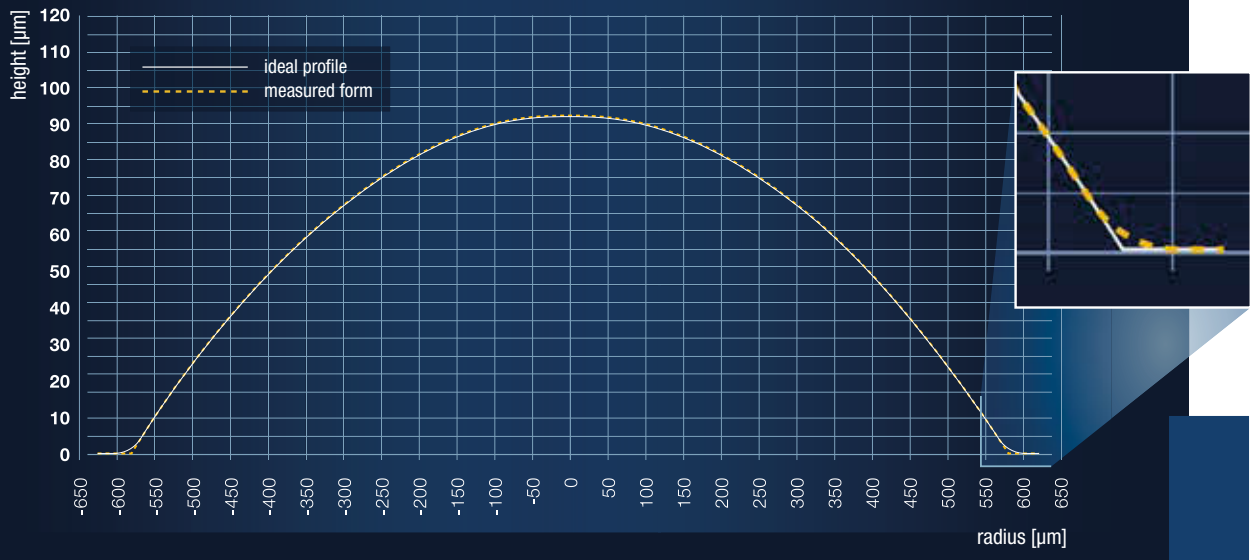
Why SUSS MicroOptics

Metrology

SUSS MicroOptics has a fully equipped state-of-the-art metrology lab for inspection and sorting of micro-optical components (ISO 9001, IATF 16949, Six Sigma).
Our pick-and-place tools allow us to extend our capabilities in the high volume market and deliver our arrays in a wide variety of formats and tapes.

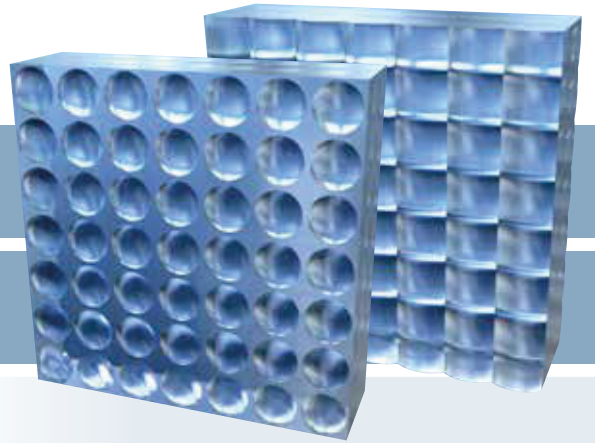
LENS MEASUREMENT

Measured Lens Profile (white line) compared to Ideal Lens Profile (yellow dotted line) etched in Fused Silica (k = -1)



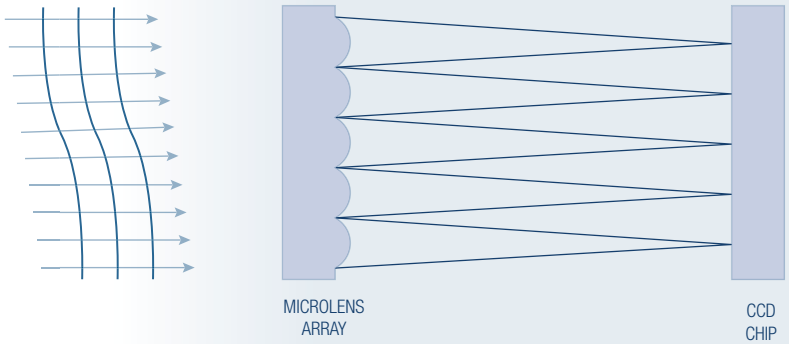
Microlens arrays are the key element in Shack-Hartmann sensors

SHACK-HARTMANN ARRAYS



The quality of a Shack-Hartmann sensor is directly related to the excellence of the microlens arrays. SUSS MicroOptics is the leading supplier worldwide of microlens arrays for Shack-Hartmann sensors, with the highest ranking in lens array uniformity and beam-pointing accuracy.

Materials	Fused silica (various grades), Silicon
Lens diameter	30 µm to 2.0 mm
F-number (F#)	Typically F/5 to F/100
Effective front focal length	Typically 1 to 100 mm
Wavefront error (Surface profile deviation, rms error)	Typically 10 to 50 nm
Array size	According to customer requirements
AR coating	UV, VIS, NIR - front side, back side, against air or glue



Our refractive microlens arrays with small lens apertures and relatively long focal lengths give high spatial resolution spot patterns which act as wave front sensors in metrology and astronomy applications.

MICROLENS ARRAY FEATURES

- 2D Microlens arrays
- Highest quality and precision
- Bulk material: fused silica, silicon, borofloat
- Wavelength range: DUV (193 nm) to IR (5um)
- Lens profile: plano-convex, bi-convex, sphere, asphere
- Additional features: apertures, pinholes, alignment marks
- Circular and square lens shape

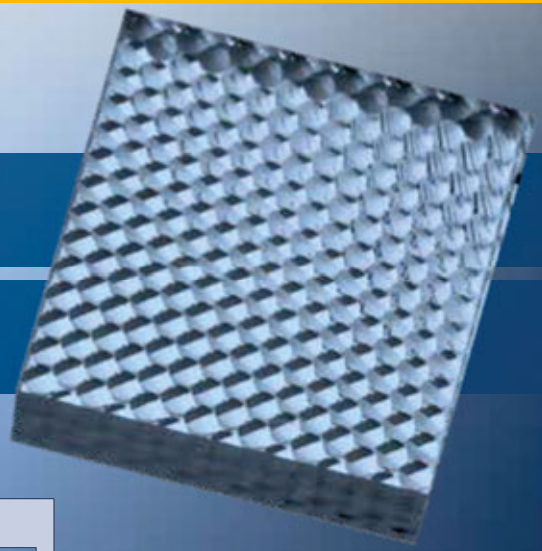
LARGE SELECTION OF STANDARD ARRAYS AVAILABLE OFF-THE-SHELF

- Pitches 100 µm, 110 µm, 130 µm, 150 µm, 250 µm, 650 µm
- Array sizes available from 5x5 mm² to 120x120 mm²
- Focal lenghts from some microns to > 100 mm

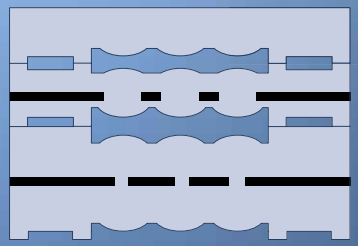
TYPICAL APPLICATIONS

- WAVEFRONT SENSING
- MATERIAL INSPECTION
- ASTRONOMY
- MEDICAL

POLYMER-ON-GLASS LENSES

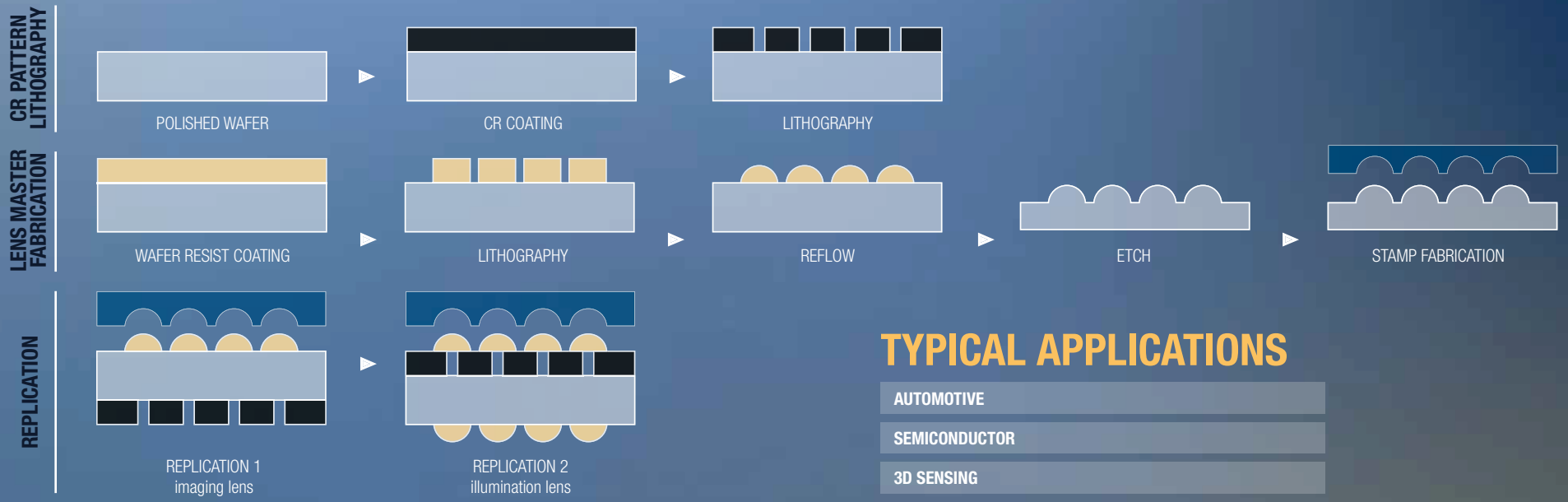


After years of close cooperation with its parent company, SUSS MicroOptics is now able to provide replicated lenses with superior performance for applications where high fill factors and efficiency are needed, while offering the best possible price.
Our company will assist you in all the steps of your custom development, from the optical simulation to the final test of the element.



Wafer-Level Optics (WLO):
- aperture layers in bulk material
- excellent overlay control

PRODUCTION OF POLYMER-ON-GLASS, IMPRINT TECHNOLOGY



TYPICAL APPLICATIONS

- AUTOMOTIVE
- SEMICONDUCTOR
- 3D SENSING

We started SUSS MicroOptics SA in 1999

to answer a growing demand for micro-optical components and within 20 years the company has grown **from 3 to more than 90 employees**.

In **2012** we moved to our current premises in Hauterive, Switzerland, and built a new 6”/8” wafer cleanroom fab.
In **2017** we launched a new production line for Wafer-Level Optics (WLO) dedicated to automotive lighting applications and
in **2018** we successfully passed IATF 16949:2016 automotive qualification.
We are currently building a second cleanroom fab in Neuchatel, Switzerland, which will be fully operational in the second half of **2019**.

Through the years, we’ve constantly evolved trying to find new ways to improve our production processes while following our main principles.

Working with Integrity: we build trust and commitment through our daily actions. Interactions with our customers, our suppliers, and our co-workers occur within a code of moral and ethical conduct that is above reproach.

Technology: we stay on the leading edge of technology in the development, production, testing and application of our products. Our investment in technology will ensure quality and reliability of our Micro-Optics. We motivate and train our collaborators.

Advocating for the Customer: we value our customers and do whatever it takes to satisfy their needs. We ensure that customer interactions are enjoyable, efficient, and effective.

Delivering Quality: we strive to do the right thing the first time. If a problem does arise, we take immediate action to resolve it. The quality of our people, our products, and our services will ensure the long-term viability of our company.

Today, we deliver high-quality micro-optics to more than 200 customers across the globe and we are recognized as preferred and leading supplier to major companies in optics, telecom, metrology, semiconductor and automotive industry.

Dr. Reinhard Völkel
SUSS MicroOptics CEO

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