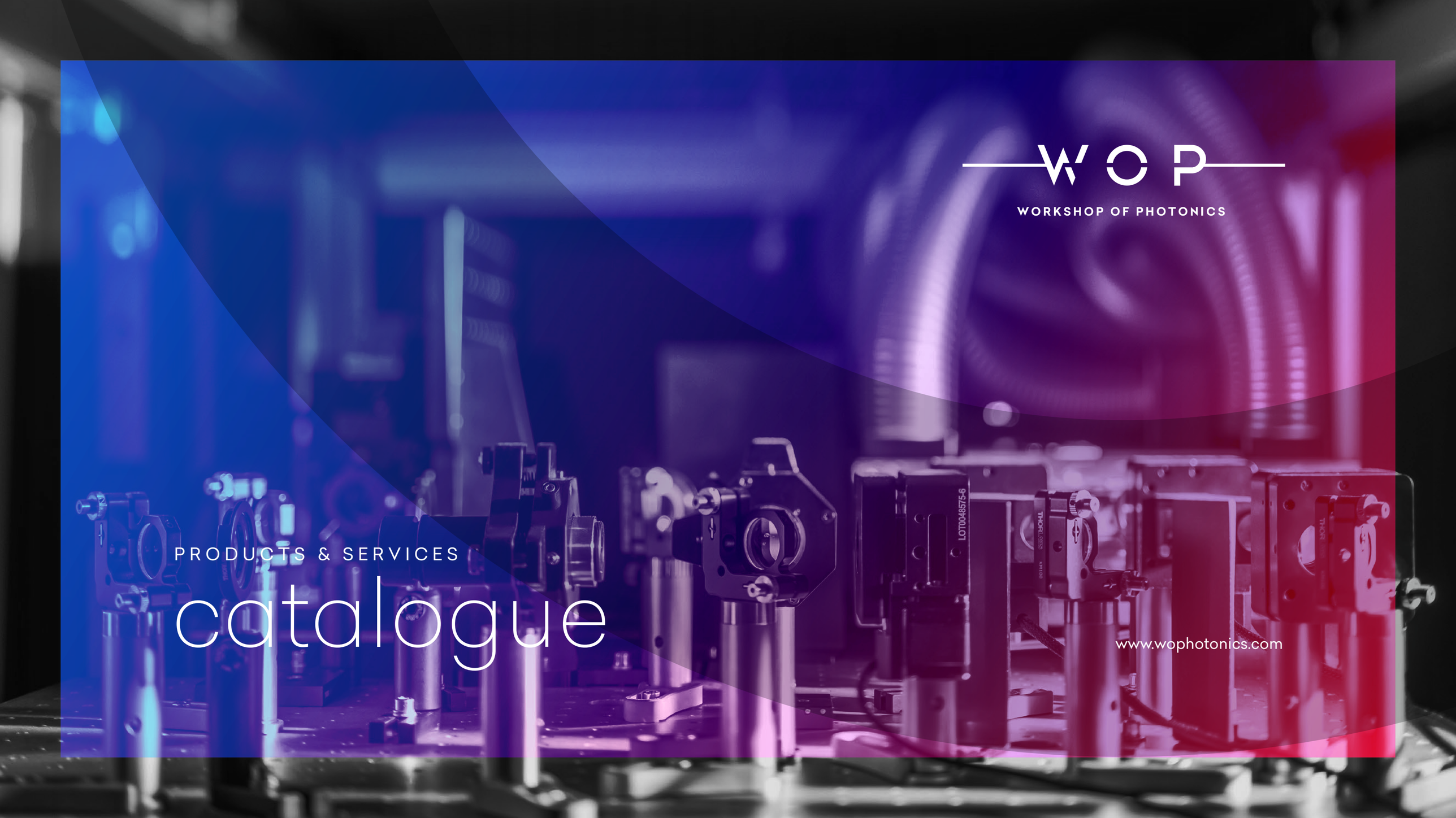


WOP

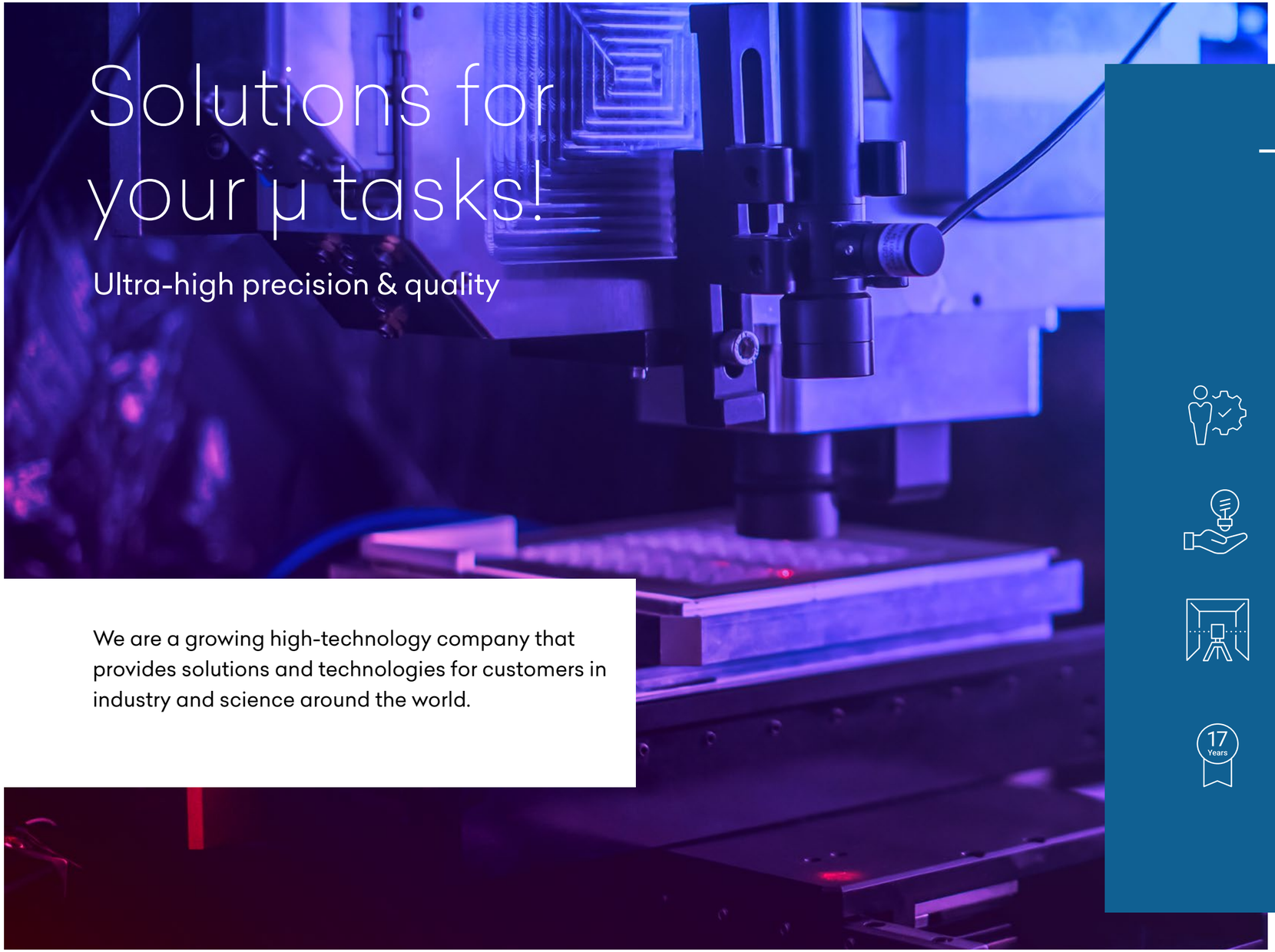
WORKSHOP OF PHOTONICS

PRODUCTS & SERVICES

catalogue

www.wophotonics.com

Contents



Solutions for your µ tasks!

Ultra-high precision & quality

We are a growing high-technology company that provides solutions and technologies for customers in industry and science around the world.

WOP
WORKSHOP OF PHOTONICS

We are:

- Laser process development professionals
- Solution providers
- Technology demonstrators
- A company with 17 years of expertise

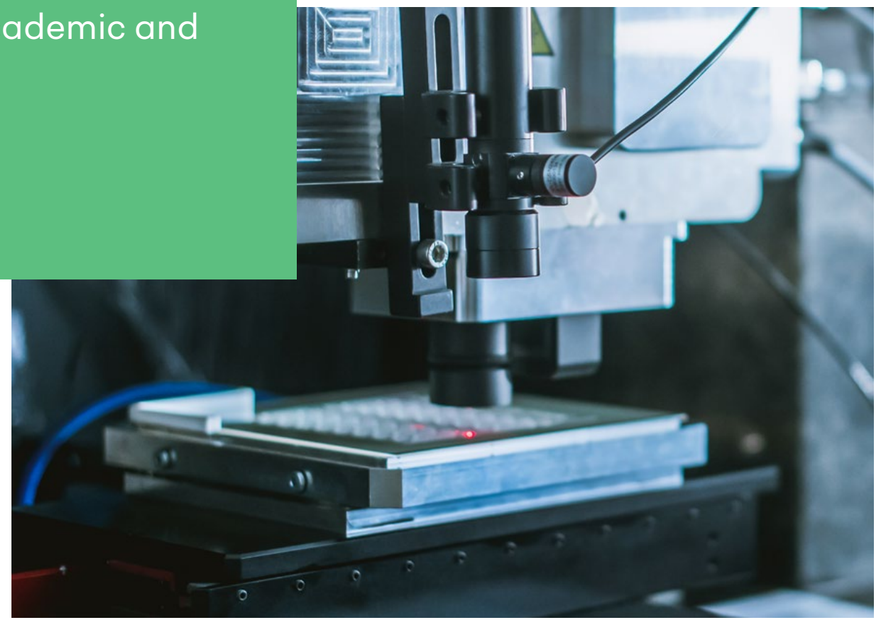
We have:

- In-house laser processing facilities, complemented by post-processing capabilities
- Clean-room facilities for even higher quality
- 6 in-house and 2 licensed patents, enabling cutting-edge technologies
- R&D studies with more than 10 academic and research partners
- ISO 9001 certification

Members of:

EPIC European Photonics Industry Consortium

LITHUANIAN LASER ASSOCIATION



WORKSHOP OF PHOTONICS

We deliver:

Fully integrated services

Your challenge

Send us your idea, task or drawing. Anything will work!

Our expertise

From idea to proof-of-concept. Our team of professionals will investigate your task, test it in our laboratory, and come back with the best possible solution.

The outcome of this stage is prototype characteristics.

Prototyping

We will develop a prototype to test the idea in a real environment.

Scaling production

Prototyping can turn into small-scale production, from 1 to 1000 units.

Laser workstation

Once we find a solution, you may decide to own a laser workstation for your application and organize production in your facilities. We will develop and install this at your site.

Recipe transfer

We will transfer you a recipe for the application so you could repeat it any time.

Support

Our team will guide you during the process and afterwards.

We implement:

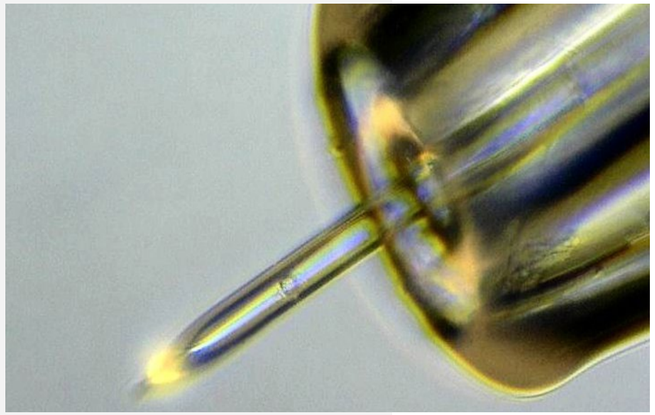
Application examples

Actual works, conducted in our laboratory

Laser drilling of biopsy probes for embryology

The GeneSearch Embryo Cradle, is a new embryo manipulation tool allowing embryo penetration and biopsy at all stages right up to the time for implantation in the uterus. After the collection of a few cells for DNA analysis, even as part of the same procedure, the device can easily remove blastocoel fluid to optimize the embryo freezing process.

One of the main components – glass biopsy probes - were drilled by WOP. Probe diameters can vary from 12µm to more than 20µm, and the biopsy ports vary in diameter from 5µm to more than 10µm. The biopsy port is a clean, sharp-edged, laser-drilled hole through the near sidewall of the probe, located near its' tip.

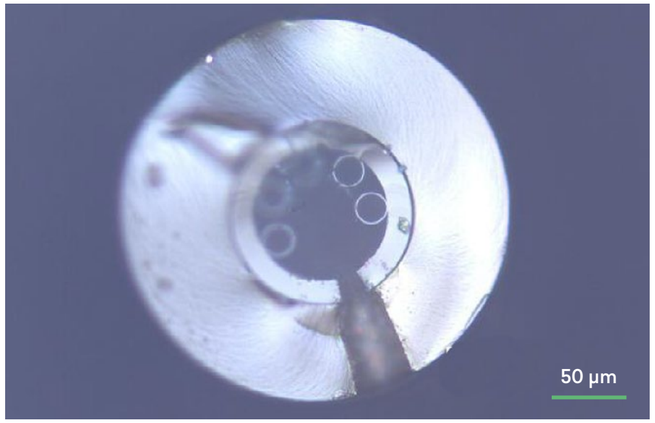


GENESEARCH, Inc

Optical fiber gas sensors

RISE RESEARCH INSTITUTES OF SWEDEN develop novel optical fibers that are suitable for gas sensing under light illumination. The unique design requires precise drilling of laser trenches to create an opening for gas to enter.

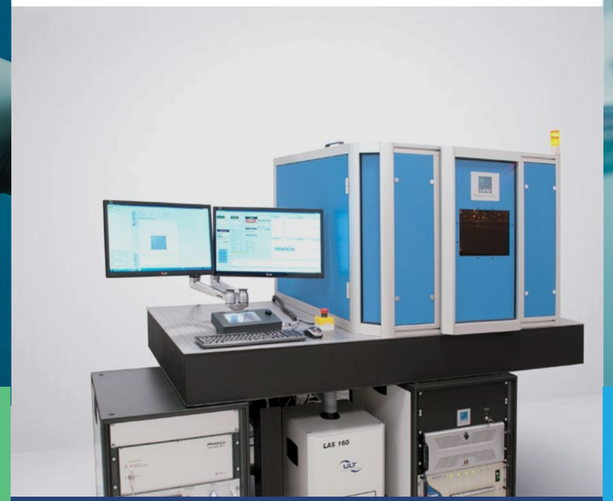
Accurate process control enables selective laser micromachining without affecting the surrounding fiber structure, as well as stable and precise alignment for laser drilling in between separate glass rings in fiber structure.



Portfolio

Contract manufacturing

- Ultra-high precision & quality
- All types of material

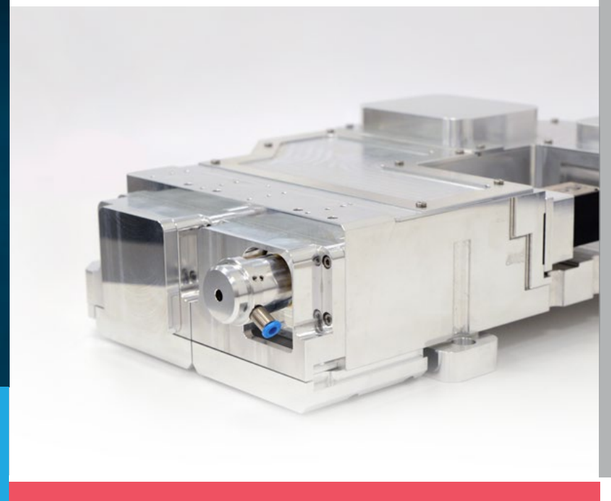


Laser workstations

- Results-based
- Upgradeable
- Flexible
- Full support

Space-variant retarders

- Ultra-high damage threshold
- High transmission
- Reliable and resistant surface



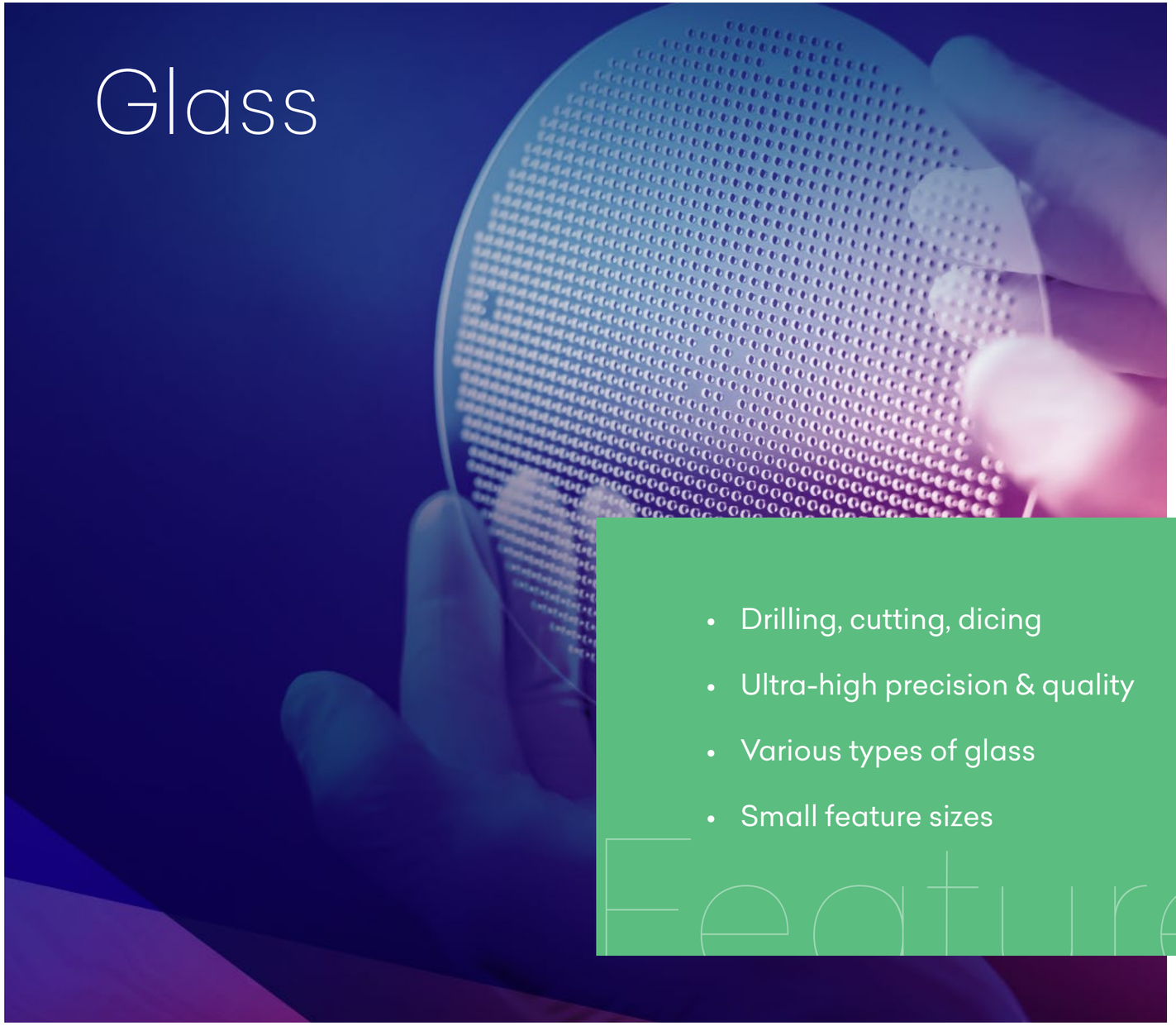
Technology for cutting glass & sapphire

- Unique laser technology developed by WOP
- Ultra-high precision and quality

WORKSHOP OF PHOTONICS

Contract manufacturing services

www.wophotonics.com



Glass

Exceptional expertise in glass processing

With glass being a demanding material, we offer more than 10 years of experience in glass processing, including drilling, cutting and dicing.

Intensive research in glass machining and unique glass processing techniques ensure ultra-high precision & quality results.

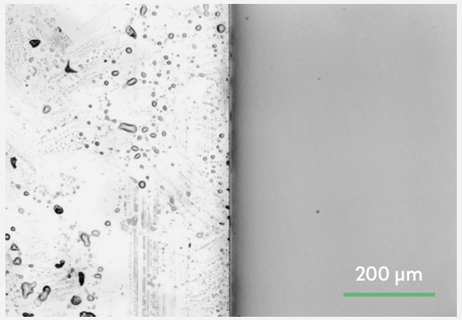
Features

- Drilling, cutting, dicing
- Ultra-high precision & quality
- Various types of glass
- Small feature sizes
- High aspect ratios unachievable with alternative technologies
- Irregular-shaped holes
- Straight & curved cuts

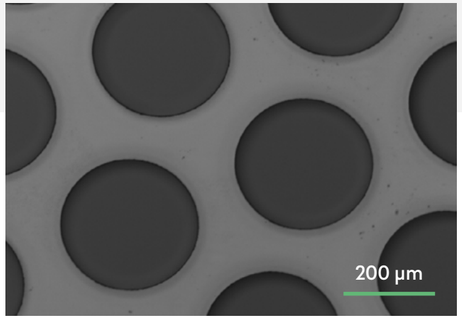
Glass

Applications

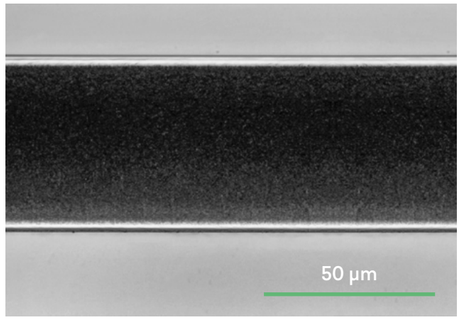
- Sensors (image, pressure, gal acceleration and other)
- Advanced packaging applications
- Semiconductors and other functional devices
- MEMS
- Wafer-level optics
- Gyroscopes
- Aerospace applications
- Analytical chips



Tempered glass cutting



Borosilicate glass drilling



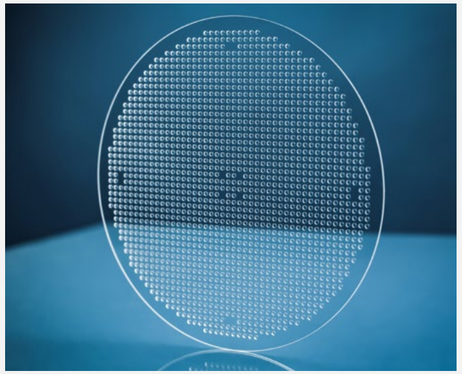
Tempered glass cutting

Specifications

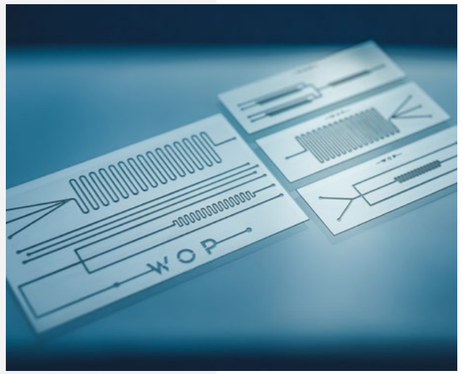
- A variety of glass types and major suppliers - Corning, Schott, Hoya, AGC
- Wafer size up to 200 mm x 200 mm (8”)
- Wafer thickness from 30 µm to 10 mm
- Circular, square, and other-shaped holes
- Straight hole cross section | no taper
- Low chipping <10 µm
- Smooth side walls, Ra <1 µm
- Typical min. hole size 20 µm (round)
- Positional accuracy ±3 µm
- No debris on back and front surfaces
- No sagging around holes
- Aspect ratio up to 1:100
- High throughput and yield
- Ability to work with metalized glass types (e.g. Au, Pt, Ni, Cr, Mo)
- Minimal or no post-processing is needed

Glass

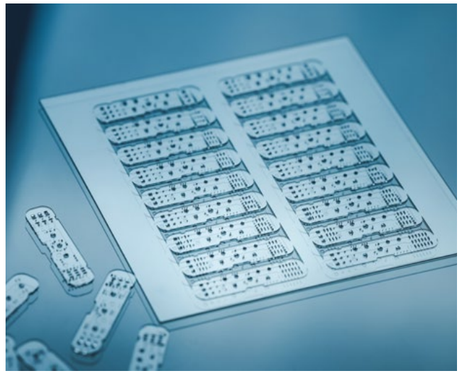
Range



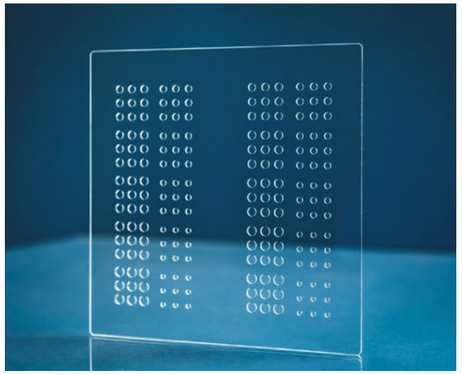
Glass spacers | Interposers



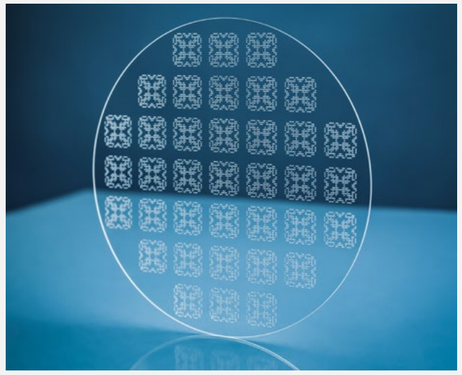
Microfluidic chips & devices



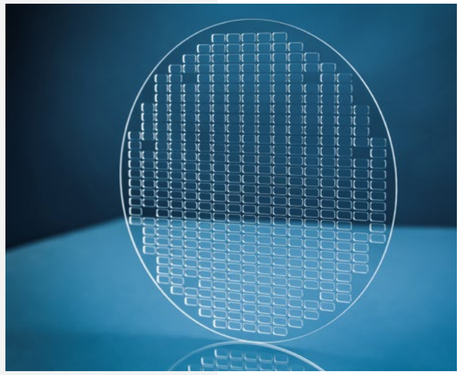
Glass guide plates for probe cards



Microwell plates



Micro drilled glass

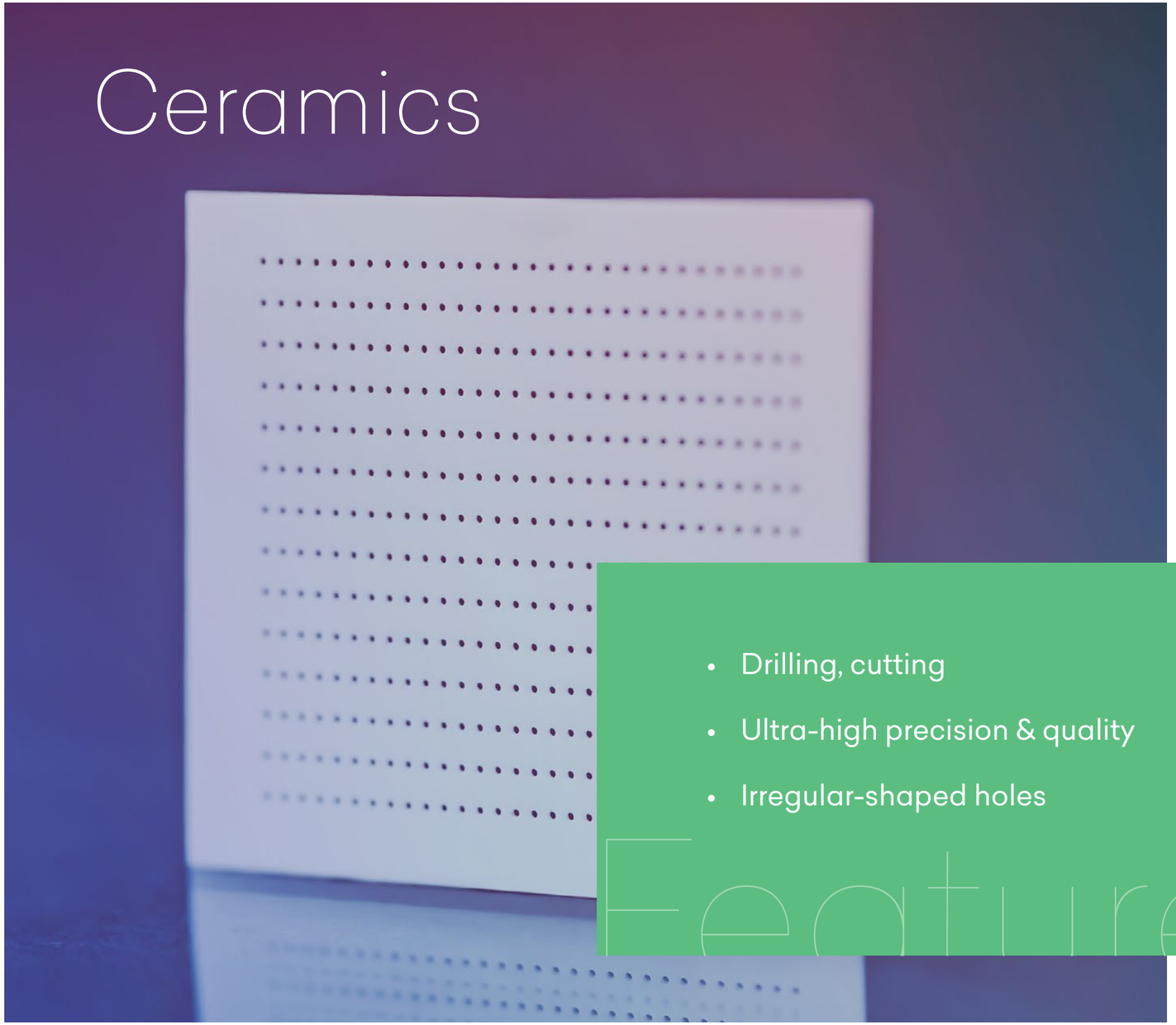


Packaging glass products

Glass cutting

Glass carrier wafers

Ceramics



Due to their unique properties, ceramics are leading materials in communications and a top choice among many of our customers.

Applying our unique femtosecond laser capabilities, our processing methods enable us to offer market-leading services.

We are confident in offering hole diameters from a few micrometers to tens of millimeters at a highly competitive prices.

Features

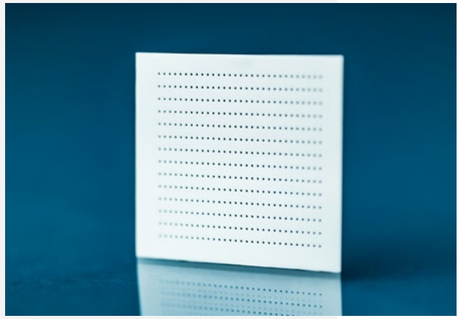
- Drilling, cutting
- Ultra-high precision & quality
- Irregular-shaped holes
- Minimal heat-affected zone
- No melting or micro cracks
- High processing speeds

Ceramics

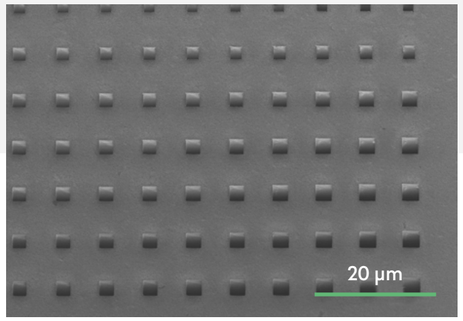
Technical specifications

- Drilling of irregular-shaped holes
- Controlled taper (positive, negative, zero taper)
- Smooth inner-wall finish (Ra ≤ 200 nm)
- Minimized stress area around drilled holes
- Low chipping <20 µm (typ. none)
- High throughput and yield
- No melting or micro-cracks at the edges
- Precise control of hole depth
- Up to 200×200 mm (8”) substrate size
- Substrate thickness of up to 1 mm
- Minimal or no post-processing needed
- Ability to work with unique types of ceramics

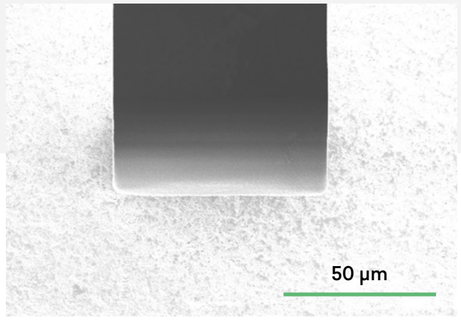
Aplication examples



Ceramic drilling

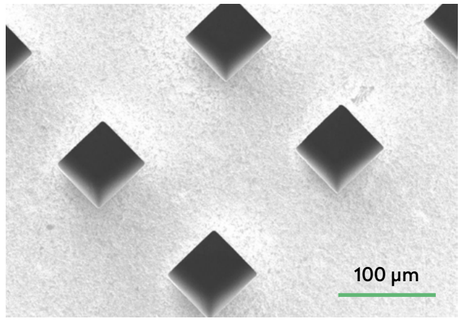


Ceramic drilling

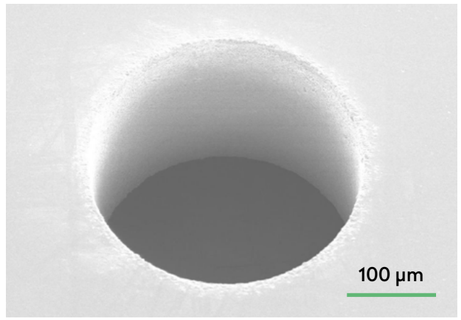


Ceramic drilling

Ceramic guide plates for probe cards



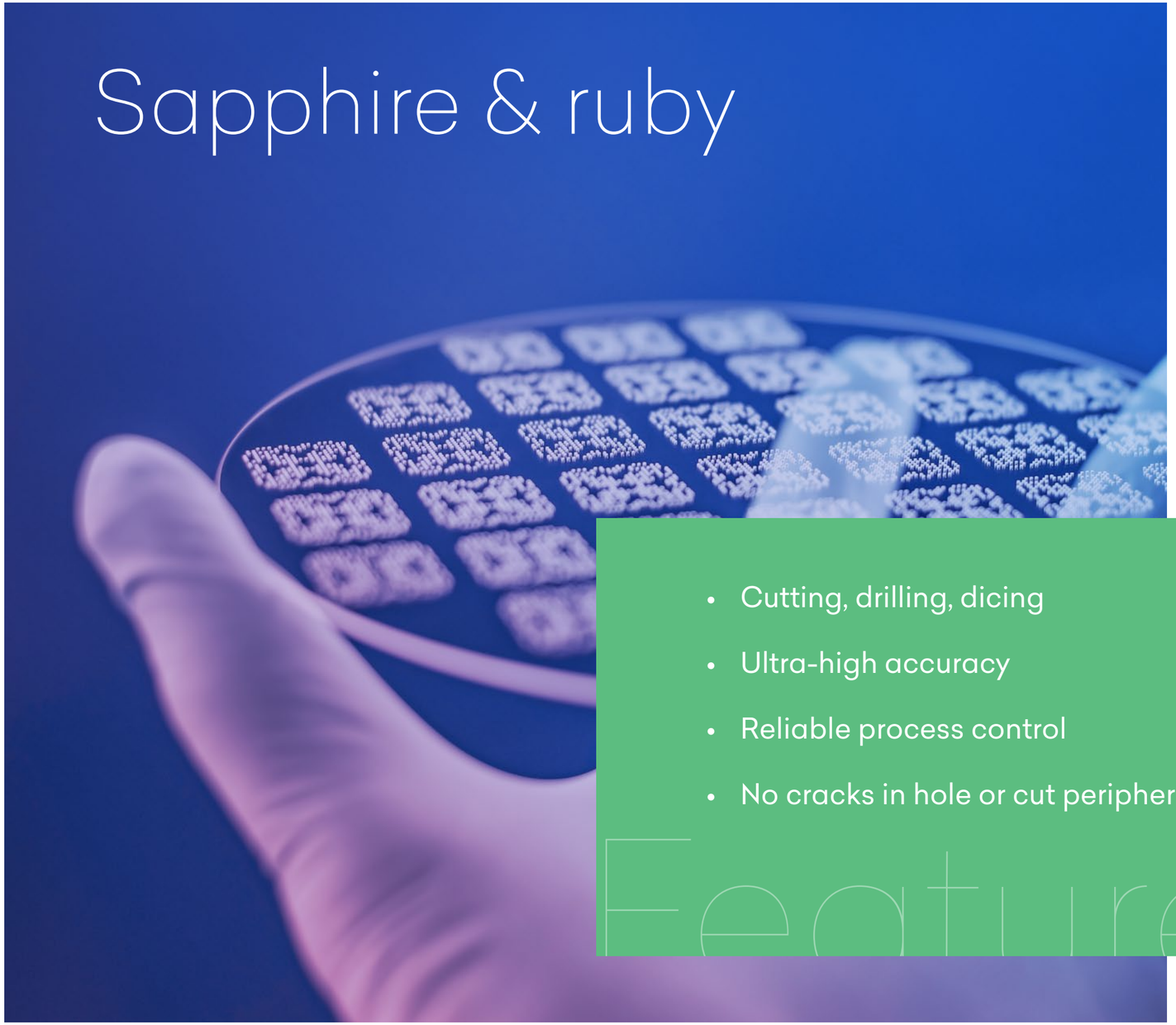
Ceramic drilling



Ceramic drilling

CONTRACT MANUFACTURING SERVICES

Sapphire & ruby



We have extensive knowledge of processing for a variety of brittle materials, including sapphire and ruby.

As one of the hardest materials, sapphire is a widespread choice for companies that work with reliable and durable high-tech products.

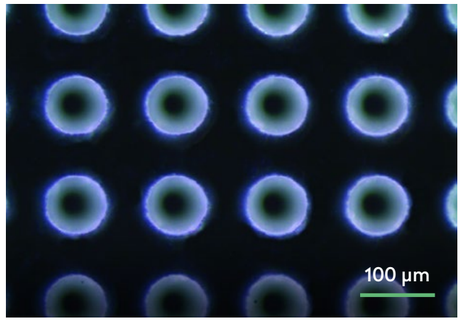
Features

- Cutting, drilling, dicing
- Ultra-high accuracy
- Reliable process control
- No cracks in hole or cut peripheries
- Accurate taper control
- Smooth edges
- Irregular shape cuts
- Minimal or no post-processing needed

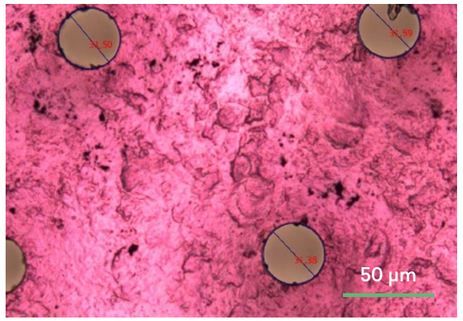
Drilling specifications

- Various hole shapes (circular, square, other)
- Controlled taper (positive, negative, zero taper)
- Smooth drilled inner-wall finish (Ra ≤ 200 nm)
- Minimized stress area around drilled holes
- High-quality lower and side walls in drilled wells
- No melting or micro-cracks at edges
- Precise control of hole depth
- Aspect ratio up to 1:6 for zero-taper holes
- High throughput and yield
- Up to 200 mm x 200 mm (8”) wafer size
- Up to 1 mm thick sapphire
- Ability to work with metalized and optically coated substrates
- Minimal or no post-processing is needed

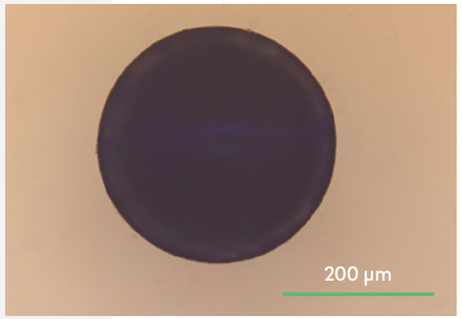
Application examples



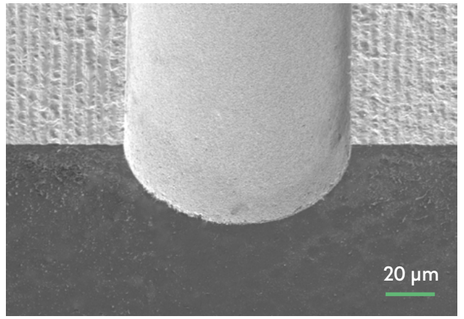
Matrix of holes in sapphire



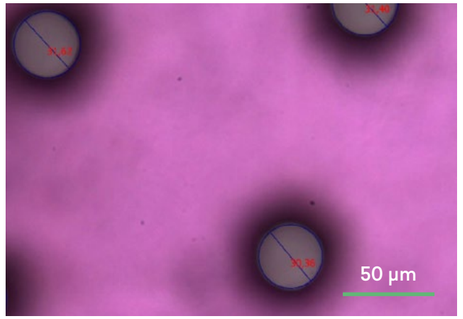
Ruby drilling bottom view



Sapphire drilling top view



Sapphire drilling



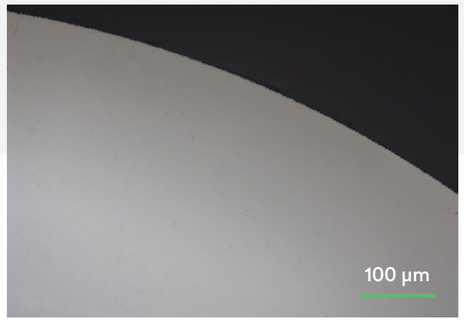
Ruby drilling top view

Sapphire & ruby

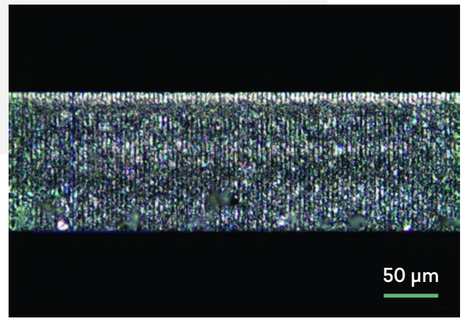
Cutting specifications

- Various shapes cutting (circular, square, irregular)
- High throughput and yield
- Low chipping (typ. <20 µm)
- Smooth sidewalls (Ra <1 µm)
- High bending strength
- Up to 200 mm x 200 mm (8”) wafer size
- Up to 1 mm thick sapphire
- No debris on the back and front surfaces
- Ability to work with metalized and optically coated substrates
- Mechanical sapphire cutting (available)
- Minimal or no post-processing is needed

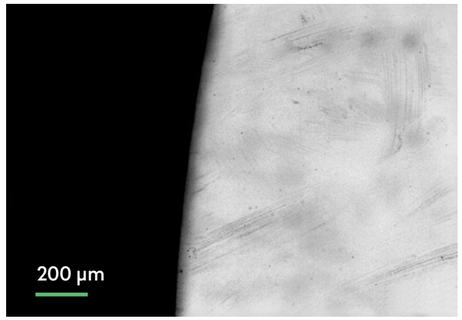
Application examples



0,6 mm sapphire cutting

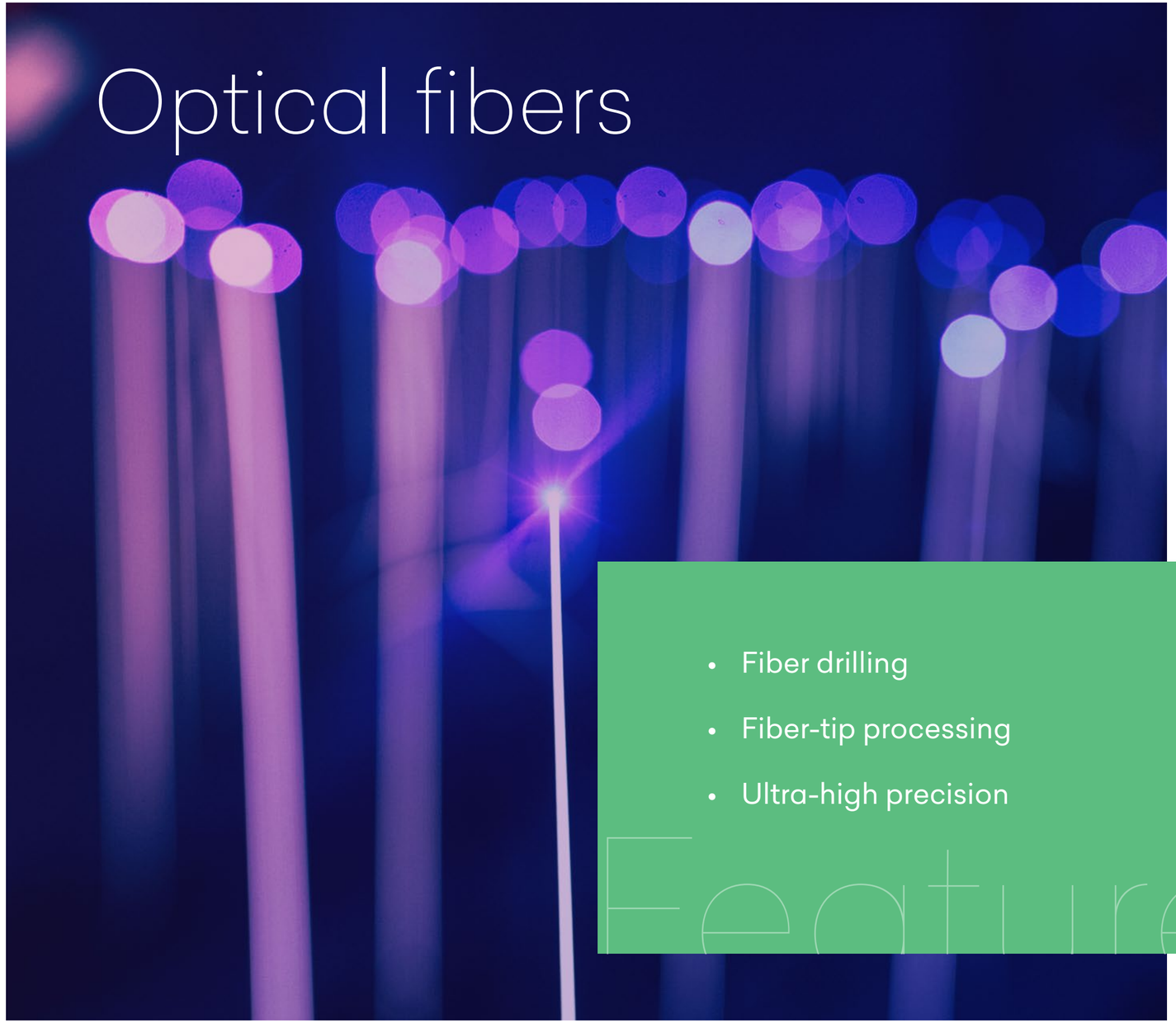


Sapphire cutting of 0,1 mm thickness.
Side view



Sapphire cutting of 0,325 mm thickness.
Top view

Sapphire cutting



Optical fibers

Our fiber processing expertise allows us to laser-drill optical fibers, and produce specially designed shaped tip fibers.

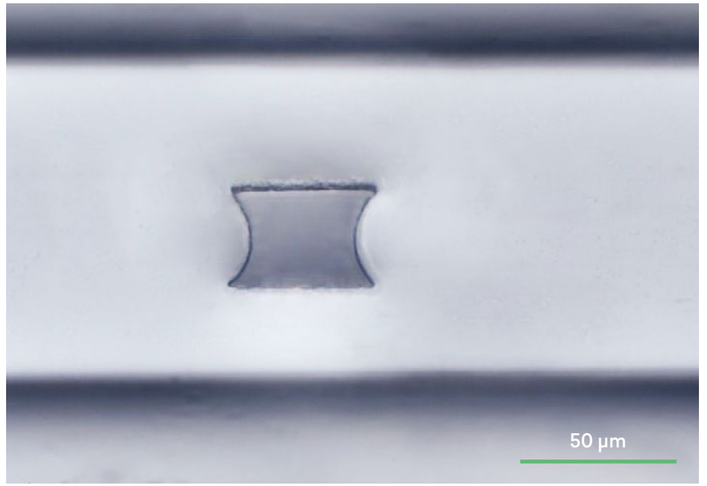
We have industry-leading fiber-processing technology and experience.

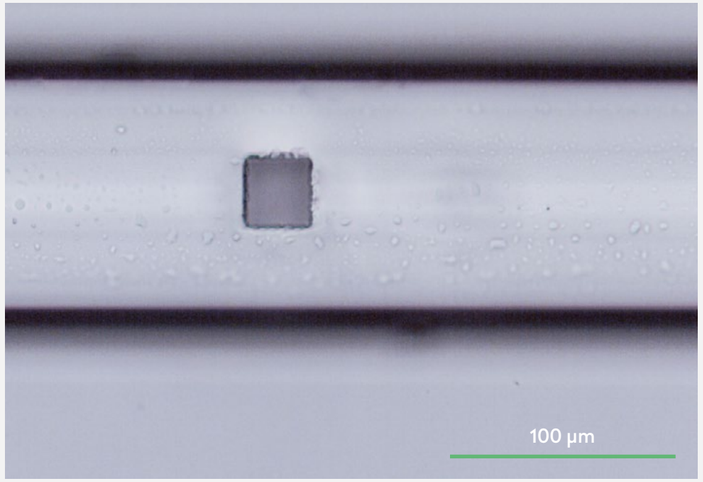
Features

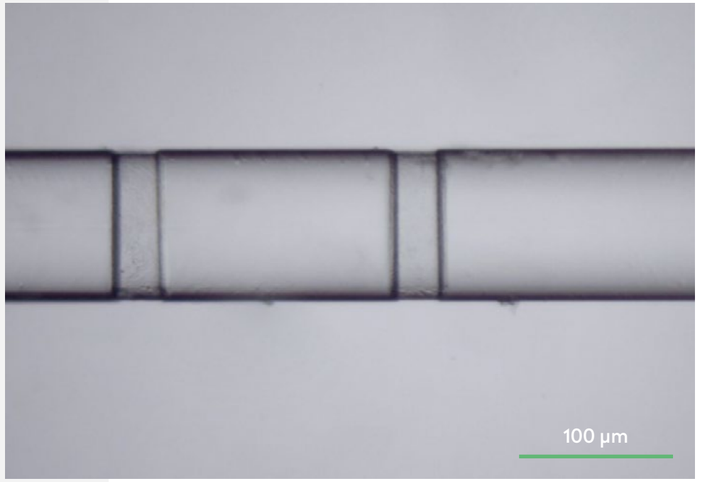
- Fiber drilling
- Fiber-tip processing
- Ultra-high precision
- High processing speeds
- Precise control
- Low costs

Optical fibers drilling

Laser drilling of optical fibers using femtosecond laser radiation is a state-of-the-art technique with many advantages over conventional laser processing, and mechanical drilling, enabling precise control of the process.







Features

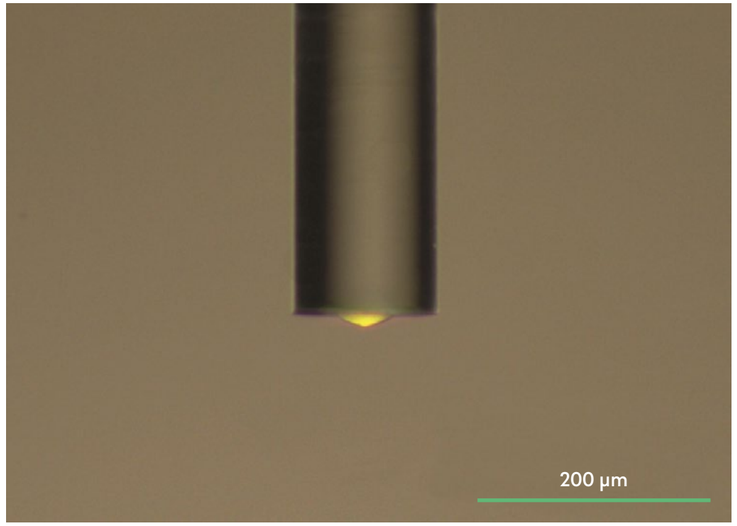
- No melting and micro-cracks at the edges
- Hole diameter as small as 10 µm
- Precise control of taper angle and depth
- Variable geometry of holes
- Different processing parameters can be developed on request

Fiber processing

Femtosecond laser custom-made fiber tips enable optimum control over beam delivery and / or increased efficiency of light collection.

Shaped optical fiber tips can be used in applications such as those for optical sensing and remote laser surgery, as well as for other applications, by controlling the angle of light leaving the fiber or directing it to one side. It provides the advantages of enhanced beam control, a robust optical system, stability, and economic advantages.

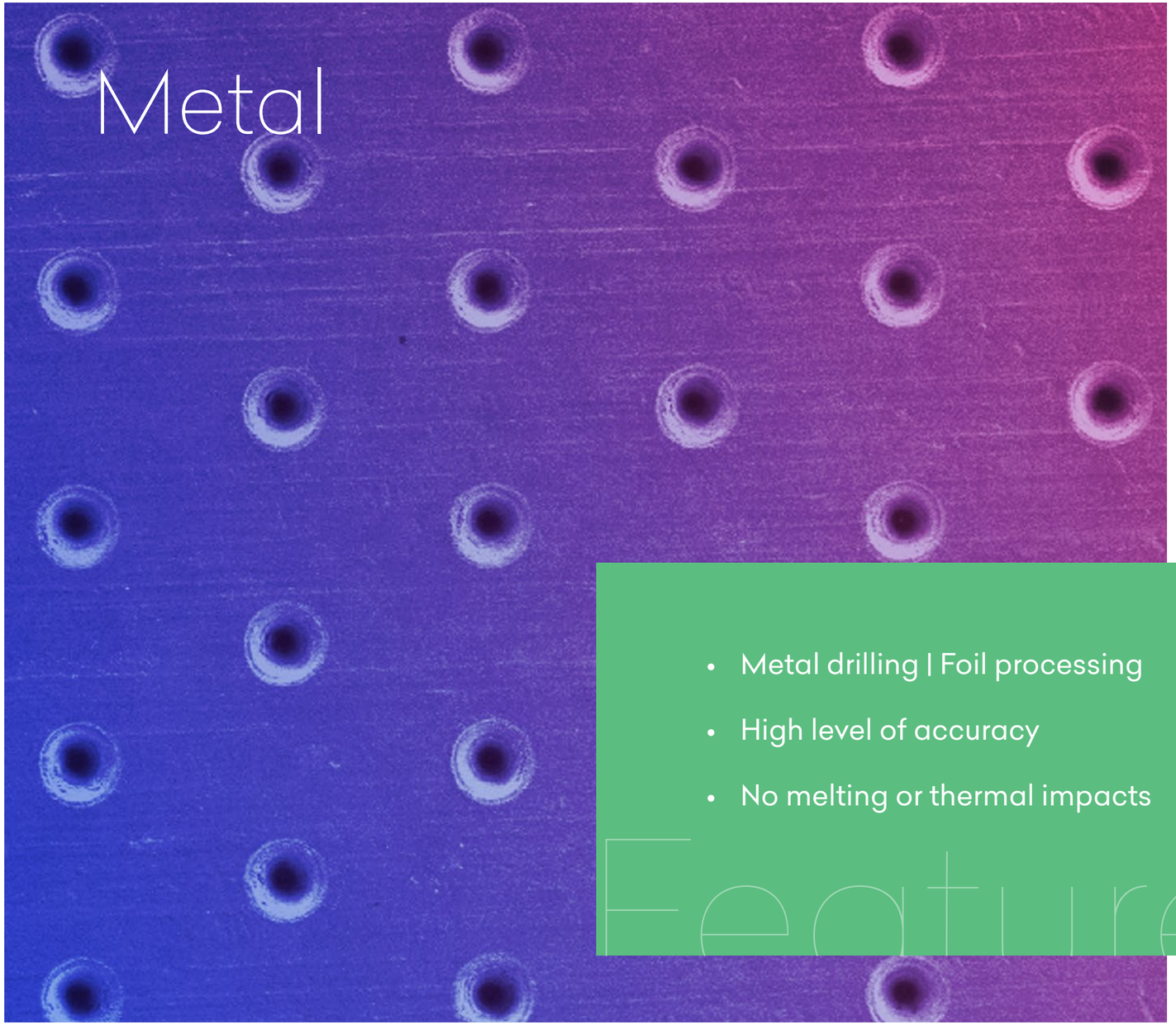
Our fiber-processing expertise allows us to produce specially designed shaped tip fibers and oversee industry-leading fiber-processing technology and experience.



Optical fiber lens

Common types of shaped fiber tips

- Lens (convex, concave, spherical ball)
- Taper (up or down)
- Diffuser
- Side-fire
- Angled end



Metal

Laser drilling of metal alloys enables high quality and precision for many applications, such as filters, functional surfaces, and fuel delivery systems.

When other lasers or mechanical processing methods do not meet technical requirements, femtosecond lasers offer a unique processing method by enabling minimized heat effects while retaining a submicron feature size.

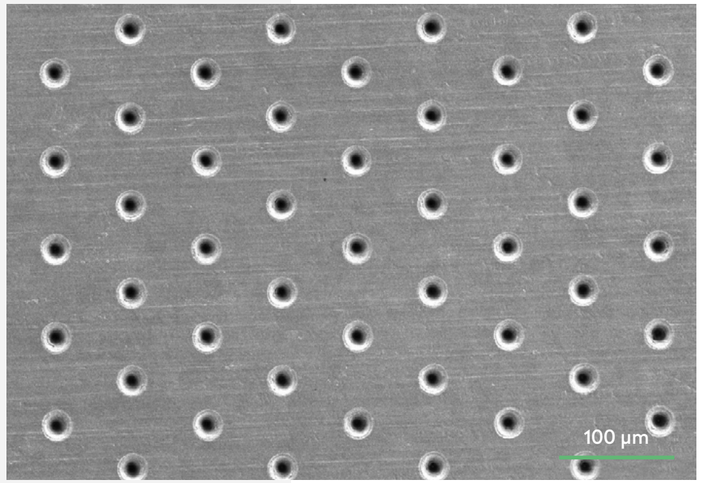
Features

- Metal drilling | Foil processing
- High level of accuracy
- No melting or thermal impacts
- Precise control of taper angle
- Variable geometry for holes
- High processing speeds

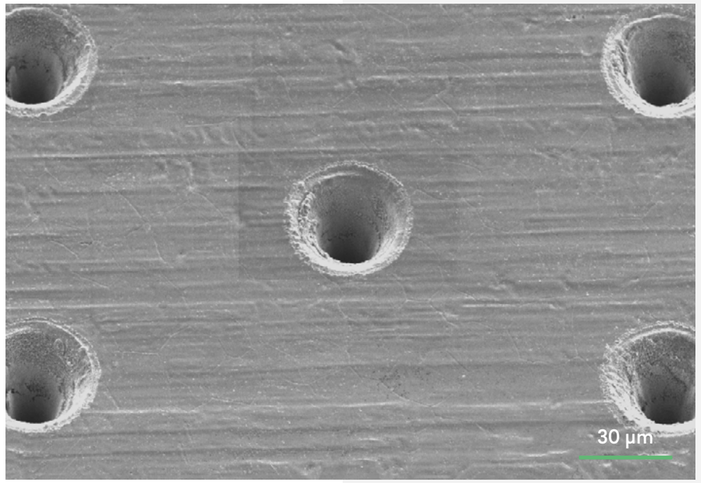
Metal

Metal drilling | Foil processing specifications

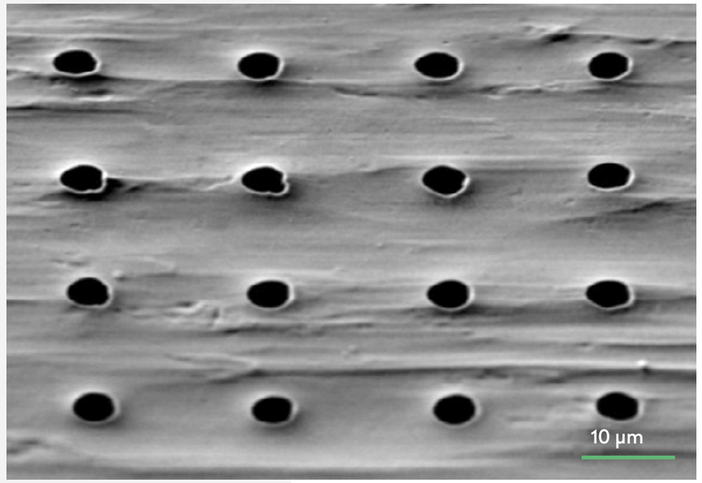
- Various shapes cutting (circular, square, irregular)
- High throughput and yield
- Minimal heat affected zone near the cutting line
- Smooth sidewalls (Ra <1 µm)
- Up to 200 mm x 200 mm (8”) wafer size
- No or minimal discoloration effects
- Minimal or no post-processing needed
- Ability to work with all types of thin films



Metal drilling

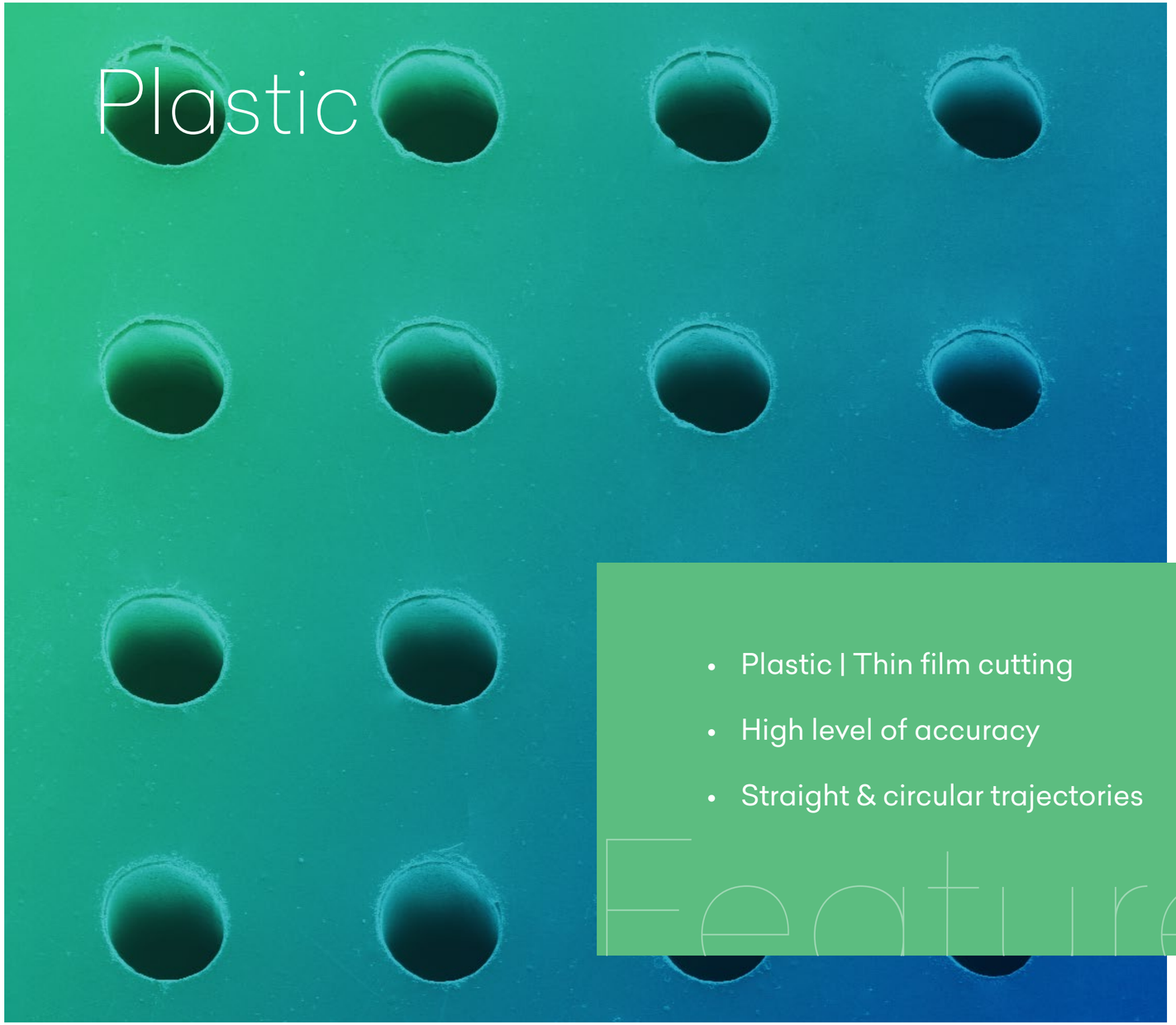


Metal steel foil drilling



Steel foil drilling

Plastic



When other types of laser or mechanical processing methods do not meet technical requirements, femtosecond lasers are unique for their processing capabilities – enabling heat effects to be minimized while retaining a submicron feature size.

Laser cutting through a cold ablation process is optimized for each material (plastic film, metal foil, or others) used.

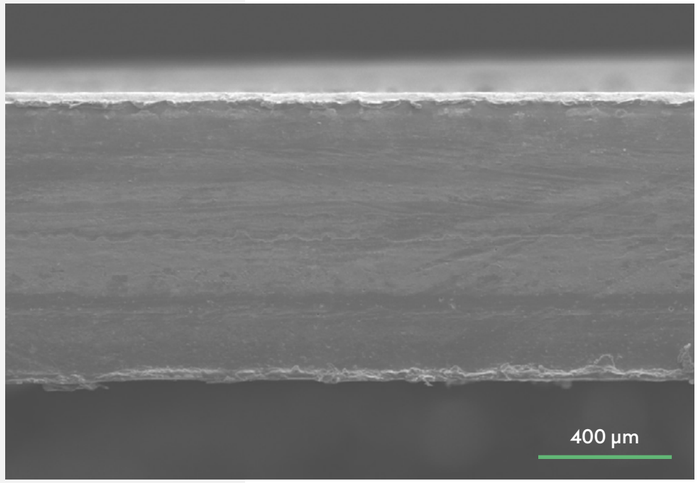
Features

- Plastic | Thin film cutting
- High level of accuracy
- Straight & circular trajectories
- Minimal or no heat-affected zones
- Minimal or no discoloration
- High processing speeds

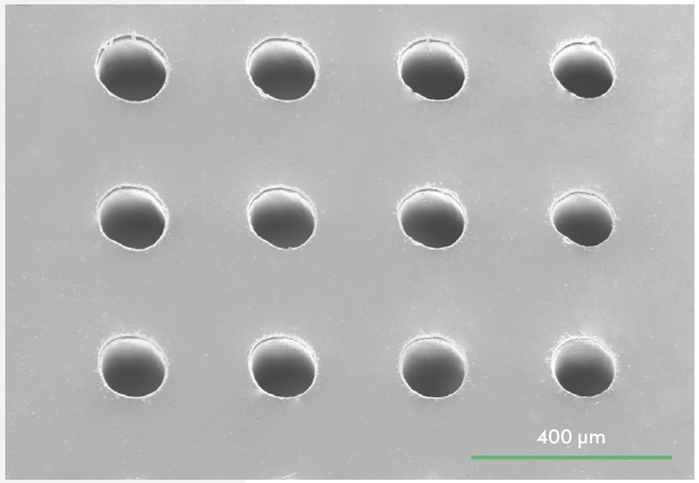
Plastic

Specifications

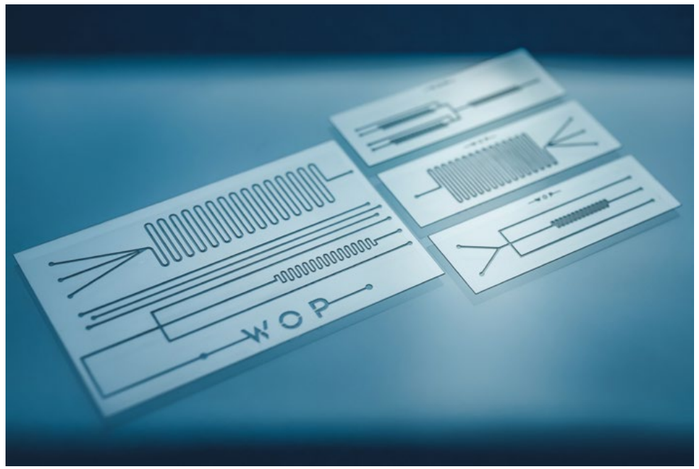
- Various shapes cutting (circular, square, irregular)
- High throughput and yield
- Minimal heat affected zone near the cutting line
- Smooth sidewalls (Ra <1 µm)
- Up to 200 mm x 200 mm (8”) wafer size
- No or minimal discoloration effects
- Minimal or no post-processing needed
- Ability to work with all types of thin films



Plastic cutting



Plastic drilling



Microfluidic chips & devices

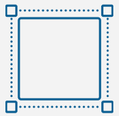
WOP

WORKSHOP OF PHOTONICS

Laser workstations

www.wophotonics.com

Why you should buy our workstations?



Custom, results-based

Every workstation is built according to the exact results you want to achieve

Full support

We will install the workstation at your premises and train your team

Upgradeable

You can add additional functionalities over time

References

Our systems are installed in a diverse range of businesses, research universities and organizations

Flexible

One workstation can be used to make several applications, not just one

1 year warranty

And after-warranty service

FemtoLAB

Femtosecond laser micromachining workstation for laboratories and R&D centers

Features

- Fabrication of complex objects with submicron resolution
- High speed micromachining
- Ultra-high precision micromachining
- Efficient beam delivery and power control
- High-end industrial-grade femtosecond laser
- High-performance galvanometer scanners
- Object movement and laser pulse synchronization in time and space
- Unique software interface controlling all hardware units

Submicron resolution

High speed

Ultra-high precision results

Top-quality components

Technical information

Parameter	Value
Pulse duration	40 fs – 10 ps
Repetition rate	1 Hz – 2 MHz (Single-Shot, Pulse-on-Demand, Burst Mode)
Average power	Up to 80 W
Pulse energy	Up to 2 mJ
Wavelength	1030 nm, 515 nm, 343 nm, 257 nm
Positioning accuracy	± 250 nm
Travel range	From 25×25 mm to 500×500 mm (larger on request)

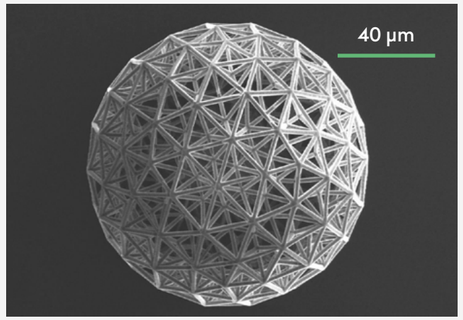
Principle configurations

- Laser source
- Sample positioning system
- Beam delivery and scanning unit
- Laser power and polarization control
- Software for system control (autofocus and machine vision on request)
- Sample holders and special mechanics (sample handling automation on request)
- Optical table
- Enclosure (full or partial)
- Dust-removal unit
- The laser system is automated with SCA micromachining software. This software is an essential part of the laser system and is not sold separately.

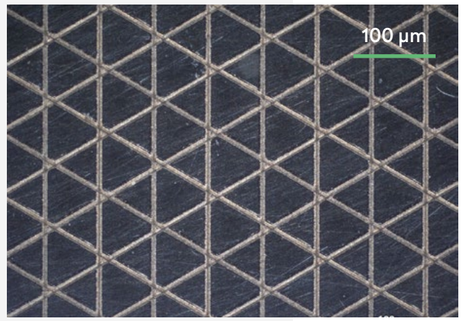
Applications

- Micro cutting
- Micro scribing
- Micro drilling
- Micro marking
- Laser surface structuring
- Selective laser ablation
- 3D additive manufacturing (MPP)
- Micro welding

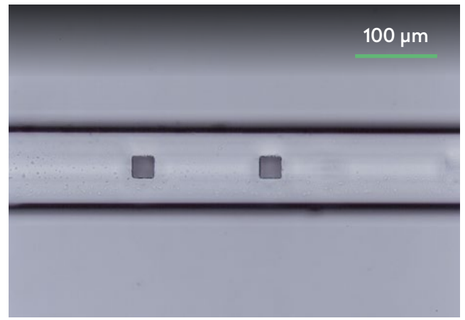
Examples



Multiphoton polymerization (MPP)

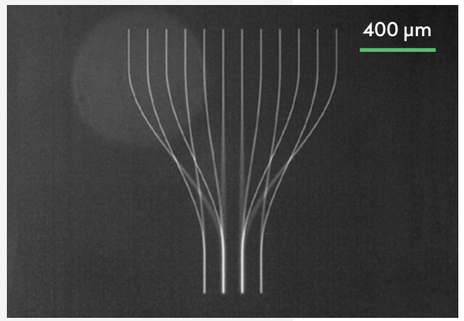


Micro welding | Glass to metal

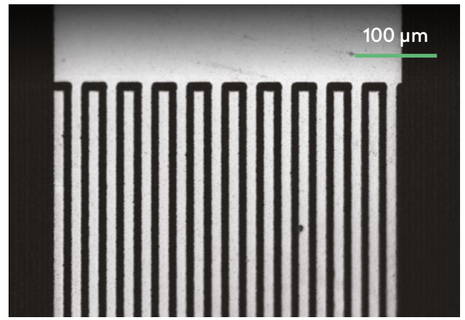


Micro drilling | Fiber

Micro drilling | Glass



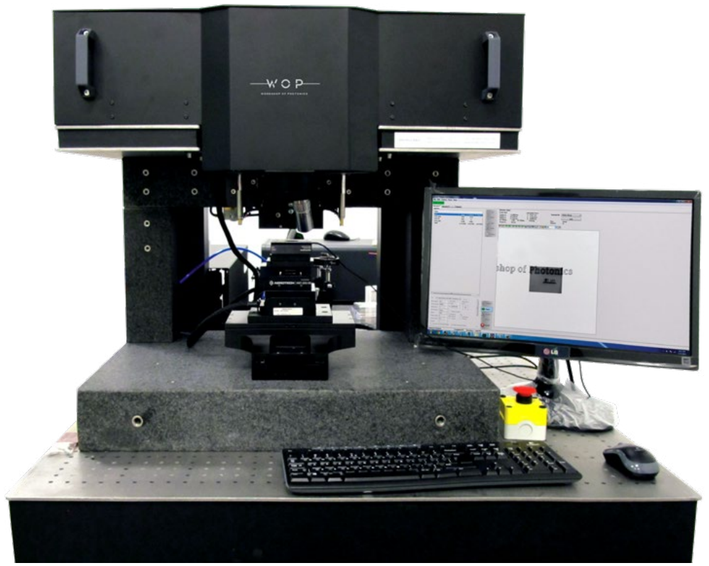
Waveguide writing



Selective laser ablation

FemtoLAB KIT

A solution for scientific and industrial customers that already have a laser source



Features

- A solution without a laser source
- Fabrication of complex objects with submicron resolution
- High-speed micromachining
- High-accuracy XYZ sample positioning
- Custom beam delivery and shaping for selected wavelengths
- Control of the entire system through a single-screen interface
- Easily upgradeable, custom design

µm

Submicron resolution

High speed

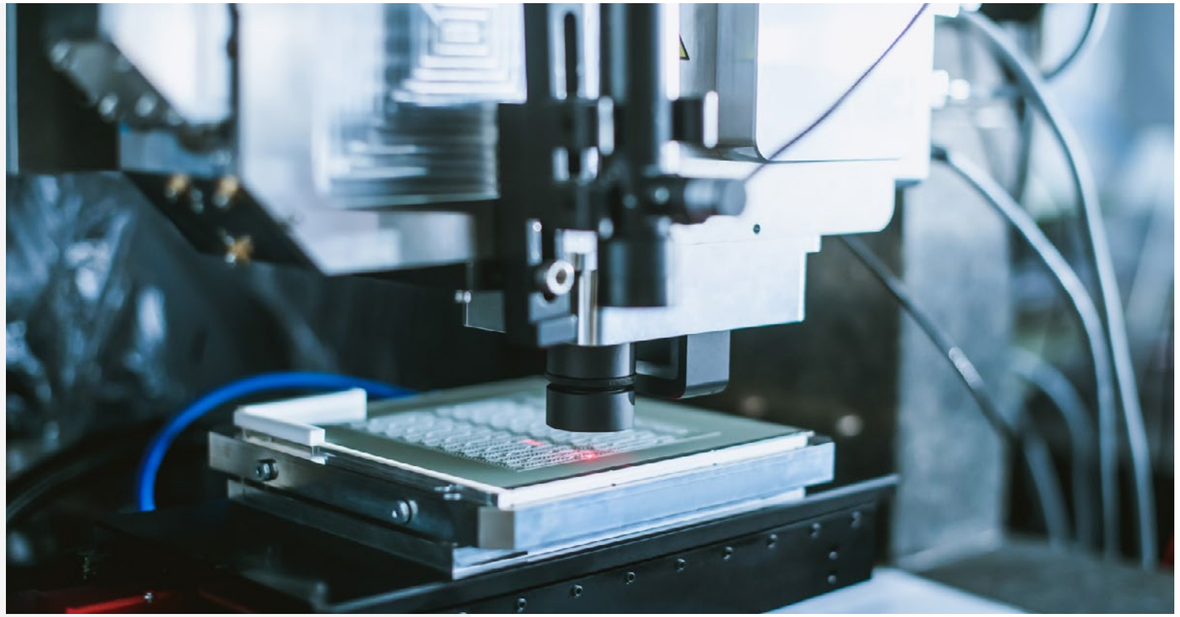
Ultra-high precision results

LASER WORKSTATIONS

FemtoLAB KIT

Principle configurations

- Laser source (provided by customer)
- Sample positioning system
- Beam delivery and scanning unit
- Laser power and polarization control unit
- System control software (auto-focus and machine vision on request)
- Sample holders and special mechanics (sample handling automation on request)
- Optical table
- Enclosure (full or partial)
- Dust removal unit
- Laser system is automated by SCA micromachining software



Applications:

- Micro drilling
- Micro cutting
- Micro welding
- Micro marking
- 3D additive manufacturing (MPP)
- Laser surface structuring

FemtoMPP

Multiphoton polymerization (MPP) technology

Cost effective 3D additive solution for customers in science and industry

Features

- Finest resolution
- Cost-effective design
- Small footprint
- Fabrication of complex & transparent 3D objects
- Variety of polymers available
- Low operating and maintenance cost

nm

Finest resolution

Cost effective

Small footprint

Complex 3D objects

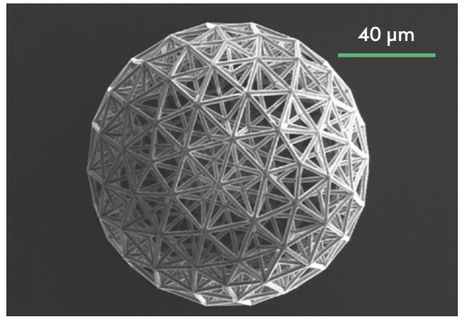
LASER WORKSTATIONS

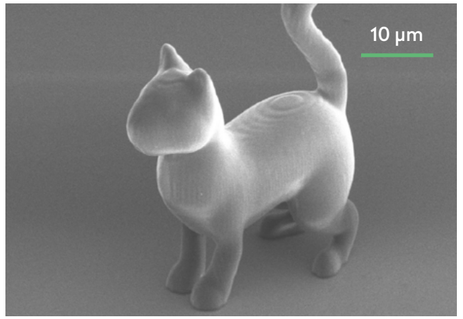
FemtoMPP

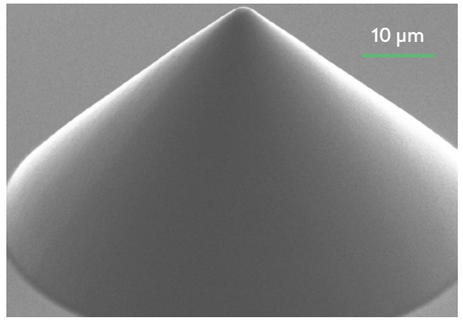
Specifications

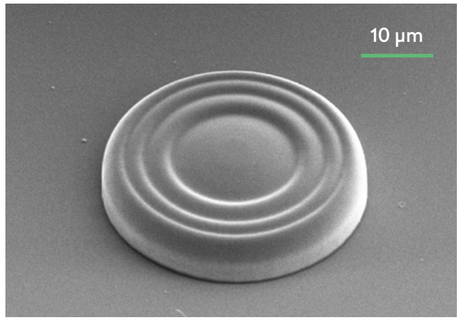
- Writing resolution: 200 nm - 10 µm
- Variety of polymers available
- Stitching error-free laser writing
- Ability to change writing resolution during writing process
- Fabrication of complex 3D objects and arbitrary microstructures
- Repeatability and stable workflow
- Possibility to integrate new structures into existing ones

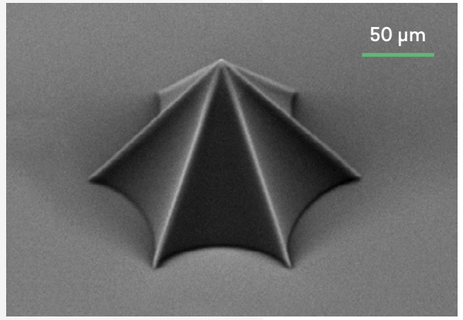
Examples

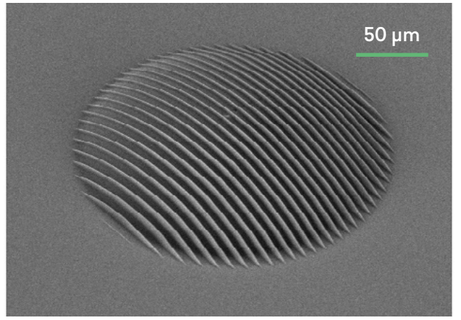






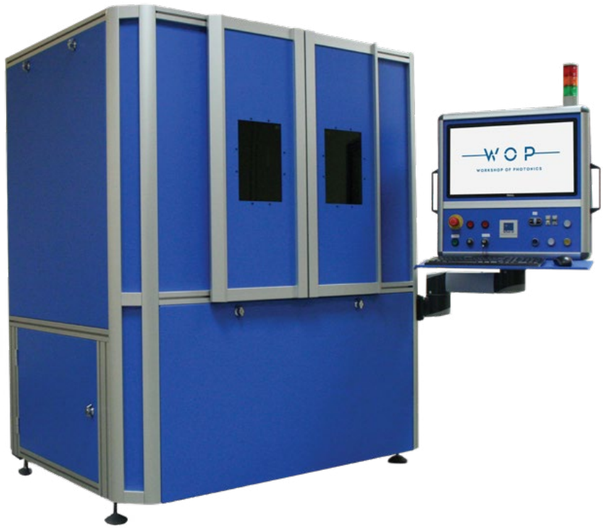






FemtoGLASS

Glass & sapphire cutting workstation for industry



Features

- Ultra-fast thin (30 µm to 2 mm) glass & sapphire cutting
- High processing speeds - up to 1000 mm/s
- Irregular shapes
- Inner and outer contours
- Easy breaking for non-tempered glass and self-breaking for tempered glass

High speed

Irregular shapes

Thin glass & sapphire

Type of glass

- Non-tempered glass
- Tempered glass
- Sapphire

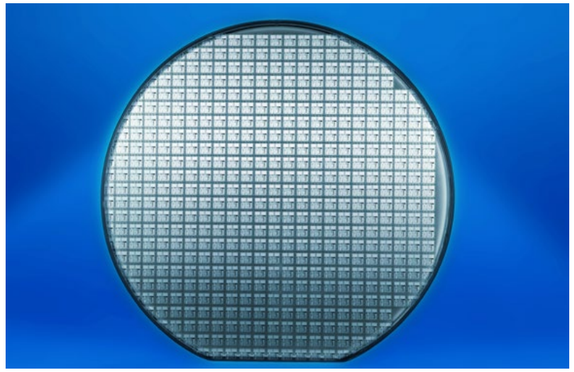
Quality of cut

- Cut width less than 1 µm
- Low chipping <10 µm
- No post-processing required

WOP Glass cutting workstation **outperforms** other glass-cutting methods:

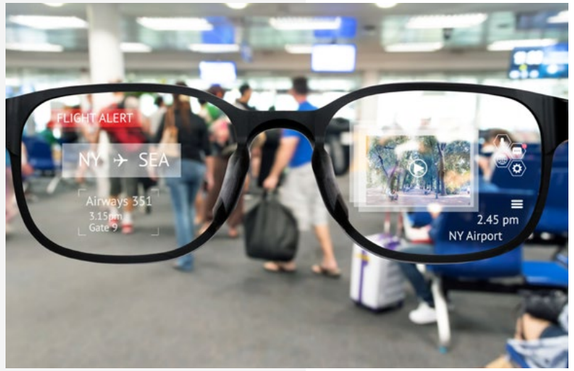
	Blade dicing	Stealth laser dicing	WOP laser dicing
Glass thickness	2 – 19 mm	200 µm – 10 mm	30 µm – 2 mm
Glass type	All types	Non-tempered Sapphire	Tempered Non-tempered Sapphire
Cutting speed	Up to 100 mm/s	Up to 300 mm/s	Up to 1000 mm/s
Possible shapes	Straight cuts only	T-shape and round shapes possible	Any shape possible
Surface chipping	<200 µm	<50 µm	<10 µm

Our technology is used for:

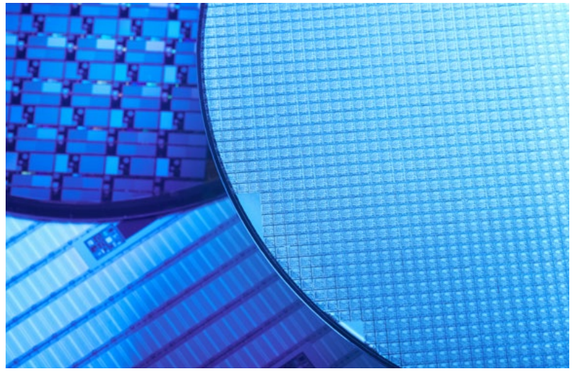


Wafer level glass product dicing

Mobile phone sapphire screens



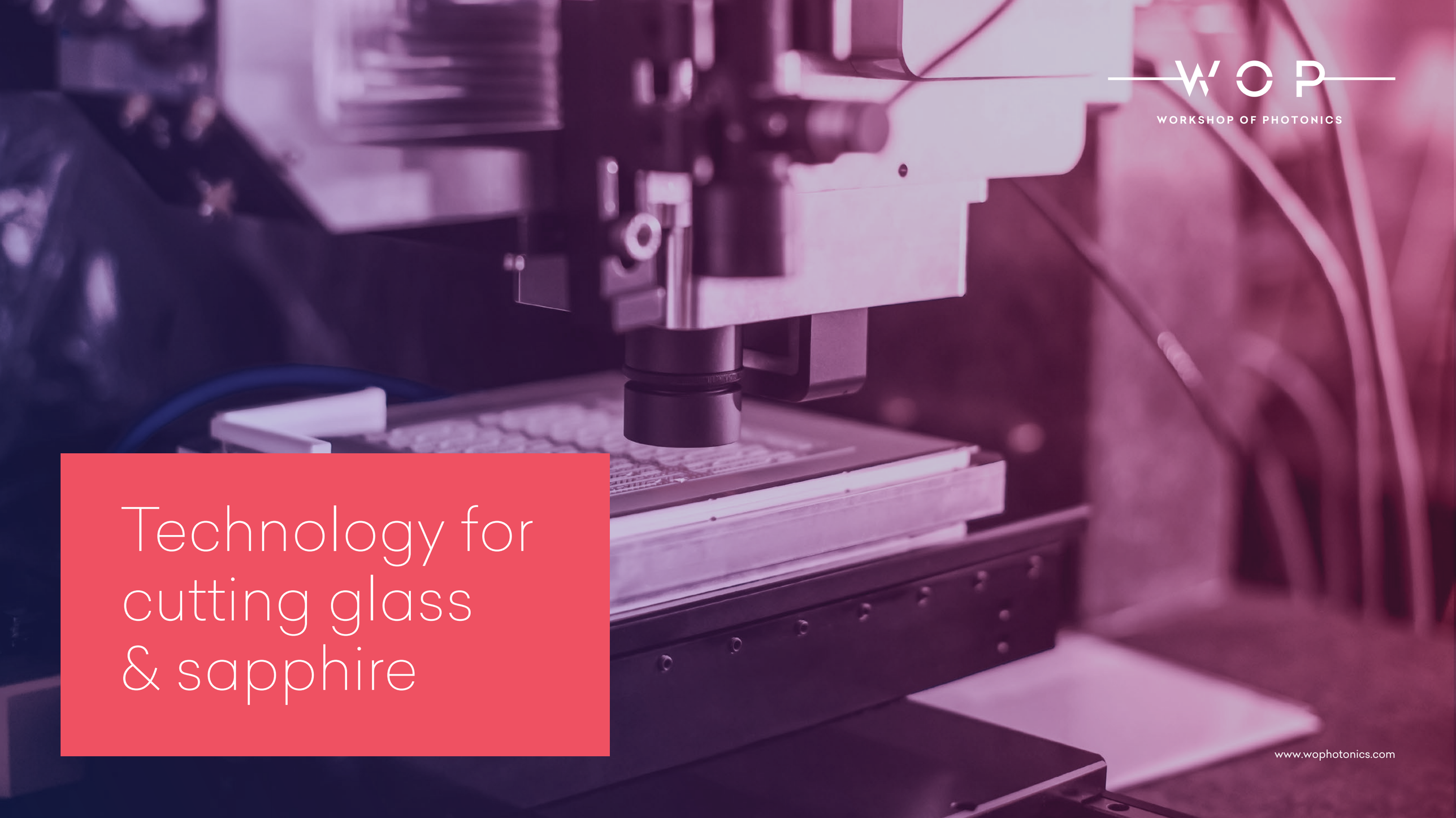
Augmented reality, smart glasses screens



Microoptics elements

Mobile phones sapphire buttons

Mobile phones camera lenses



WOP

WORKSHOP OF PHOTONICS

Technology for cutting glass & sapphire

www.wophotonics.com

Technology for cutting glass & sapphire

High speed

Irregular shapes

Ultra-high precision & quality

Thin glass & sapphire

Features

- Ultra-fast thin (30 µm to 2 mm) glass & sapphire cutting
- High process speeds - up to 1000 mm/s
- Cutting of irregular shapes
- Inner and outer contours
- Easy breaking for non-tempered glass and self-breaking for tempered glass
- High bending strength

Technology for cutting glass & sapphire

Solutions for system integrators

- Optimized for 1028-1064 nm wavelength (515-532 on request)
- Sealed monolithic housing
- Integrated monitored linear axis with 15 mm travel (eliminates need for external Z axis)
- Optional external Machine vision unit
- Optional alignment module for adjustment
- Packages include optical module and technology license
- Dimensions HxWxD: 395x240x95 mm

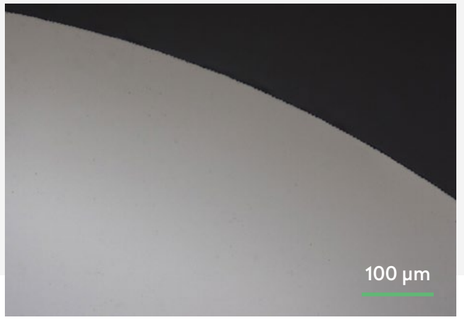
Type of glass

- Non-tempered glass
- Tempered glass
- Sapphire

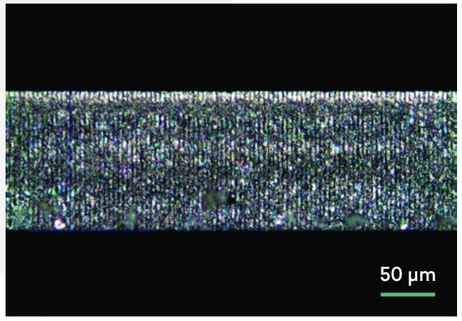
Quality of cut

- Cut width less than 1 µm
- Low chipping <10 µm
- No post-processing required
- Smooth side walls after breaking, Ra < 1 µm

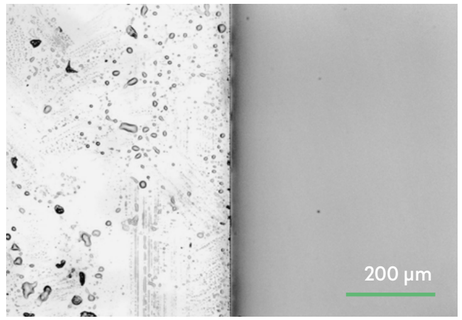
Glass cutting



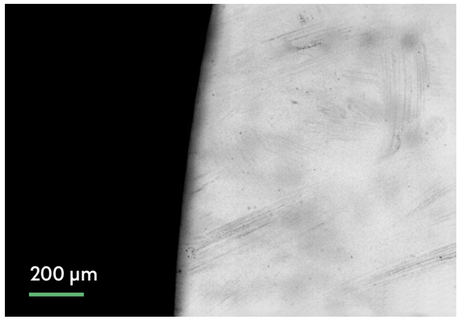
Sapphire: 0.6 mm thickness



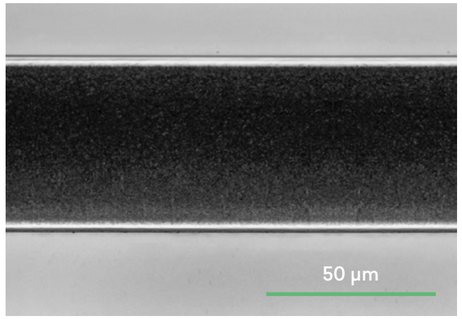
Sapphire: 0.1 mm thickness



Tempered glass: 0.55 mm thickness



Sapphire: 0.325 mm thickness



Tempered glass: 0.55 mm thickness

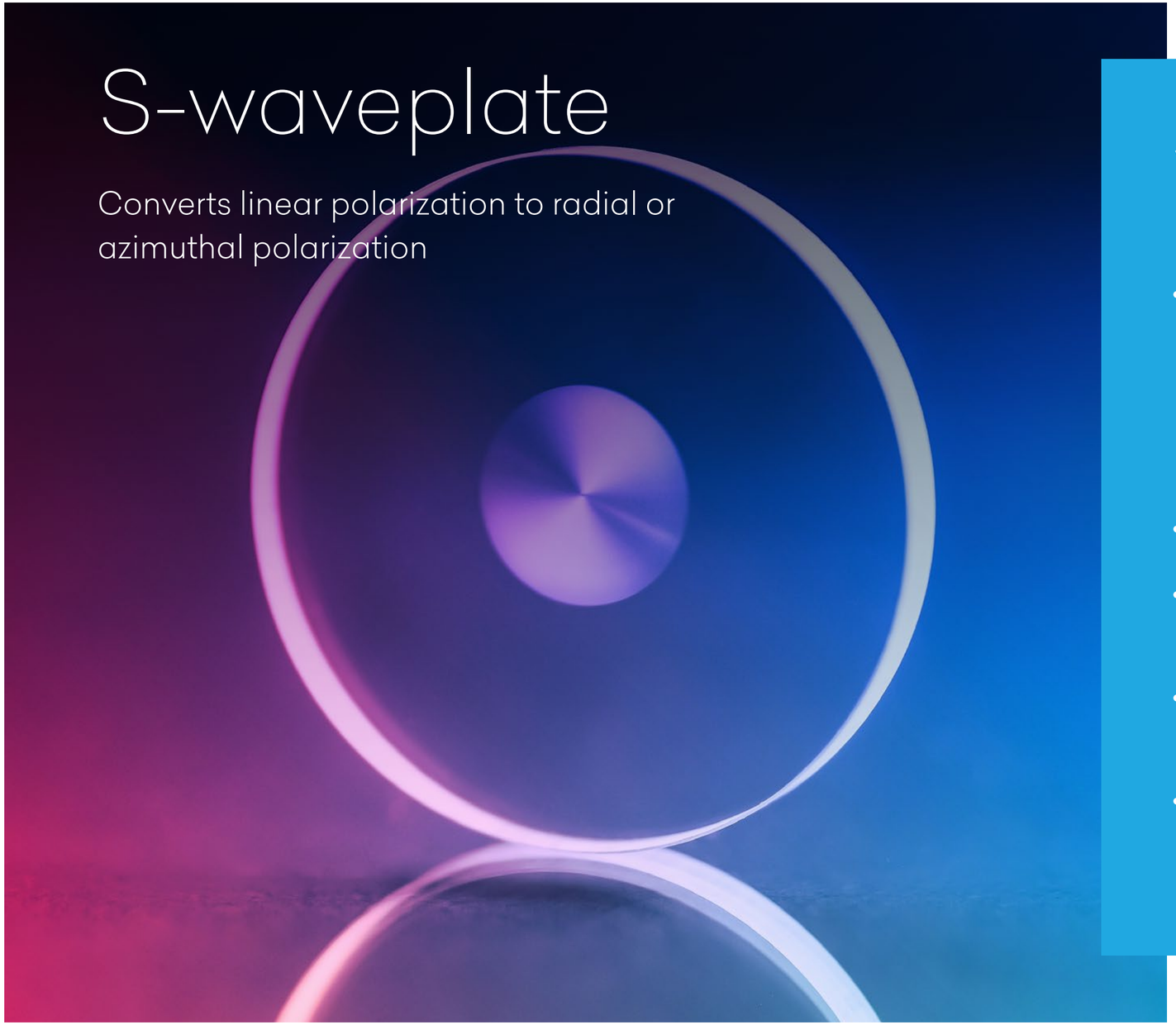
WORKSHOP OF PHOTONICS

Space-variant retarders

www.wophotonics.com

S-waveplate

Converts linear polarization to radial or azimuthal polarization

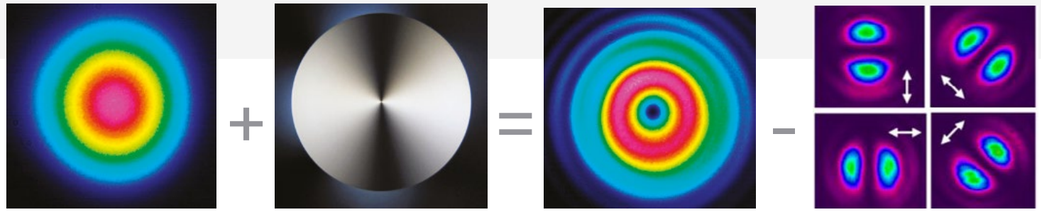


WHY CHOOSE AN S-WAVEPLATE?

- Best choice for converting:
  - linear polarization to radial or azimuthal polarization
  - circular polarization to an optical vortex
- 94% transmission @ 1030 nm (no AR coating)
- Stand-alone – no additional optical elements needed
- Suitable for high LIDT applications and high-power lasers
- Reliable and resistant surface - the structure is inside the bulk

S-waveplate

This comprises a space-variant retarder that converts linear polarization to radial or azimuthal polarization and circular polarization to an optical vortex. The fabrication of S-waveplates is based on the inscription of self-organized nanograting's inside fused silica glass using a femtosecond laser.

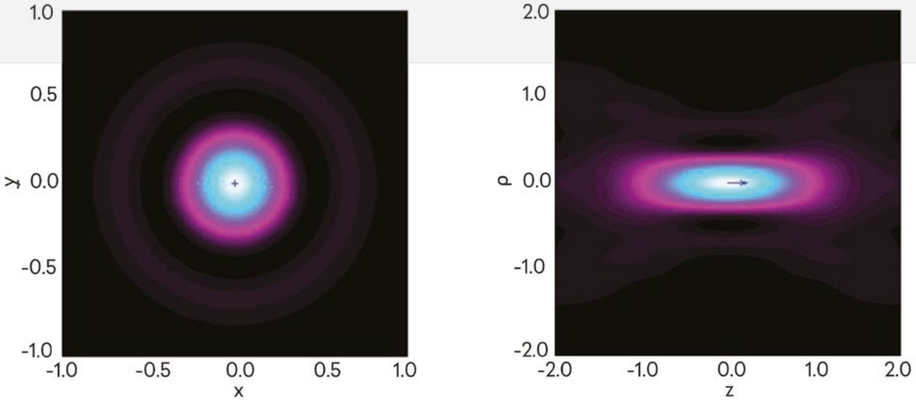


Linear polarization | S-waveplate | Radial/azimuthal polarization | After linear polarizer

Beams with radial or azimuthal polarization attract significant interest due to having unique optical properties associated with their inherent symmetry.
Such beams enable resolution below the diffraction limit and interact without the undesirable anisotropy produced by linearly polarized light. [1]

S-waveplates can be beneficial for polarization-sensitive applications. For example, a radially polarized beam is more efficient at drilling and cutting high-aspect-ratio features in metals. Vector beams are also applicable in optical tweezers, laser micromachining, STED microscopy, and two-photon-excitation fluorescence microscopy.

Application example:



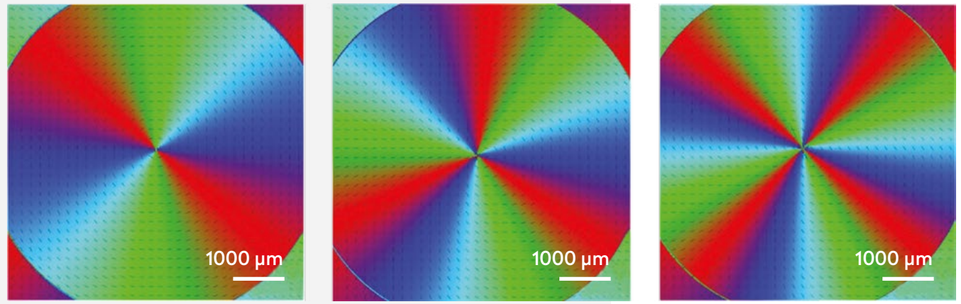
Normalized intensity of the longitudinal (z-) component of a high-NA (1.32) radially polarized beam at focus and through focus. Intensities of 0 and 1 correspond to black and white, respectively. The units of x, y, ρ, and z are in wavelengths. [2]

[1] Radially polarized optical vortex converter created by femtosecond laser nanostructuring of glass Martynas Beresna, Mindaugas Gecevičius, Peter G. Kazansky, and Titas Gertus.

[2] Focusing of high numerical aperture cylindrical-vector beams KS Youngworth, TG Brown - Optics Express, 2000

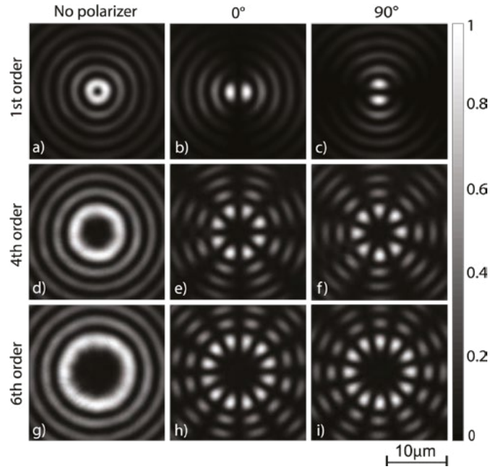
Higher-order S-waveplate

Higher-order S-waveplate converts linear polarization to higher-order polarization patterns.

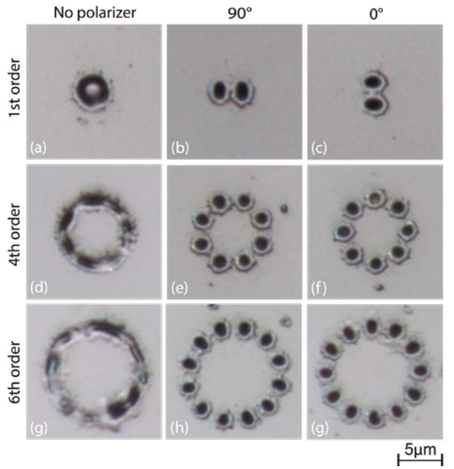


Examples of fast axis patterns for 2nd (left), 3rd (center) and 4th (right) order S-Waveplates (measured with Hinds Instruments Exicor MicroImager).

Combining HOS with an axicon enables vector Bessel beams (VBBs) to be obtained that can be used for the efficient drilling of transparent materials.



Beam spatial intensity profiles of the 1'st, 4'th and 6'th order vector Bessel-Gauss beams (a, d, g) and their single polarization component spatial intensity distribution when polarizer was rotated at two different angles. When the polarizer was parallel to incoming polarization (0 deg) beam intensity profiles are depicted in second column and when polarizer was perpendicular (90 deg) beams are depicted in third column. [3]



Transparent material modification on the D263t glass sample surface with higher order VBB's and their transverse polarization components. 1'st, 4'th and 6'th order VBB damages are depicted in a, d, and g respectively. The single polarization component of the appropriate VBB are depicted in second and third column. [3]

[3] Justas Baltrukonis, Orestas Ulcinas, Pavel Gotovski, Sergej Orlov, Vytautas Jukna, "Realization of higher order vector Bessel beams for transparent material processing applications," Proc. SPIE 11268, Laser-based Micro- and Nanoprocessing XIV, 112681D (2 March 2020); doi: 10.1117/12.2545093

S-waveplate

Technical features

- LIDT | High damage threshold:

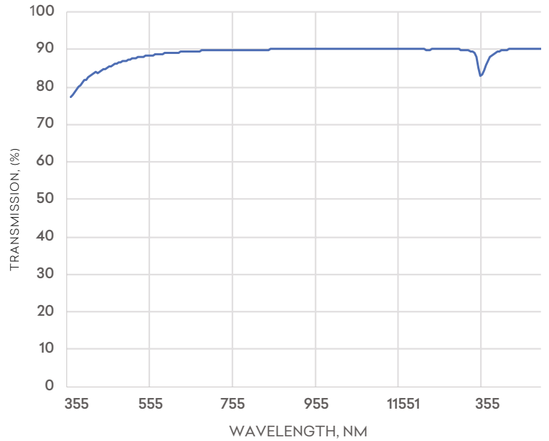
  63,4 J/cm² @ 1064 nm, 10 ns
  2,2 J/cm² @ 1030 nm, 212 fs

- High transmission (no AR coating):

  94% @ 1030 nm, 92% @ 515 nm,
  85% @ 343 nm of most SS lasers

- Large aperture possible - up to 15 mm

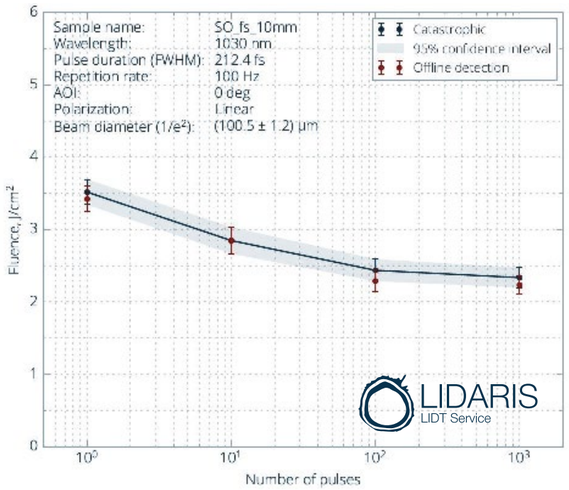
Transmission of uncoated s-waveplate



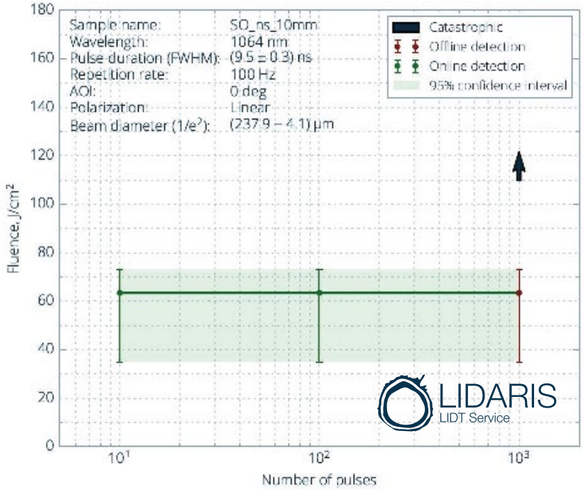
Application examples

- STED microscopy
- Micromachining
- Micro drilling high-aspect-ratio channels
- Generate any cylindrical vector vortex
- Multiple particle trapping
- Micro-mill is driven by optical tweezers
- Use as an intracavity polarization-controlling element in cladding-pumped ytterbium-doped fiber laser for radially polarized output beam generation

LIDT at femtosecond regime

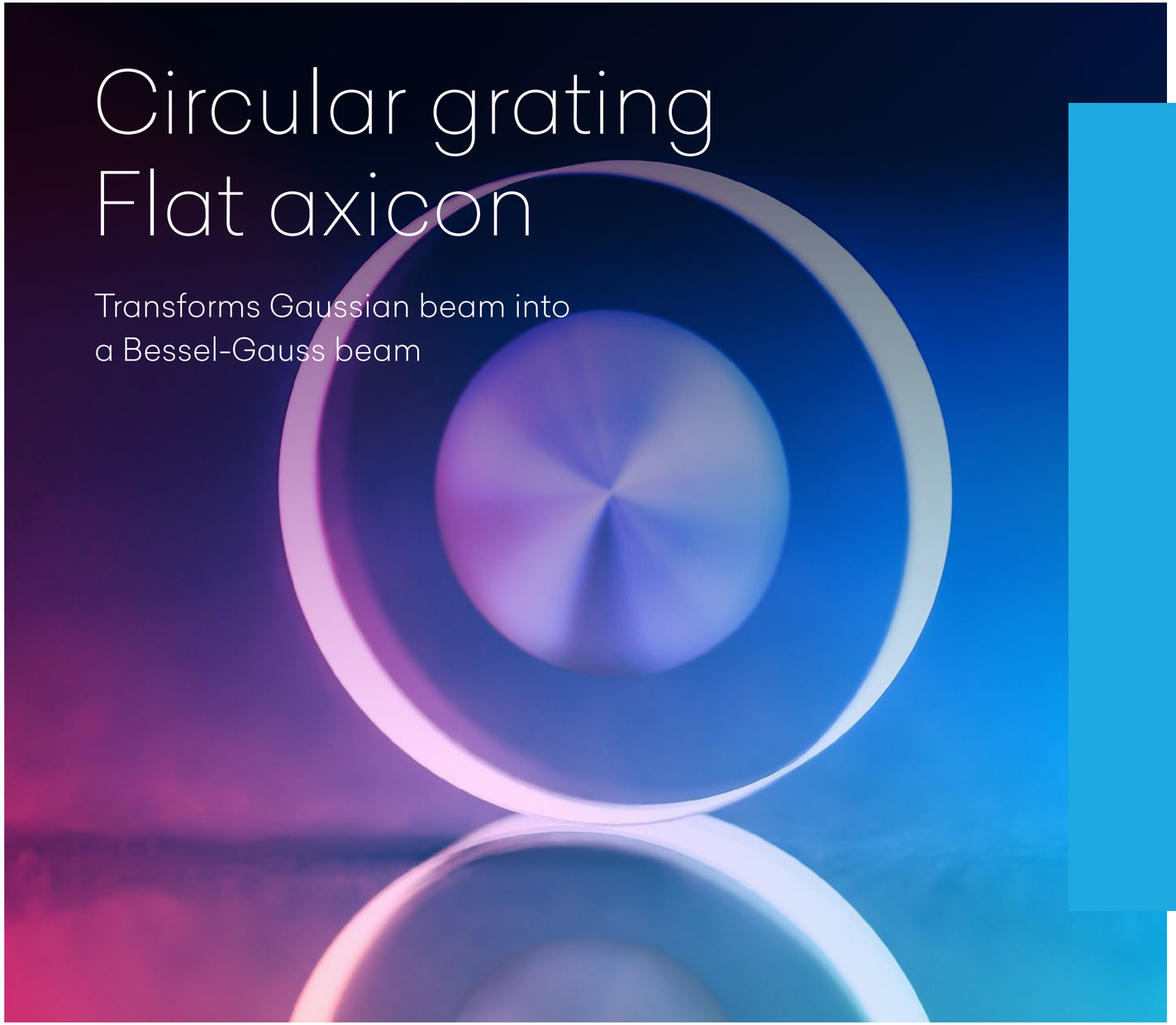


LIDT at nanosecond regime



Circular grating
Flat axicon

Transforms Gaussian beam into
a Bessel-Gauss beam



WHY IS THIS BETTER THAN AN ORDINARY AXICON?

- Positive and negative Bessel-Gauss zones, 3-in-1 usage possibilities
- Suitable for high-LIDT applications and high-power lasers
- Flat optics - saves space, easy to handle
- Reliable and resistant surface - the structure is inside the bulk

Flat axicon

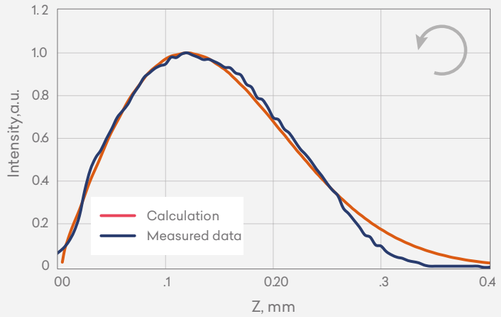
Description

A circular grating (a.k.a flat axicon) is a space-variant retarder that transforms a Gaussian beam into a Bessel-Gauss beam.

This product stands out for its high damage threshold compared with alternative devices. It has a laser irradiation resistance similar to that for uncoated fused silica substrates.

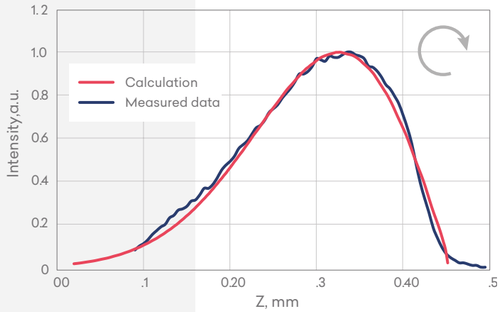
The structure of the element is unique due to the formation of birefringent nanogratings inside a bulk of fused silica glass, sensitive to the incident polarization.

A circular grating can generate both positive and negative Bessel-Gauss zones, with LHCP and RHCP polarizations respectively. Also, positive and negative zones simultaneously with linear polarization. The working regime depends only on incident polarization.



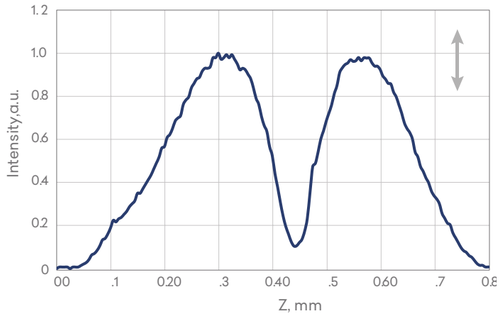
Positive Bessel-Gauss zone

Incident light polarization > left-hand circular – emulating convex axicon.



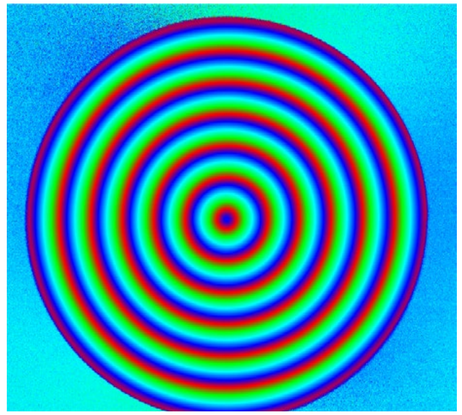
Negative Bessel-Gauss zone

Incident light polarization > right-hand circular – emulating concave axicon.



Positive & Negative Bessel-Gauss zones

Incident light polarization > linear – emulating both axicons simultaneously.



Fast axis distribution across the element (measured with HINDS MicroImager)

Technical features

- Materials: UVFS, IRFS
- Wavelength range: 330nm to 2000 nm
- Min apex angle: 176-179.9° @1030 nm
- Diffraction efficiency: up to 95%
- Element size: up to 15 mm
- Coating (optional): AR/AR coating
- Uncertainty of cone tip diameter ~20 µm
- LIDT | High damage threshold:
  63 J/cm @1064 nm, 10ns;
  2 J/cm @1030 nm, 212fs
- Transmission (no AR coating):
  85% @343 nm,
  92% @515 nm, 94% @1030 nm

Applications

- Micromachining
- Ultra-high aspect ratio micro holes drilling
- High 90% efficiency Bragg gratings
- Cutting of transparent materials

Flat top

Transforms Gaussian beam
to a Flat-Top beam

WHY CHOOSE THIS PRODUCT?

- 100% suitable for your application – designed according to your laser beam specifications
- Suitable for high-LIDT applications and high-power lasers
- Wavelength range from 300 nm to 2 µm
- Conversion efficiency up to 70% (wavelength dependent)
- Large aperture (up to 15 mm; standard is 6 mm)

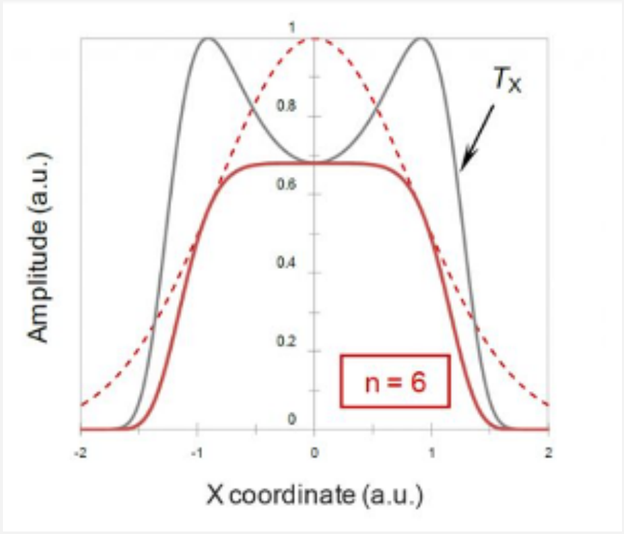
Flat top

Description

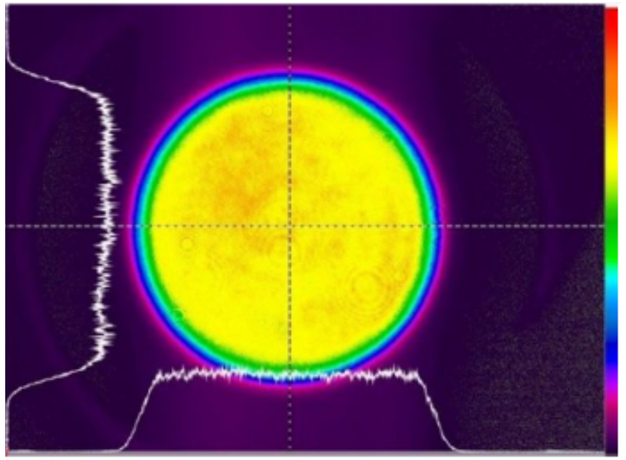
Space-variant waveplate for flat-top conversion is beam-shaping optics. A combination of a space-variant waveplate and a polarizer acts as a space-variant transmission filter that converts a Gaussian beam spot profile into a flat-top beam with equal energy distribution.

It is a space-variant phase retardation plate inscribed inside a bulk of fused silica glass by femtosecond laser pulses. A well-known fact is that flat-top intensity distributions have noticeable advantages in micromachining in terms of efficiency and quality compared to Gaussian beam profiles.[1]

A converter enables on-the-fly adjustment of the beam shape from flat-top to a shape with a dip in the middle. The converter is compatible with high-power ultrashort lasers.



One-dimensional initial Gaussian function (dashed red line), 6-th order super-Gaussian function (solid red line) and calculated transmission function TX (solid grey line)



Flat-top intensity distribution after converter

[1] Homburg, O., & Mitra, T. (2012). Gaussian-to-top-hat beam shaping: an overview of parameters, methods, and applications. Laser Resonators, Microresonators, and Beam Control XIV. doi:10.1117/12.907914

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