PULSAR PHOTONICS
a schunk company

Pulsar Photonics GmbH

Manufacturing solutions for laser micromachining

Company presentation – Product & service overview

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PULSAR PHOTONICS
a schunk company

Innovative laser technology

Dear business partners,

We are pleased to present you with our latest company brochure – your compact introduction to PP GmbH and our world of high-precision laser micromachining.
As a dynamic and innovation-driven company, we are committed to delivering tailor-made solutions and outstanding service. Since our foundation, we have grown steadily and are now proud to offer a comprehensive portfolio of high-performance systems and services for a wide range of industries.
Our experienced team is passionate about transforming your individual requirements into effective, success-oriented solutions. Our process expertise is a key component of this. Our Laser application center is equipped with a constantly expanding machine park. Our machines are uses worldwide and are able to cover the wide range from manual prototyping to fully automated series production.
What makes PP GmbH unique is the combination of cutting-edge laser micromachining systems, our powerful machine control software, and advanced optics technology. All of this is backed by deep process expertise, allowing us to deliver solutions from a single source and with maximum precision.
We combine technological excellence with strong values. Our commitment to the highest quality and customer satisfaction goes hand in hand with our focus on sustainability and social responsibility. We firmly believe that long-term economic success is inseparable from responsible action – both environmentally and socially.

We invite you to explore our brochure and get to know us better. We look forward to your inquiry and to a successful collaboration.

The management
Dr. Stephan Eifel, Dr. Jens Holtkamp und Dr. Joachim Ryll

Our drive: technology, society and business

The potential of ultrashort pulse lasers is immense: As efficient all-purpose tools for micromachining, they enable highest precision and repeatability independent of material, e.g. for microdrilling, fine cutting and surface structuring - digitally and wear-free. Pulsar Photonics is the **technology leader** in the field of ultrashort pulse lasers and is continuously developing them further.

Open, honest, constructive

Our customers benefit from resource-efficient processes and machines, professional service and intelligent state-of-the-art software. You know Pulsar Photonics as a high-tech partner, as a competent and fair business partner for complex challenges.

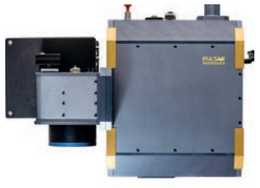
For us, **customer orientation** is not an empty phrase, but a corporate philosophy. We work quickly, agilely, pragmatically and develop successful solutions together.

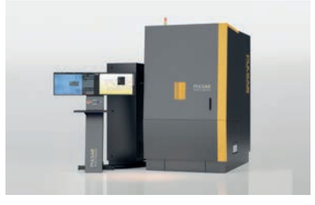
Competent and professional

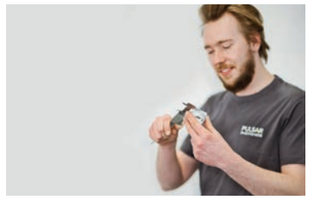
We take responsibility for people and the environment. Because long-term, forward-looking planning benefits everyone. For our highly motivated employees, this means that we always have their welfare in mind. They are at the center of everything we do.
People at Pulsar take a lot of personal responsibility for the tasks they are qualified for – the Pulsar Photonics team consists of cross-application experts. This is the only way we achieve **top performance**. Only this way we grow healthy and profitable in the long run.

10 years of Pulsar Photonics:

Our milestones







2013

After intensive preparation, Dr. Jens Holtkamp, Dr. Stephan Eifel and Dr. Joachim Ryll founded Pulsar Photonics GmbH on September 30, 2013 in Aachen.

This was preceded by work at the Fraunhofer-Institute for Laser Technology ILT and a successful selection process „Exist-Reseach Transfer“. The technology core will be the compact multi-beam system MBS. The focus of the company is on laser micromachining with ultrashort pulse lasers (UKP).

2014

Pulsar Photonics hires its first employees and begins with the development of the of the MBS multi-beam system. The machine software Photonic Elements gets its name.

2015

Relocation of the company to the TPH-Herzogenrath site. Europe’s largest investment fund (High-Tech Gründerfonds) invests in Pulsar Photonics.

2016

The RDX1000 laser machine is launched. Development MSE and digital beam shaping system FBS

2017

The compact RDX 500 machine for laser micromachining is launched.

2018

The Laser Application Center LAZ receives its own production rooms and is equipped with additional UKP laser machines and measurement technology. The machine software Photonic Elements is completely rebuilt and receives the current modular architecture.

2019

Growth champion! Pulsar Photonics lands in the national top 10 of the fastest-growing companies in the mechanical engineering sector, according to Statista.

The first fully automatic machine with robotic loading is launched on the market.

2020

Certification of production and development according to ISO 9001:2015.

The mixture fits! Group meets growing company. Pulsar Photonics becomes part of the Schunk Group and the P1000 laser production machine is launched: cycle rate of up to 250,000 parts/day with 100 % inspection.

2021

2022

With the opening of Plant 2 in Aachen-Verlautenheide, Pulsar Photonics doubles its own assembly capacities. The RDX800 and RDX2Fiber series machines are launched in a new design. At the same time, the first four apprentices are trained as production technologists.

2023

Pulsar begins its anniversary year with the opening of Plant 3 in Aachen-Verlautenheide. The digital learning environment Pulsar Academy goes online. The company’s strong growth continues; at the beginning of **2024**, the workforce numbers 100 employees

2025

The people at Pulsar Photonics

People are in the foreground

As a high-tech company, our products and innovations with their fascinating functions almost automatically take center stage. But it is the people who tackle complex problems, develop processes and solutions, coordinate internally and communicate with customers at our company. It is these people who want to develop further and thus drive change in the company:

Student assistants

In this way, **student assistants** who gain their first professional experience become new employees. By the time they are 30, at the latest, they are the new veterans. They know the machines and products, the customers. That is part of the company's DNA.

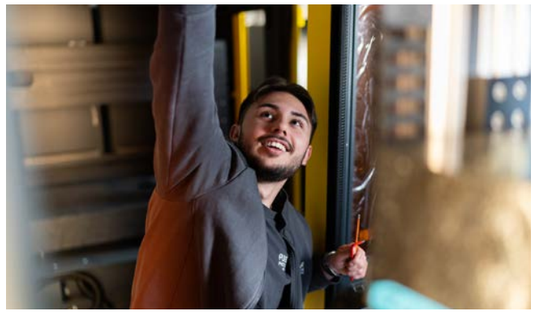
Trainees

Trainees are trained with a high level of commitment and by many participants in the company working together, because their skills will be in demand everywhere in the company in just a few years.

Career changer

Hello **career changers**! Hand on heart: Who has actually learned laser technology properly? Almost no one can claim that. And we know that. But the company also needs important other disciplines – even part-time. Those who want to learn and come to stay are welcome. It shouldn't be less than that.

Professionals



Who is missing from the team? **Professionals** who value a hands-on approach and openness have found their place with us. We have developed from a small start-up to a medium-sized company, yet we still have a long way to go. Our professionals bring with them work experience. They also come with new views, professionalism and resilience. They are sometimes in a different stage of life and have proven processes and insights with them.

Young executives

Young executives also get their chance with us and can take on their first responsibility.
We passionately support people who take on real responsibility. With further training, with practical advice and also sometimes with backing.
They do great.

Lasertech pioneers for a new era

At Pulsar Photonics, we attach great importance to the **training of our future employees**. As an innovative and future-oriented company, we offer them first-class training with excellent career opportunities. In doing so, we not only pass on specialist knowledge to the next generation, but also offer room for personal development.

In our apprenticeships **Production Technology** (m/f/d) and **Electronics Technician for Industrial Engineering** (m/f/d), our apprentices learn everything they need for a successful career in the field of laser technology. In the process, they actively work on the production of components as well as the machines and process innovative projects on our laser systems.

We want to offer our trainees the best possible environment in which to develop their skills. That is why we are committed to open communication and close cooperation between our experienced employees and our trainees. We are convinced that through this cooperation and feedback from the next generation, everyone involved will move forward.

Training at Pulsar is very varied. It's always a great feeling when a new application works in the end!

Fabian Savelsbergh, Trainee

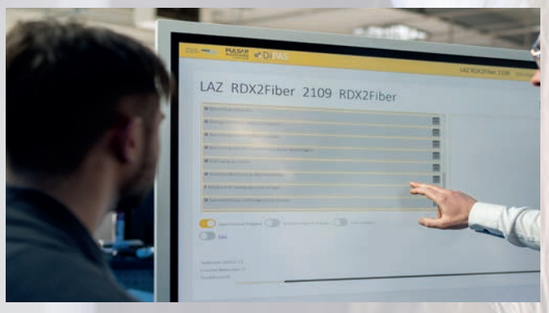
Looking ahead: Digital future

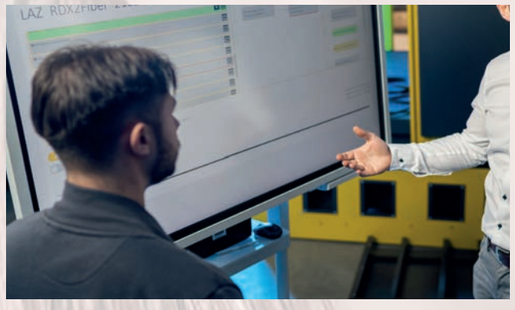
Strategic IT investments and data-driven decisions

We have set ourselves the goal of bringing digitalization to all business areas and fields of activity of Pulsar Photonics. To this end, we have made strategic investments in IT hardware, database technologies, assembly and ERP systems, and software tools for process automation. The aim is to optimize the complex processes in goods logistics and to make information available in a timely manner.

Optimized assembly processes: DIPAS supports the plant engineering team

For the production of RDX laser machines, we have the Digital Production Assistance System (DIPAS) at our disposal. The core mission of the system is to provide the best possible support for assembly personnel in plant construction. CAD files and assembly instructions can be called up directly at the assembly station, and complications and functional tests can be documented. The system was developed in cooperation with the WZL of RWTH Aachen University.





Greatest possible ease of use: legibility, stylus-free touch operation, clear navigation and the shortest response times.

Augmented reality for effective communication and support

The digital strategy also focuses on synergies with partners, customers and suppliers, user acceptance and usability, interfaces and data management, as well as high-performance standard solutions and support. For example, our augmented reality function provides support with the direct image channel and is used in communication between project management and assembly personnel or as 3rd-level support for tasks in the field.

Products & Services

One solution provider

PULSAR PHOTONICS
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As a UKP expert, Pulsar Photonics offers an interdisciplinary portfolio that is structured like an ecosystem. Convince yourself.

Laser Application Center

- Application development
- Contract manufacturing
- Accompaniment into series production

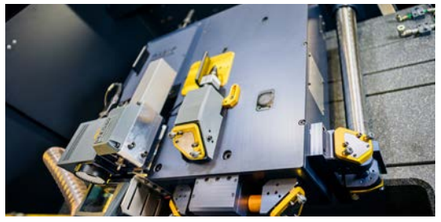
Machine design

- Standard machines
- Special machines
- Laser machines for series production

Service

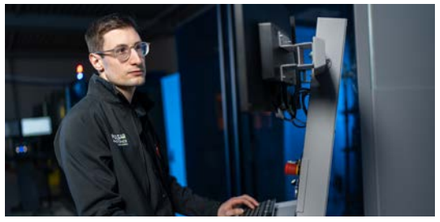
- Remote Support
- On-site support
- Pulsar Academy

System technology



- Special optics
- Customized optics systems

Software



- Machine control: Photonic Elements PE
- Customized adaptations based on PE
- Simulation and test tools

Your contact persons

Dennis Pechner

Technical sales for the laser application center

If you have any questions about our application portfolio, technical feasibility, or the ideal machining process for your project, I will be happy to assist you. You can reach me by phone and e-mail as follows:

+49 2405 495-04-74
applications@pulsar-photonics.de

Louisa Draack

Technical sales in the area of plant engineering

I am responsible for plant engineering and will be happy to advise you on the design of an optimal laser system solution for your process. I can be reached by phone and e-mail as follows:

+49 2405 495-04-20
machines@pulsar-photonics.de

2. Laser Application Center

Precision meets versatility

For many customers, cooperation with Pulsar Photonics begins at the Laser Application Center (LAZ). In close cooperation with our technical sales department, we are happy to advise you on your inquiry and plan the technological approach together with you.

Since the foundation of Pulsar Photonics, application development and series production have been central components of our services in the Laser Application Center: In application development, we bundle process expertise to prove feasibility, develop prototypes and prepare projects for possible series production. We approach series customers with a high degree of continuity. Awareness of production excellence and systematic consideration of production processes lead to high delivery reliability in compliance with technological specifications and thus to satisfied customers.

The equipment pool of the Laser Application Center is growing both in depth and breadth: For the core business of micromaterial processing, additional UKP laser systems are being built in a targeted manner. But also laser beam sources with pulse durations in the nano-second and (Q)CW range complement this technology and expand our processing spectrum and our internal capabilities. Enter the world of laser material processing with us.

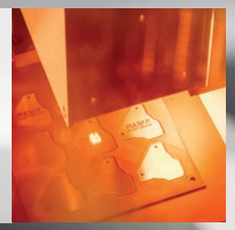
Yours, **Philip Oster**, Head of Laser Application Center (LAZ)

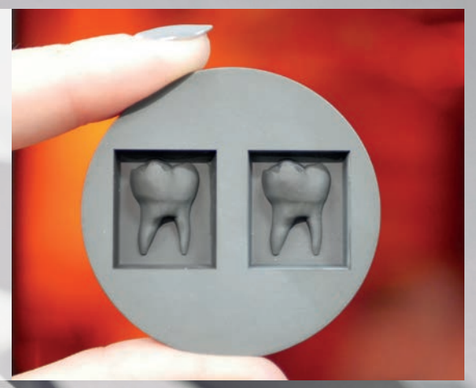
You would like a personal consultation?

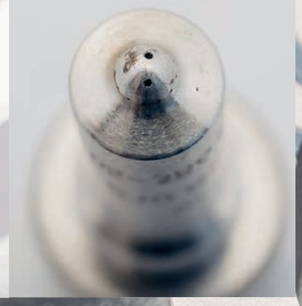
Do not hesitate to call us. Our sales team will be happy to assist you.

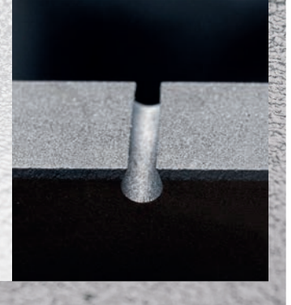
+49 2405 495-0 - 14
applications@pulsar-photonics.de

The services in the laser application center





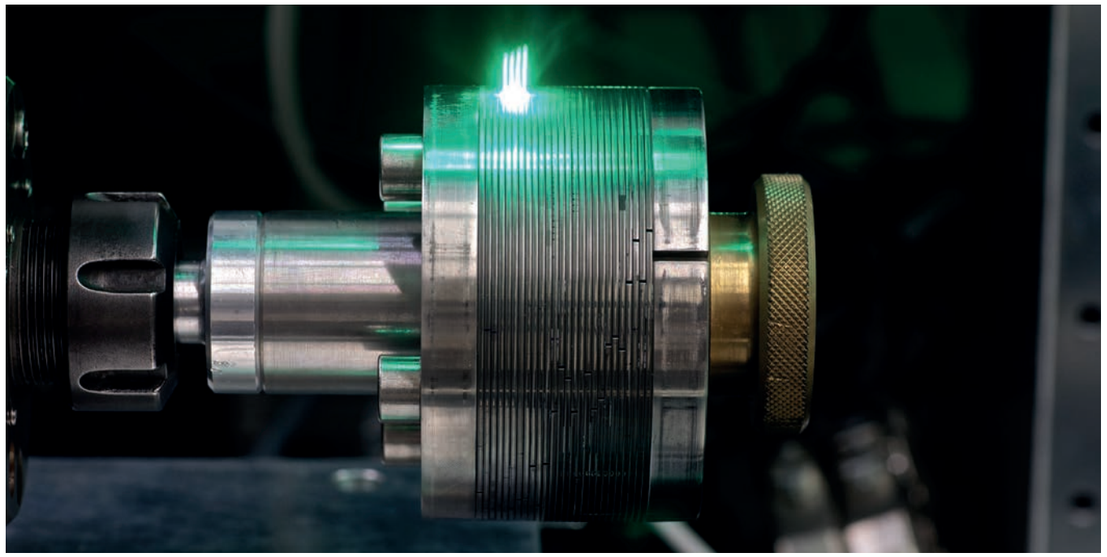




Our tool: ultrashort pulse laser

Material removal by sublimation

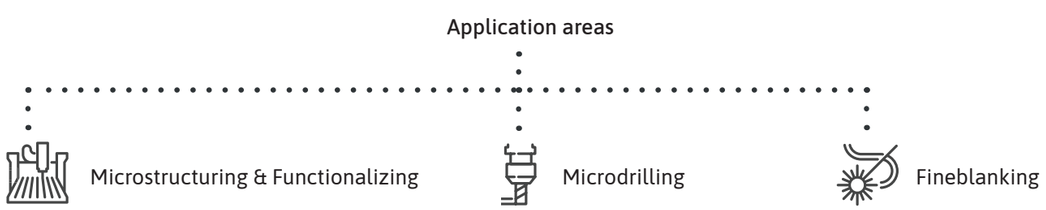
Ultra short pulse lasers are an established tool in laser technology for micro material processing with highest precision. The laser emits radiation in the form of (ultrashort) pulses with a duration in the picosecond (10-12 s) to femtosecond (10-15 s) range. The intensity of the pulses is so high that the material vaporizes immediately without an extensive melting phase. Another advantage of the high intensities is that all materials can be processed.



Structuring example of piston rings with a green picosecond laser

Micrometer by micrometer

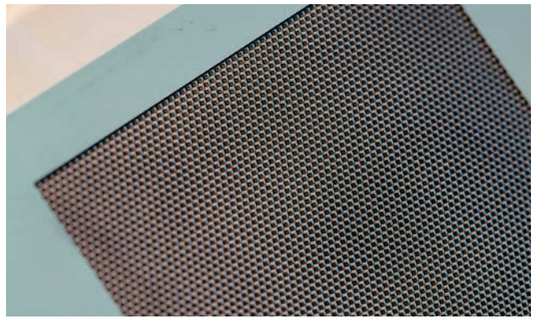
Due to these characteristic ablation properties of the UKP laser, material ablation on a micrometer scale can be achieved. The lateral resolution limits in the micrometer range and the depth-accurate ablation down to the nanometer range enable a completely new processing quality, which means that new applications can be continuously developed.



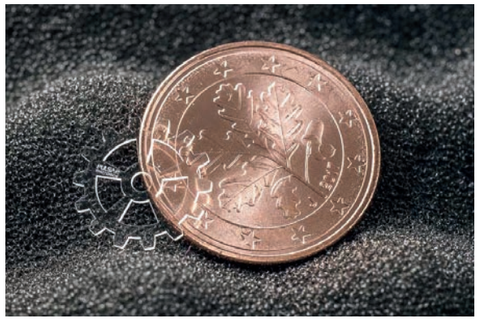
The tool for highest precision

Precise tool in material processing

The usually clear advantages in terms of quality and also resolution are often the trigger for a change from an established machining process to UKP laser machining. The variety of laser applications in the field of microstructuring, microdrilling or fine cutting is almost limitless.



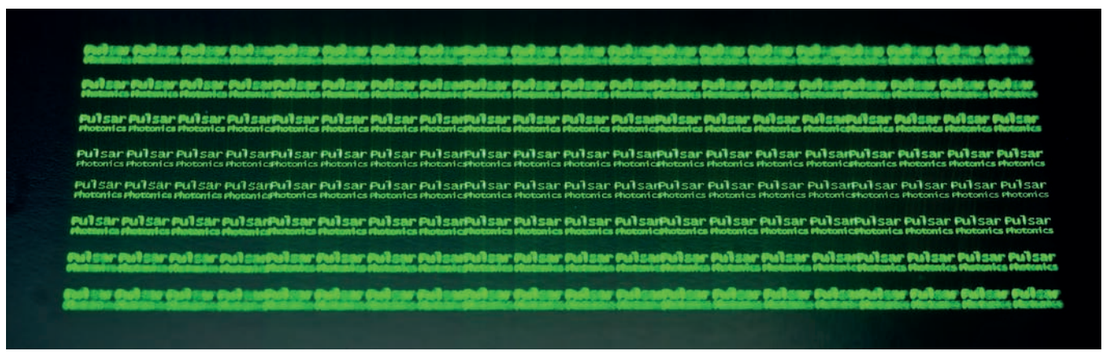
Tool insert for micro injection molding and micro embossing



Laser precision cut glass gear with marking

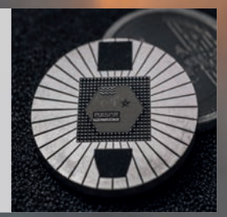
The advantages of material processing with ultrashort pulse lasers

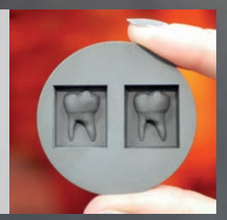
- All materials can be processed
- High lateral structure resolution up to 1 µm
- Depth resolution down to < 1 µm
- Lowest thermal influence zones
- High reproducibility
- No post processing required

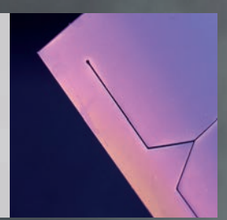


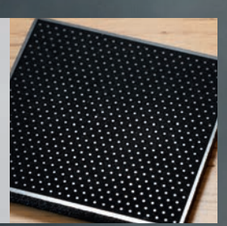
Material marking by laser

2.2 Microstructuring at a glance





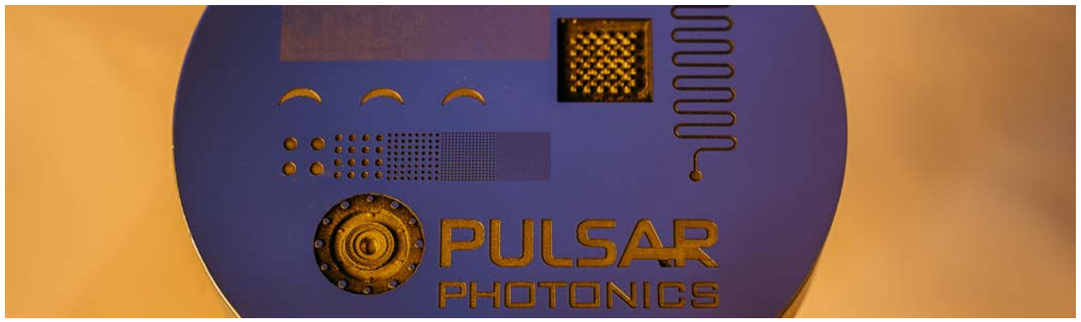




Machining of tool inserts

Laser microstructuring of stainless steel, carbide or aluminum for the production of replicative tools

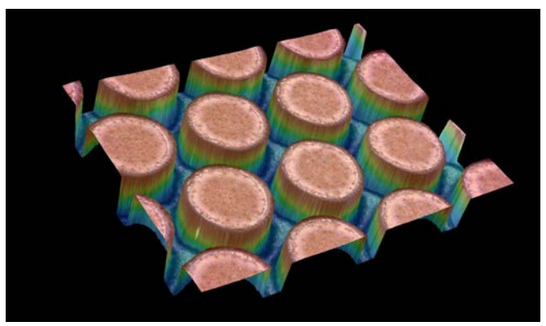
Laser microstructuring has increasingly established itself as a manufacturing process for tool technology. In addition to maximum geometric and material flexibility, key advantages of laser structuring are the small structure sizes and surface roughnesses that can be achieved. Furthermore, the end-to-end digital process chains enable the fastest possible design changes with significant effects on production flexibility.



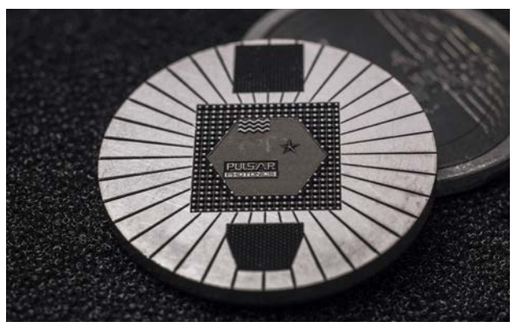
Tool insert with demo structures

Technical details

- Structure resolution: typ. from 5 µm
- Surface roughness: typ. Ra = 1 µm, smaller roughness by laser polishing
- Aspect ratio: up to 1:3



Structuring examples in aluminum

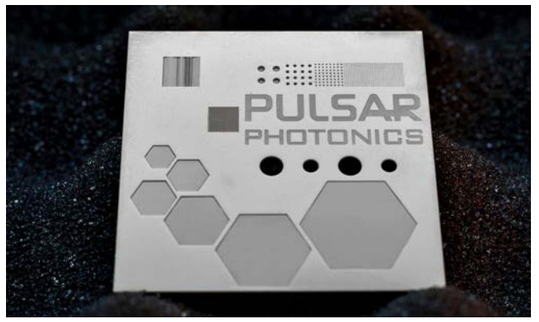


Embossing tool in stainless steel and carbide

Machining of brittle-hard materials

Ceramics, glass and semi-metals

The very high light intensities that occur during micromachining with UKP lasers enable the processing of brittle-hard materials where mechanical and other laser processes reach their limits. Thus, (technical) ceramics (e.g. silicon carbide), glasses or semi-metals can be structured without leaving residues and with a high degree of geometrical freedom. Especially the insertion of round elements or tapered cavities by the UKP laser holds completely new processing possibilities for these materials.



Structuring examples in an Al_2O_3-ceramic

2.5D Structuring: Root of a dental implant made of a high-performance ceramic material

Technical details

- Materials: ceramics, glasses, semi-metals, brittle-hard materials
- Material thicknesses: 5-300 µm
- Structure resolution: typ. from 5 µm

Cutting and structuring of a glass gear wheel

Structuring example of SiC

Machining of plastics

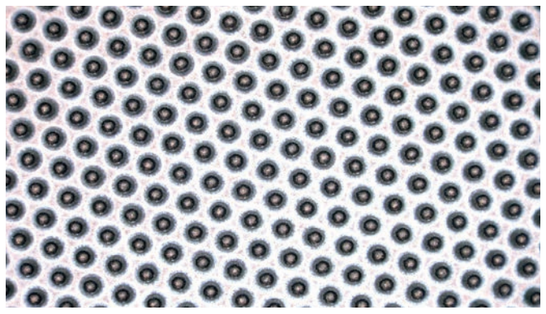
UKP as a solution for the processing of polymers

Many manufacturing processes reach their limits in plastics processing: The elasticity, insulating effect and usually low thermal stability of polymer materials make micromachining especially difficult. UKP laser technology offers a good solution for plastics processing. Due to the extremely short interaction time between laser pulse and material, the material is vaporized abruptly without heating or melting the surrounding material. Molded plastic components or materials in their raw form can thus be precisely structured.

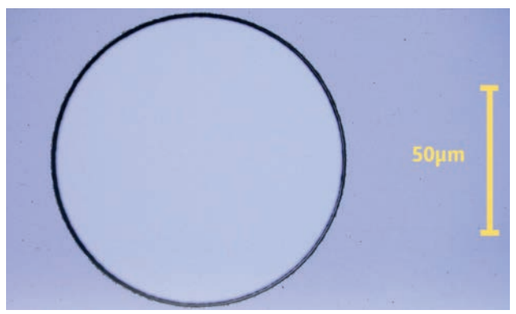
Laser processing of a Teflon foil

Technical details

- Materials: Polymers, PEEK, POM, PE, PP, PTFE, etc.
- Material thicknesses: 5-300 µm
- Structure resolution: typ. from 5 µm



Cell structure in POM



Drill hole in PP

Precise pin structures in wafer chucks

For semiconductor technology

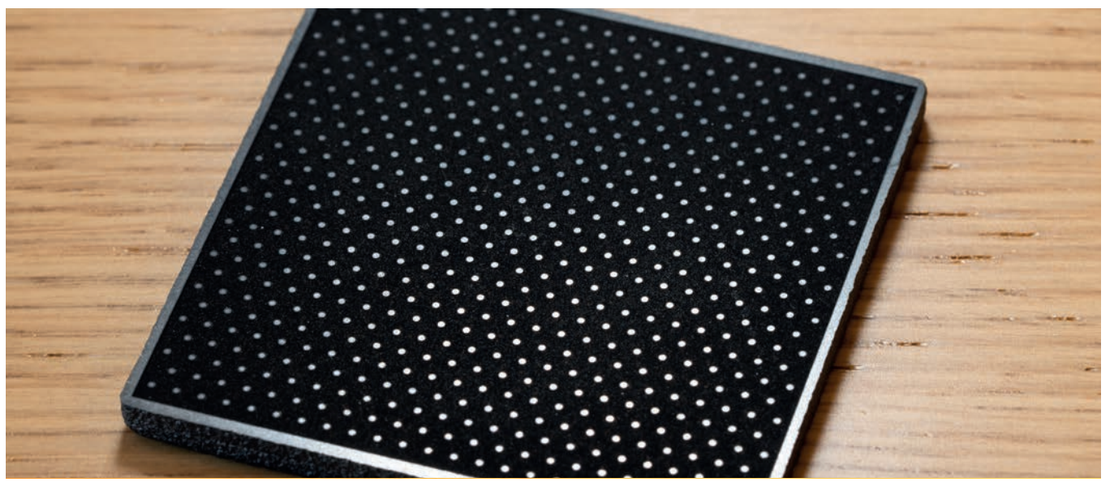
Wafer chucks are used in the semiconductor industry for the precise fixing of wafers during processing. Pin structures on the Freiformkontur eines Laserwaterjet-Ausschnittes in Siliziumcarbid ir surface ensure a minimal contact area and thus reduce the deformation of the wafers, which is particularly important in lithography and inspection. Materials such as silicon carbide (SiC) with high thermal conductivity and stability and Zerodur with very low thermal expansion are particularly suitable for this purpose.

- Precise production of pin structures in Zerodur and SiC wafer chucks
- No change in material properties through the use of ultra-short pulse lasers
- Surface roughness in the base Ra < = 3 - 4 µm

As an ablative procedure, the material areas around the pins to be produced are specifically removed

No change in material properties through the use of ultra-short pulse lasers

The precise production of pin structures requires modern manufacturing technologies. Ultra-short pulse lasers (USP lasers) enable very precise, sharp contour processing with minimal thermal influence through local material vaporization. The starting point is usually a polished or lapped surface. The pins take over their roughness and evenness, whereby particular attention is paid to low surface contamination and roughness (Ra < 3-4 µm). Residues can be removed by reworking.



Pin structure in SiC component

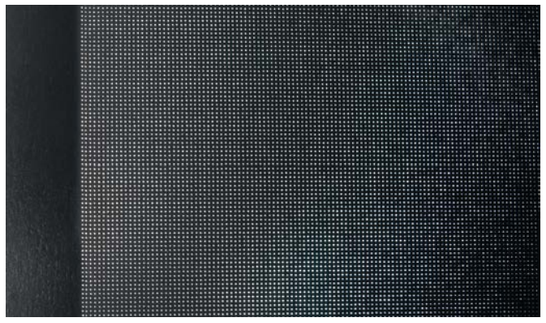
2.3 Microdrilling at a glance

Laser microdrilling

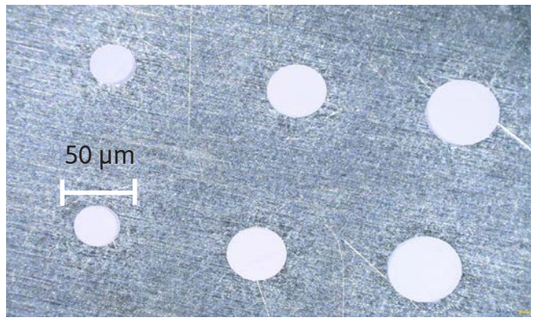
Precision drilling with the laser

Laser drilling is a non-contact and non-cutting drilling process that enables both fine drilling of a few micrometers and precision drilling of up to several millimeters in diameter. Various laser drilling methods can be used here, depending on the requirements. Ultra-fine holes in thin films are typically drilled with a UKP scanner-based laser. For higher material thicknesses, (Q-)CW lasers or UKP lasers with special optics are suitable.

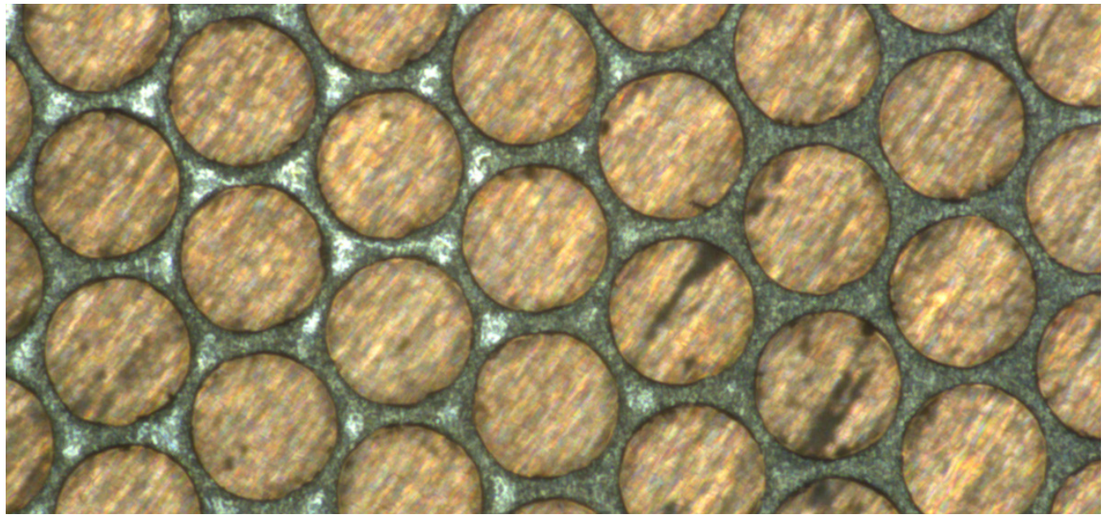
- Due to the melt-free ablation process, UKP laser drilling produces post-processing-free precision holes
- Examples of applications are nozzle bores, sieves and filters, bores in pipes or also glass vials
- Advantages lie in high reproducibility as well as high roundness



Laser micro-holes in a tungsten foil



Micro holes in metal foil

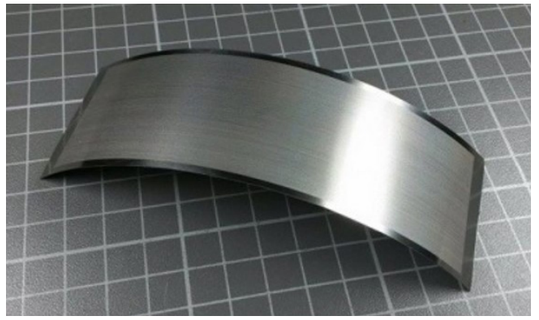


Micro holes with high packing density

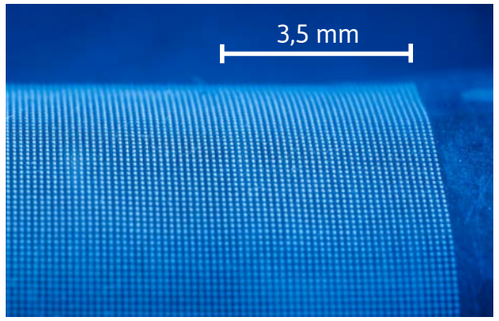
Laser drilling of micro sieves

Laser-drilled micro sieves as an alternative to etching processes and electroplating

By means of a laser microdrilling process, sieves can be produced from foils and thin sheets of almost any material with high drilling density and high aspect ratio. Drill hole diameters and drill hole spacings are almost infinitely adjustable, allowing a high degree of flexibility and a wide range of products to be manufactured. Especially in the field of metallic micro sieves, UKP laser processing is thus a real alternative to etching processes or electrochemical deposition processes. In selected processes, the use of laser-drilled stainless steel screens has increased the throughput in the application by a factor of 4 and significantly increased the service life of the sieves.



Micro sieve for process engineering



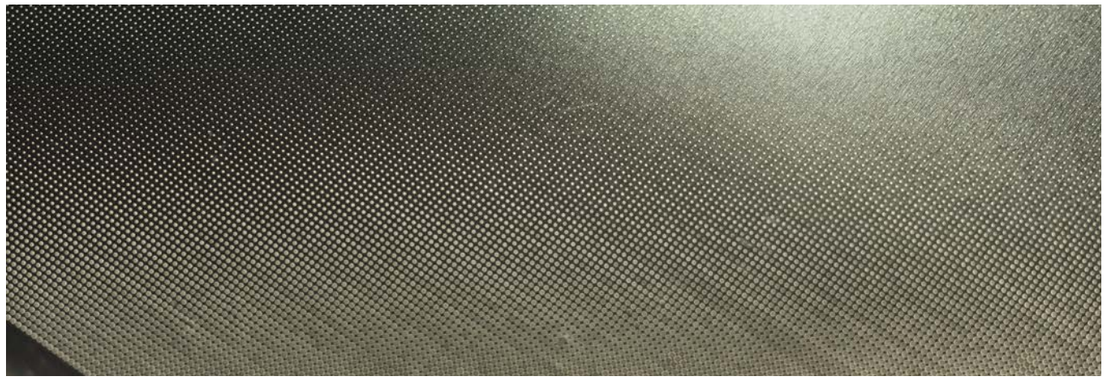
Laser-drilled PTFE-diaphragm, bore diameter 25 µm

Technical details

- Materials: stainless steels, aluminum, titanium, ceramics
- Material thicknesses: 5 - 100 µm
- Hole diameter: < 10 µm - 50 µm
- Number of holes per component: typ. up to 2 Mio holes

Applications

- Microfiltration
- Analysis technology
- Microfluidics
- Micro Dispenser/ Low Volume Dispenser

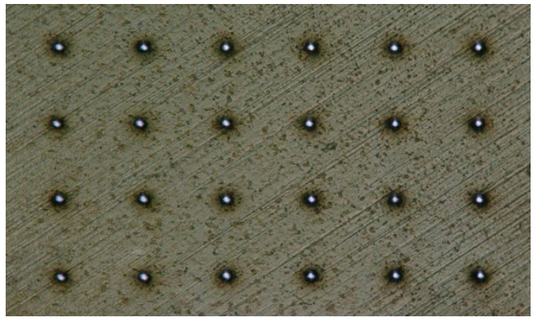


Micro holes for a filter application

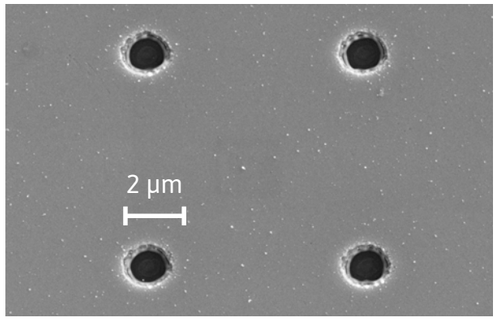
Micro holes with diameter < 5 µm

Microdrilling at the limits of laser technology

Especially in metrology, medical technology and industrial separation, there is an increasing demand for defined microbores in the single-digit micrometer range. With the Microscan technology developed by Pulsar Photonics, bore diameters down to less than 2 µm can be reproducibly produced. By using UKP lasers, high-quality holes can also be produced in these size ranges.



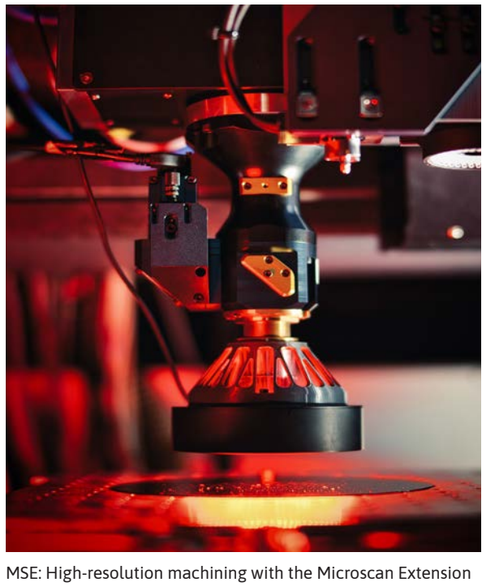
Micro-holes in stainless steel foil t = 30 µm
with diameter < 4 µm



Microholes in metallic thin film with
diameter of 1.6 µm (SEM image)

Technical details

- Hole diameter up to < 2 µm
- Material thicknesses up to 50 µm
- Number of wells: 1-10,000
- Variation bore diameter depending on application
  - In the same machining step: up to < 5 % STABW
  - Between components: up to < 10 % STABW
- Materials: metals, ceramics, thin film systems



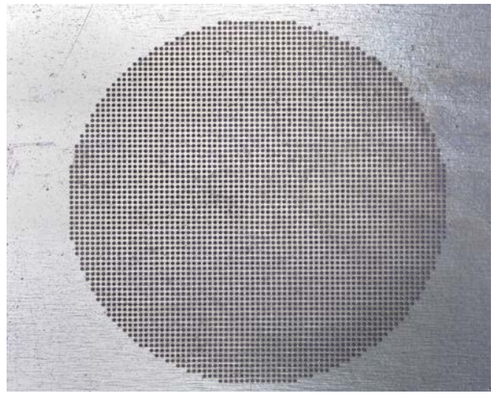
MSE: High-resolution machining with the Microscan Extension

Production of micro holes in nebulizers

Laser-drilled nebulizers for medical technology

The principle of a membrane nebulizer is based on an oscillating membrane with micro-openings through which liquid is pressed and atomized as a fine aerosol.
The aim is to produce particularly fine micro-holes. Conventional methods such as mechanical or electrochemical drilling reach their limits here, as the necessary precision is difficult to achieve and high tool wear occurs.

An innovative method is therefore the use of laser systems with ultra-short pulsed laser radiation, with which holes with a diameter of around 3 µm and smaller can be produced, depending on the focusing lens used and the wavelength of the laser system.



Laser-drilled grid before separating the perforated membrane.

Technical details

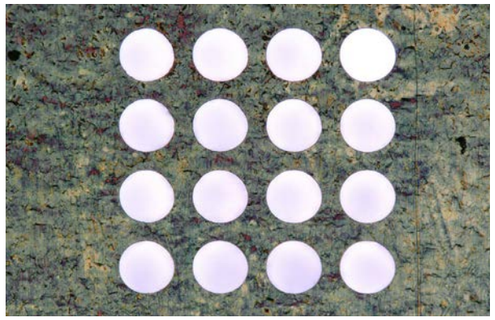
- Material: Typ. stainless steel or plastics
- Type of hole: Conical borehole
- Material thickness: 100 µm
- Hole diameter: Approx. 3 µm
- Space between the holes: Approx. 55 µm
- Drilling frequency: 160 Hz
- Application area: Medical technology

Nebulizers: used to atomize medication for inhalation, transforming the liquid into an aerosol that can be dispersed in the lungs.

Microdrilling with high aspect ratio

Precision drilling in functional components

By using helical drilling optics, precise micro-drillings can be made in components with material thicknesses down to the millimeter range. In combination with an ultrashort pulse laser, holes of the highest quality can be produced in almost any material. The use of the special optics makes it possible to produce cylindrical bore curves, whereby the bore exit can assume the same diameter as the bore entry.
Examples of applications are injection nozzles, spinnerets, vent holes and filter applications.

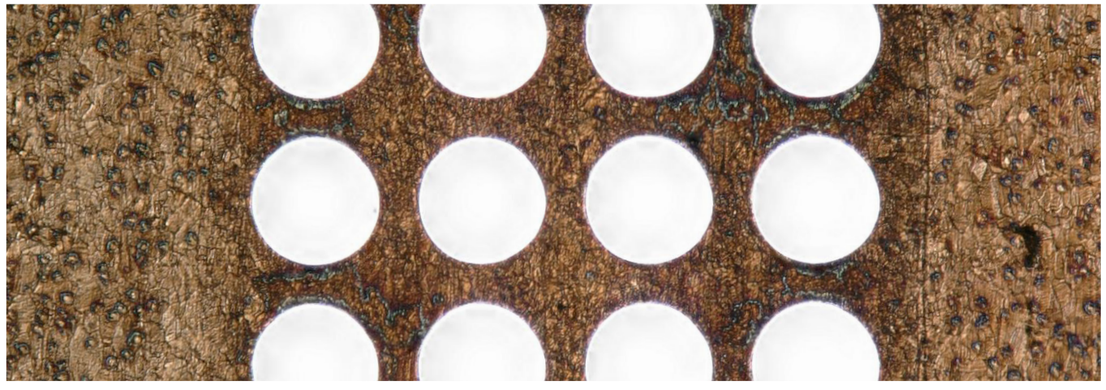


Matrix of precision holes in steel

Laser drilled injection nozzle

Technical details

- Special feature: Cylindrical bore course
- Materials: steels, ceramics, plastics, etc.
- Material thicknesses: up to 1 mm
- Typical aspect ratio: up to 1:15
- Hole diameter from 50 µm



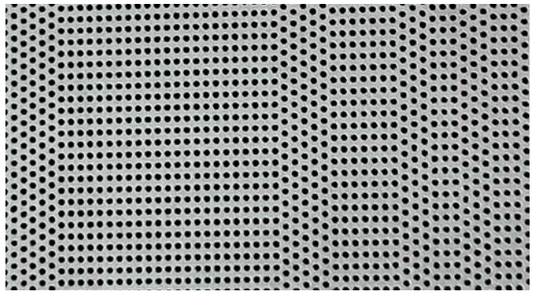
Matrix of precision holes in brass

QCW drilling of sieves

Melt-dominant drilling processes for high material thicknesses and high drilling rates

Material thicknesses of several millimeters are a real challenge for the evaporation-dominant UKP process in terms of achievable drilling rates. For many applications with this material thickness, a Q-switched continuous-wave laser, also known as a quasi-CW laser (QCW), is therefore used. Unlike the UKP range, this type of laser melts rather than vaporizes the material. The material melted by the laser is expelled by a connected axial crossjet (compressed air, inert gases) and the bore is created. Melt residues adhering to the top or bottom of the material must be removed by a subsequent cleaning step. Despite the high material thicknesses, drilling rates in the range of 10 - 100 Hz can be achieved.

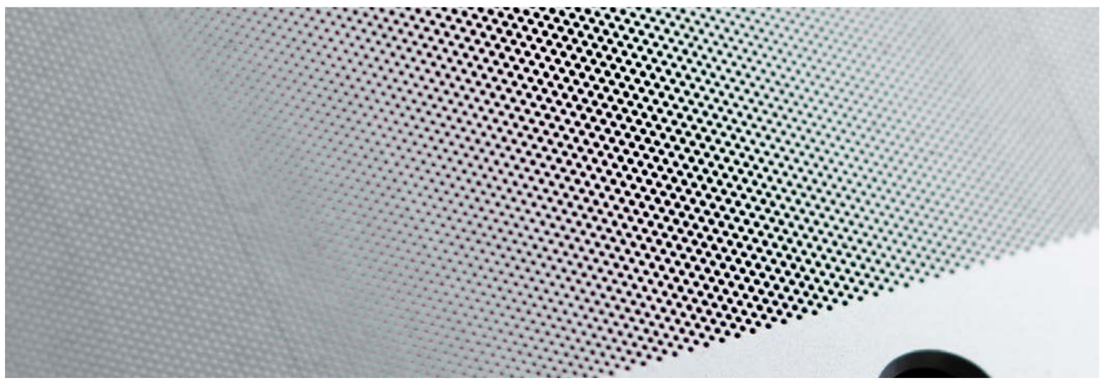
Melt dominant QCW drilling process



QCW holes in a sieve

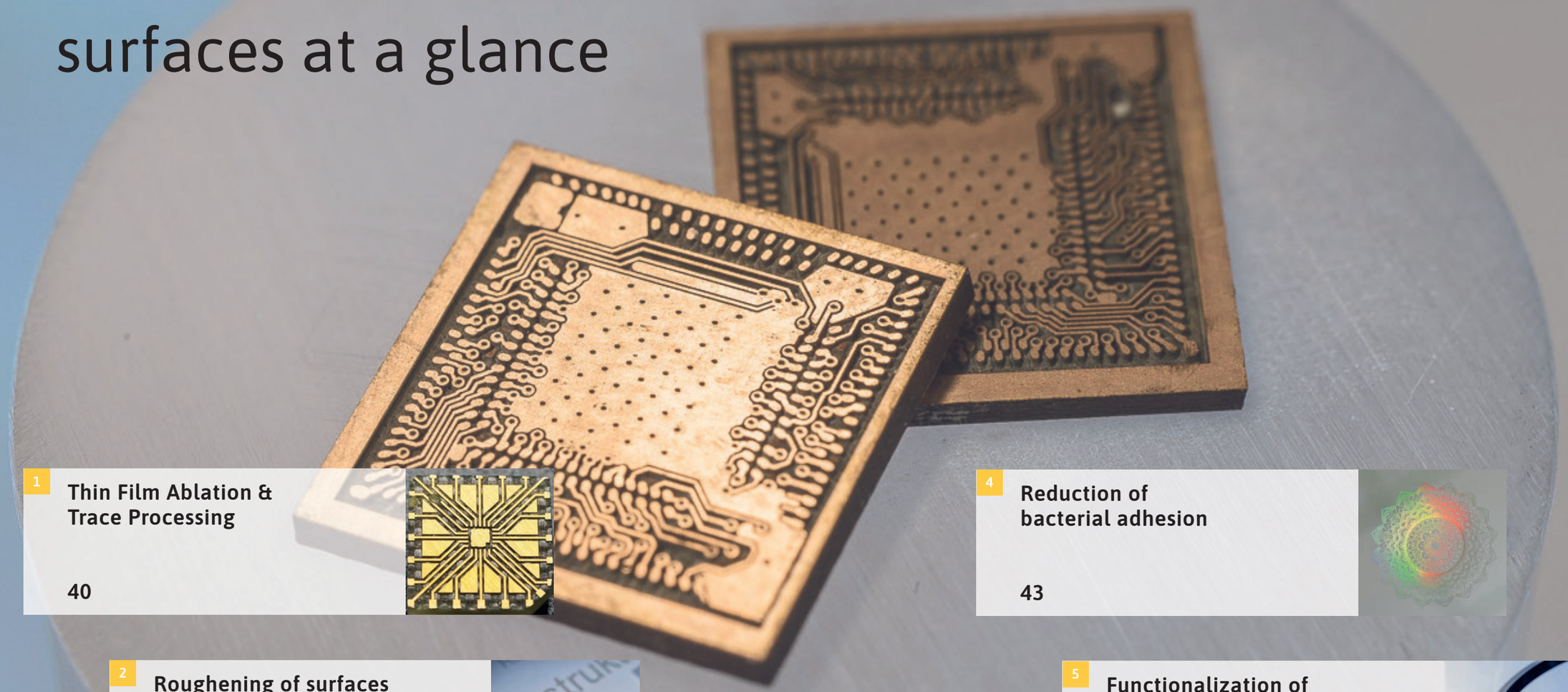
Technical details

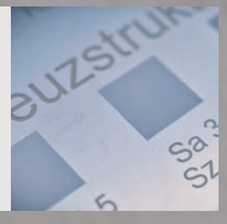
- Material: Mainly suitable for steel machining
- Material thicknesses: 0.5 mm - 2.5 mm
- Drilling rates: 10 - 100 Hz

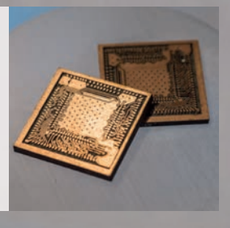


QCW holes of a sieve (after cleaning step)

2.4 Functionalization of surfaces at a glance



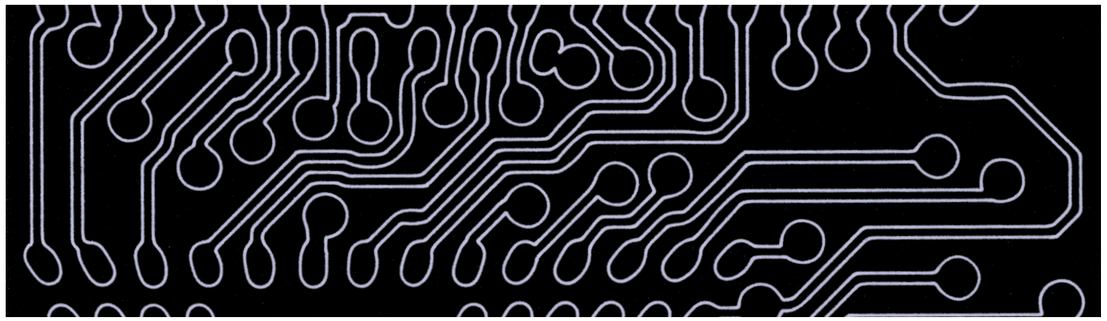




Thin Film Ablation & Trace Processing

Selective machining of thin material layers

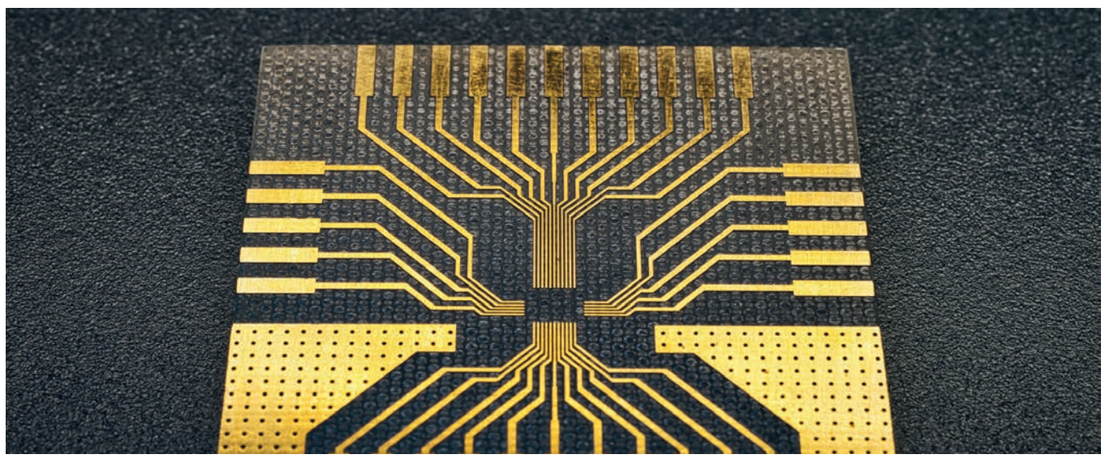
Ultra-short pulse lasers can be used for highly selective processing of thin-film systems in all three spatial dimensions. For example, metallized surfaces on a dielectric base substrate can be provided with insulation trenches by laser ablation with micrometer precision and thus functionalized for applications in electronics and sensor technology.
By selecting suitable laser parameters, it is possible to remove the metallic surface without removing or significantly damaging the underlying base substrate.



Insulation trenches on a metallized ceramic substrate

Technical details

- Lateral resolution: typ. 5 µm, up to 1 µm
- Depth resolution: typ. 100 nm, selective layer separation possible
- Applications: Sensors, electronics, solar cells

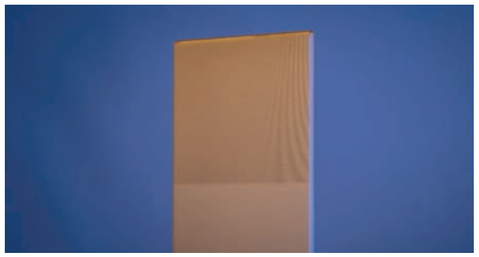


Interposer produced by laser ablation of a thin gold layer for ultrahigh-frequency applications

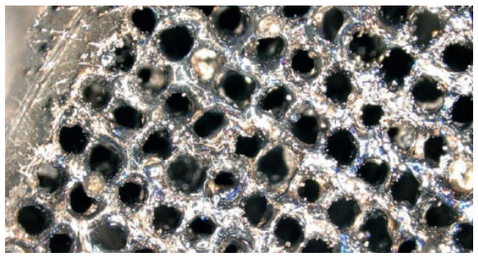
Roughening of surfaces

Targeted enlargement of material surfaces by laser ablation

Smooth material surfaces can be artificially roughened and functionalized by targeted laser ablation. The roughening can be deterministic in the form of simple line or cross structures or by introducing a statistical, random arrangement. The UKP laser is suitable for roughening in the micrometer range. Due to the fine material removal, Ra and Sa values can be specifically adjusted. For macroscopic processing, the (Q)CW laser is used, which allows deeper structures to be produced and larger surfaces to be processed. The roughening of material surfaces opens up new possibilities in the field of joining technology for dissimilar materials or for adhesive joints.



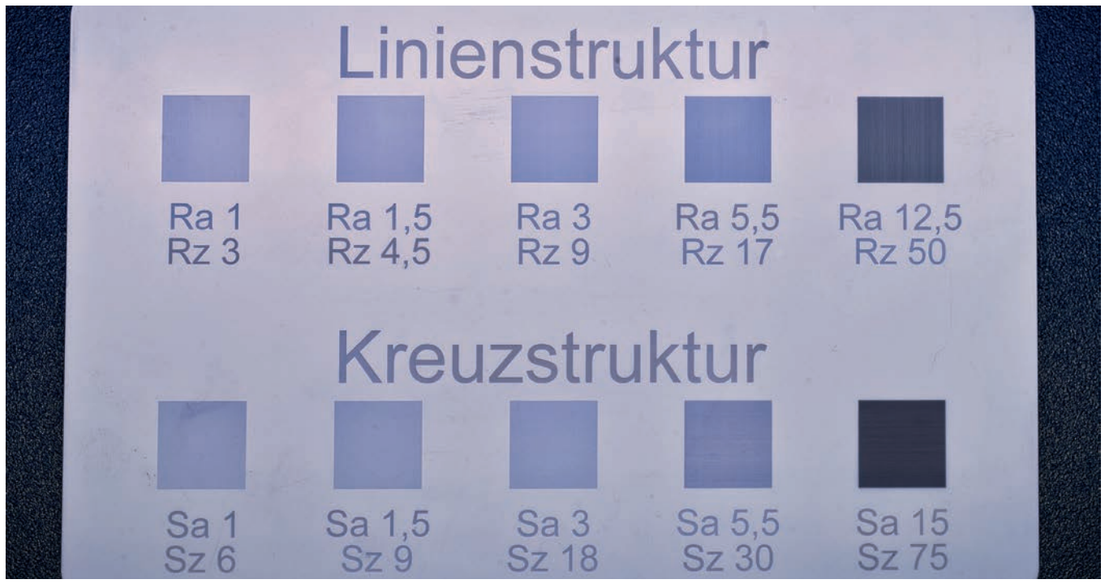
Microscopic roughening of ceramics



Macroscopic, statistical roughening in stainless steel

Technical details

- Microscopic and macroscopic roughening of surfaces
- Ra and Sa values adjustable from Ra/Sa = 1 µm
- Stepless adjustments of the roughnesses

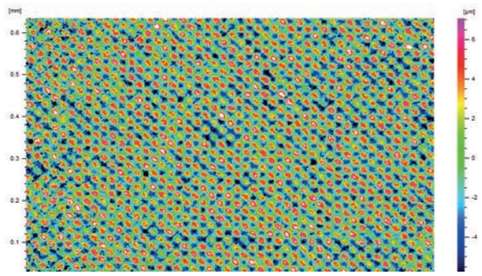


Generation of defined Ra/Sa values in ceramics

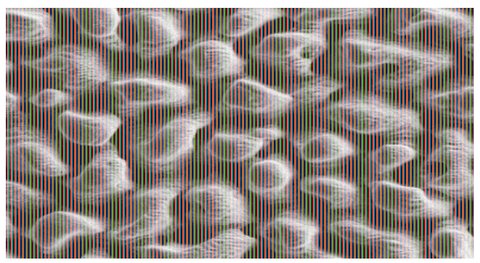
Surface treatment for joining and bonding processes

Improvement of joining and bonding properties

With the use of an ever greater variety of materials, e.g. in electronic products, joining processes of dissimilar materials (e.g. metal-plastic joints) are becoming increasingly important. Improved adhesion can also be produced for bonded joints through surface enlargement by the laser. In both processes, the quality and strength of the bonded joint depends decisively on the surface properties of the joining partners. For example, the contact area of the joining partners can be significantly increased by roughening metal and ceramic surfaces through targeted laser structuring.



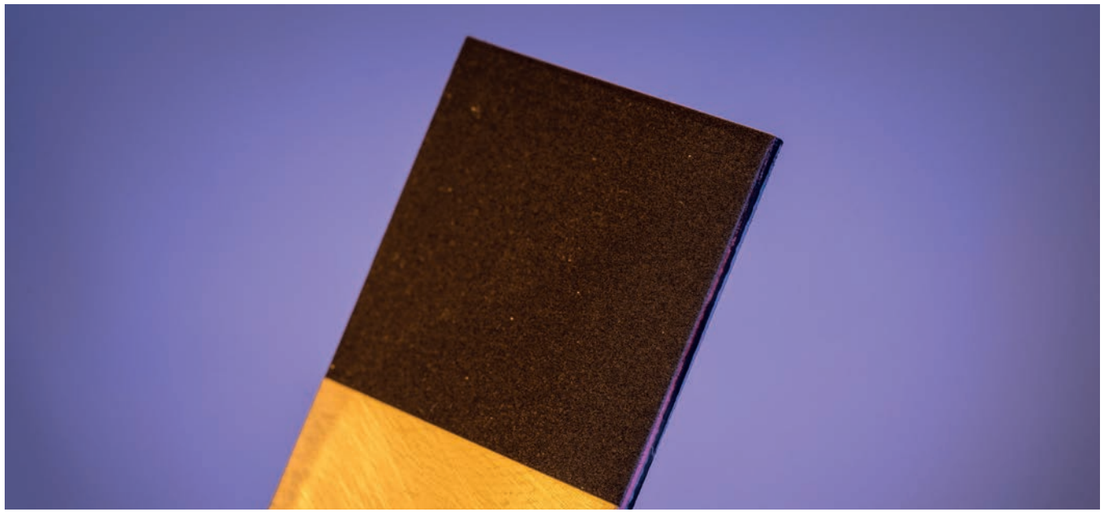
Cross-hatching with only a few micrometers Ablation depth (approx. 10 µm)



Hierarchical structures in steel with undercuts (SEM image)

Selective roughening

Joining processes of dissimilar materials such as metal-plastic or metal-ceramic joints are becoming more important in electronic assemblies, medical products and automotive engineering. Typical joining processes used here are adhesive bonding or laser-transparent welding.

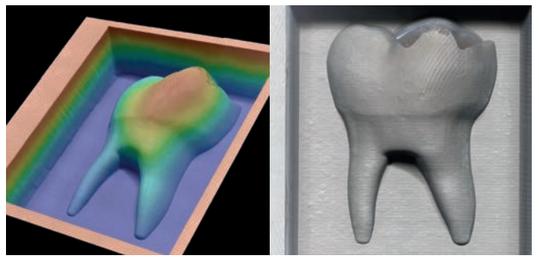


Laser processing as preparation of materials for a subsequent joining process

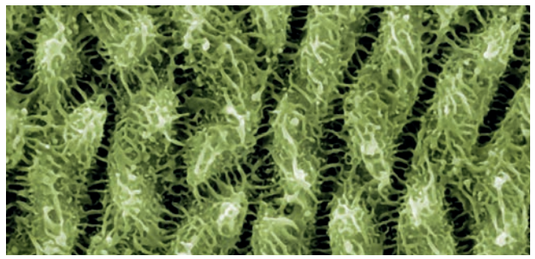
Reduction of bacterial adhesion

Structures for changing the contact properties

Targeted material processing with an ultrashort pulse laser can greatly change the functional properties of surfaces. Usually, a overlay of macroscopic and microscopic structures is created for this purpose. As a result of the laser processing, the surface changes its contact properties to a medium located on it. This can suppress the spread of bacteria or promote cell growth. The microscopic structures can become so small that they have a resolution in the nanometer range.



2.5D structure of a ceramic dental implant



Biomimetic surface achieved by laser structuring

Rejection or Attachment – What‘s it going to be?

These nanostructures can be produced in a targeted manner using special optics that overlap two or more laser beams at the focus, thereby creating laser beam interference. In combination of this structure with a macroscopic structure, cell growth can be improved, hydrophobic or hydrophilic properties can be adjusted or bacterialadhesion to the surface can be reduced. Color effects for component identification can also be generated in this way.

Light diffraction at nanometer structures

Functionalization of sliding rings, bearings or seals

Change in friction properties, wear or leakage due to microstructuring

As part of the increase in environmental regulations, particularly in the automotive sector, there is an increasing need for the optimization of tribological systems. This also includes sliding rings, which are used for example in pumps, bearings and seals.
By functionalizing the surface with microstructures, tribological properties can be specifically adjusted. The UKP process allows the machining of almost all materials with high structural resolution.

Functionalization examples of SiC sliding rings

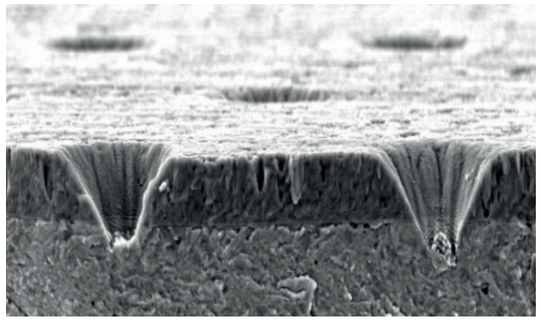
Functionalization options

- Insertion of hydrodynamic wedge gaps with angles up to < 0.1°
- Insertion of cell strucures for hydrodynamic pressure build-up without throw-ups and without damage to edge areas
- Machining of all common materials also silicon nitride (Si3N4), silicon carbide (SiC), oxide ceramics

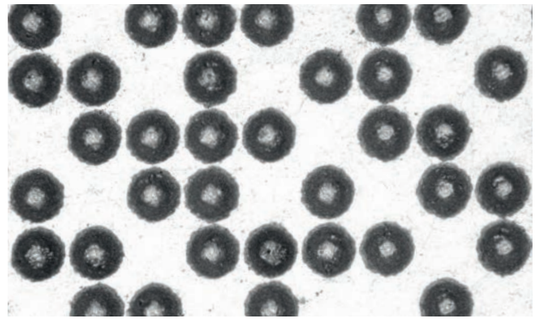
Sliding rings with functionalized effective area

Cell structure for targeted influencing of the Stribeck curve

Friction properties can be improved by structuring the functional surfaces with micrometer precision. Cells serve as lubricant depots and build up hydrodynamic pressure so that the friction partners float against each other and wear is reduced. The shape, arrangement and number of the cells can be quickly adapted using a digital CAx chain.



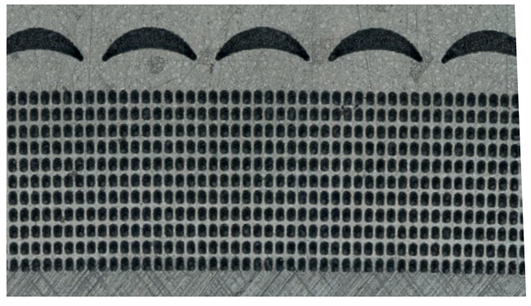
Cell structure in PVD coating (SEM image)
Source: Final report BMBF „Smartsurf“



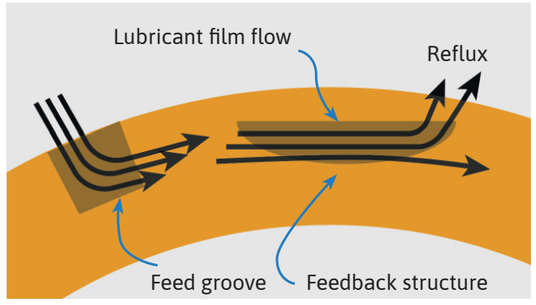
Cell structure as lubricant depot

Conveying structures for optimizing the sealing properties of mechanical seals

The lubricant depots reduce friction by selectively floating the friction partners in relation to each other. The resulting larger sealing gap has the disadvantage that leakage occurs more strongly and the system has an increased lubricant requirement. Special return structures at the edge of the functionalized surfaces keep the lubricant in the sliding area and reduce leakage.



Combination of conveying structure and cell structures in a plain bearing



Functional diagram conveyor structure

Thrust washer with functionalized running surface

Resistant markings

Markings for demanding environments

Ultra-short pulse lasers can be used to produce corrosion-resistant, high-contrast and abrasion-resistant markings in many metal components, especially those made of stainless steel.
Unlike conventional marking lasers, the marking is made by introducing a special microstructure.

Scalpel with resistant laser marking

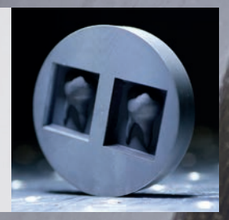
Resistant laser marking in steel surface

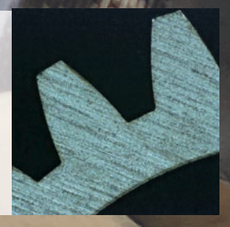
The microstructure introduced has broadband light absorption properties, which results in a high contrast with simultaneous abrasion resistance, the marking appears deep black.
The chemical resistance of the marking is mainly due to the topography-related absorption mechanism used and, in the case of stainless steels, to the preservation of the protective effect against corrosion using a chromium oxide layer. Component markings, batch or lot numbers, marketing markings and many other applications are conceivable.

High contrast labeling of a component

Laser Application Center

2.5 Laser fine cutting at a glance





Laser-cut CFRP component with inserted precision cuts to create a hinge for mobile phone applications.

Laser fine cutting of thin foils

High geometrical freedom through scanner-based fine blanking

Classic laser cutting is a process that has been firmly established for many years and is characterized by high cutting speeds with maximum geometric freedom of the cutting contour. However, a wide range of materials cannot be processed in this way.

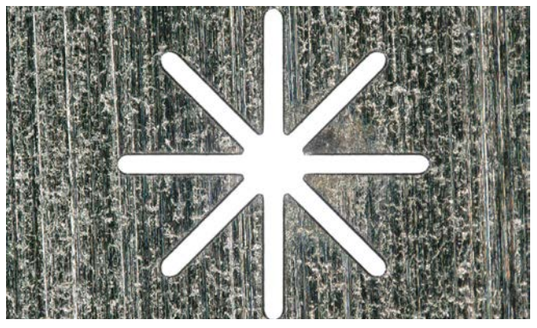
In fine cutting with ultrashort pulsed laser radiation, the cut is created by removing material layer by layer without thermally affecting edge areas. In this way, cuts can also be produced in temperature-sensitive materials or in thin foils. Very high cut qualities can be achieved without melting edges and low roughness values.

UKP laser cutting parts

Detail of a micro gear

Technical details

- Ablative laser fine cutting of almost all materials
- Material thicknesses: typ. < 500 µm
- Edge radius: up to < 10 µm
- Aspect ratio: typ. up to 1:5
- Wall angle: 7-13° to the half opening

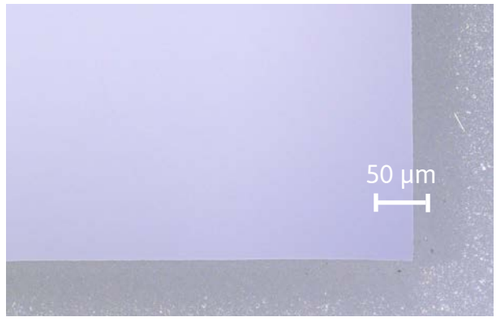


Star-shaped microcuts in stainless steel

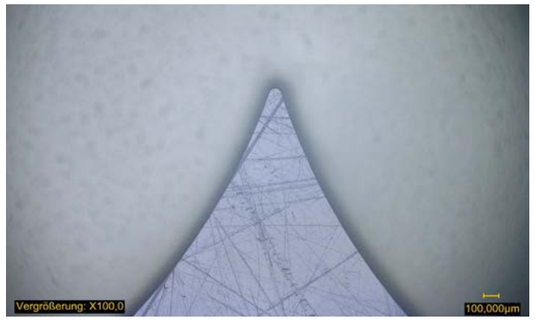
Laser fine cutting of brittle-hard materials

Full geometrical freedom in brittle-hard materials

In classical laser dicing of thin ceramic substrates and semiconductor wafers, wafer saws or laser-based fixed optics systems are usually used. Both methods allow either only straight cutting or cutting with comparably large edge radii.
Scanner-based fine cutting with the UKP laser allows a cutting process with high precision, small edge radii and without microcracks in the workpiece. Small holes or micro-apertures can also be introduced.



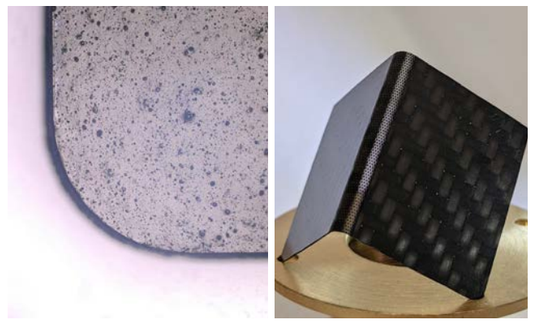
Angular contour cut in Al_2O_3 with edge radius < 10 µm



Shape free cutting of a ceramic

Technical details

- Ablative laser fine cutting of ceramics semiconductor materials, CFRP, or similar with high geometrical freedom
- Material thicknesses: typ. < 700 µm
- Edge radius: up to < 10 µm
- Aspect ratio kerf width to material thickness; typ. up to 1:5
- Wall angle: typ. < 10°

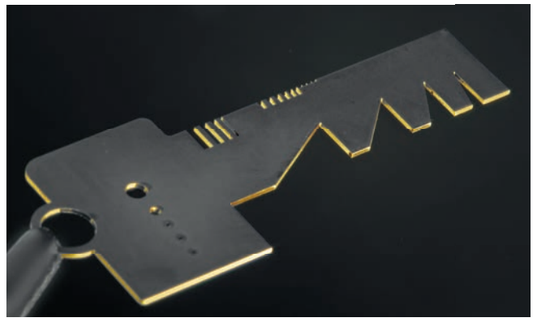


Cut edge of a CFRP film

Precision cuts with vertical cutting edges

Burr-free precision cuts of the highest quality

The manufacturing technology of helical drilling optics can also be used to produce precision cuts. Due to the relative movement of the component to the process head (fixed optics), any path geometry can be processed in two dimensions. Metals, plastics, glasses and other brittle-hard materials can be cut.

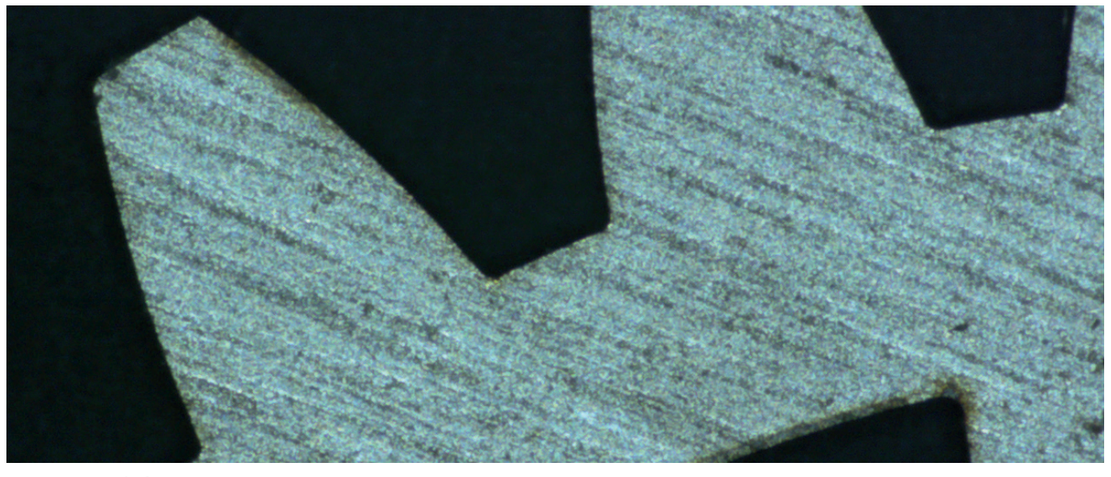


Stainless Steel Laser Cut Micro Gear

Demo part with burr-free precision cuts

Technical details

- Separation cutting method by using special optics
- Creation of vertical cutting edges possible
- Material thicknesses: up to < 1 mm
- minimum kerf width: 70 µm



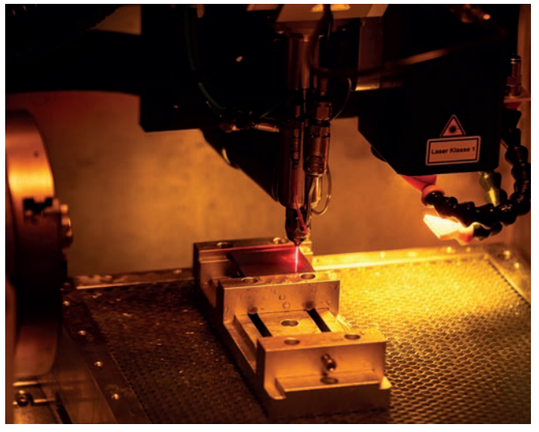
Laser cut: Detail of a micro gear

Waterjet-guided laser material processing

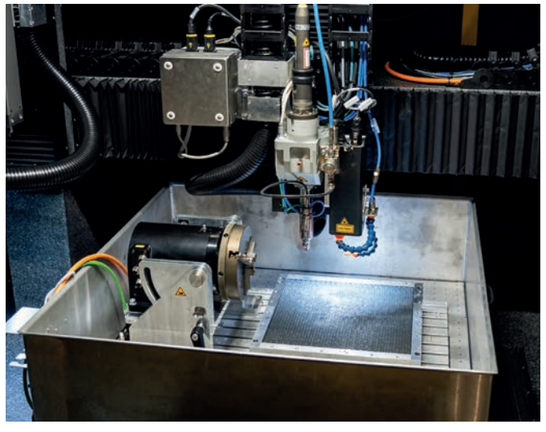
For precise cuts with high aspect ratio in brittle-hard materials

Water-jet guided laser cutting (LWJ) is a special type of laser cutting technology especially useful for materials which are difficult to machine and use-cases in which a precise laser cut is needed while minimizing heat input. A key advantage of waterjet-guided laser cutting is the high achievable aspect ratio of up to 1:100.

The waterjet-guided laser machining technology is based on a special processing head which initially creates a thin waterjet of around 100 µm diameter through a nozzle, comparable to waterjet-cutting. High pressure creates a laminar flow, which allows the waterjet to propagate for several centimeters without a significant growth in diameter.



Waterjet-guided laser cutting process in Pulsar's RDX1000 Laserwaterjet.



Inside view of machine with water collecting basin.

Technical details

- Machining of material thicknesses: 1 – 20 mm
- Cutting kerf widths: 50 – 200 µm
- Aspect ratios: up to 1:100
- Our machines of the type **RDX1000 LWJ** utilise the patented MicroJet® technology by Synova S.A.

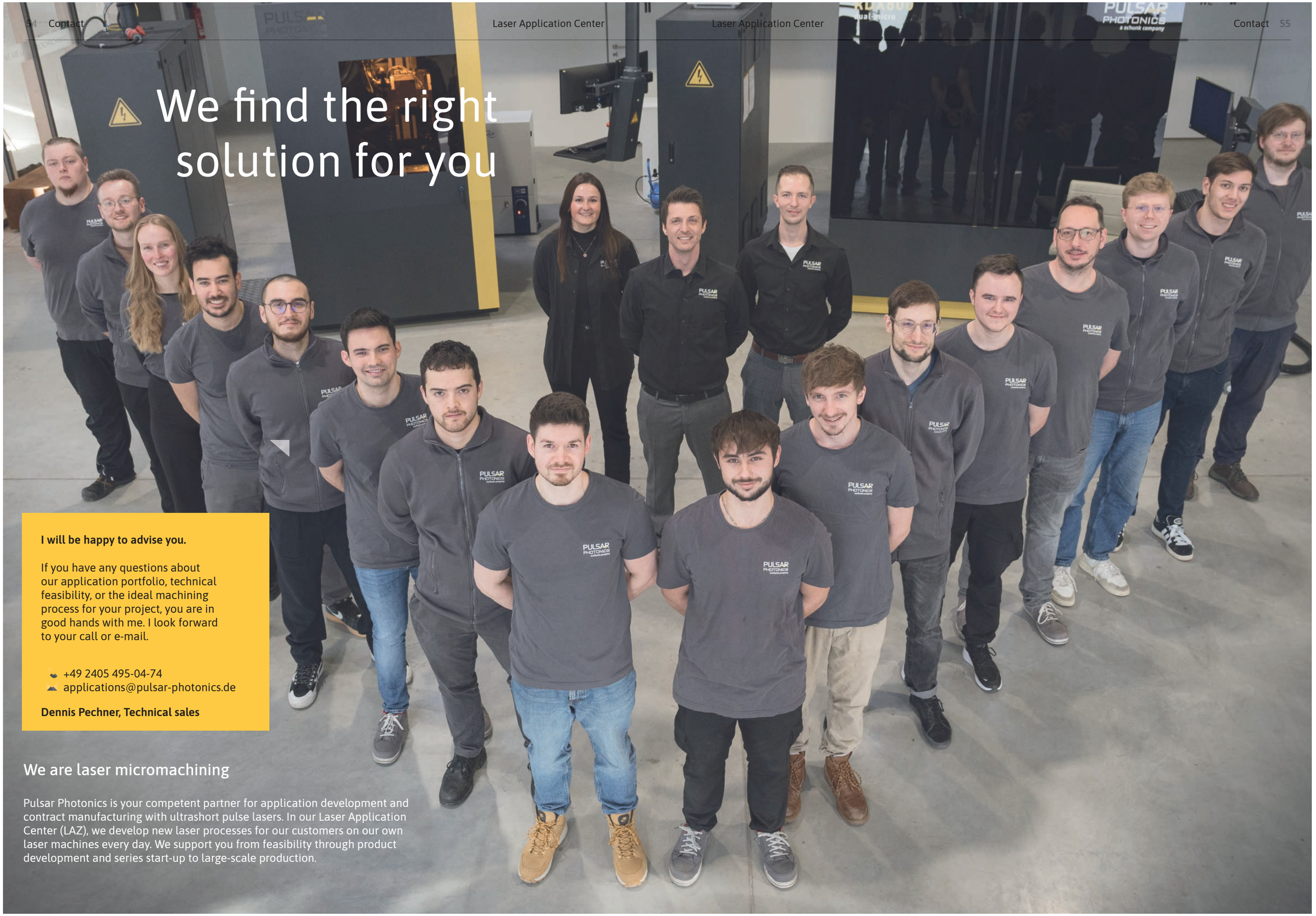
Materials

- Metals and hard metals
- Technical ceramics
- Silicon carbide SiC / SiSiC
- Composite materials

Deep hole drilling in technical ceramics (SiSiC, material thickness 10 mm)

Free-form contour cut in 3D-printed SiC-ceramics, material thickness 5 mm.

We find the right solution for you



I will be happy to advise you.

If you have any questions about our application portfolio, technical feasibility, or the ideal machining process for your project, you are in good hands with me. I look forward to your call or e-mail.

+49 2405 495-04-74
applications@pulsar-photonics.de

Dennis Pechner, Technical sales

We are laser micromachining

Pulsar Photonics is your competent partner for application development and contract manufacturing with ultrashort pulse lasers. In our Laser Application Center (LAZ), we develop new laser processes for our customers on our own laser machines every day. We support you from feasibility through product development and series start-up to large-scale production.

3. Machine manufacturing

Laser systems for your production

The industrial applications of laser micromachining have gained significantly in breadth in recent years and continue to be characterized by high dynamics. In our day-to-day application development, we are driving this development forward together with our customers. Our focus is on laser micromachining and especially on ultrashort pulse machining (UKP). This results in high-tech manufacturing processes that help our customers to further optimize their products. With our modern laser machines, we offer the necessary platform for the industrial implementation of series production of your components.

With our product portfolio, we cover a wide range of laser processes, component sizes and automation requirements. In doing so, we benefit from a modular approach that enables customized manufacturing solutions. Controlled by a flexible and modular software solution and through the integration of measurement technology, even complex laser processes can be realized with series-connected autonomous 100 % quality control.
You too can benefit from our unbeatable combination of in-depth process know-how, targeted digitization, flexibility and the highest quality standards and choose a laser processing machine from Pulsar Photonics.

Discover our laser machines – we are looking forward to your inquiry!

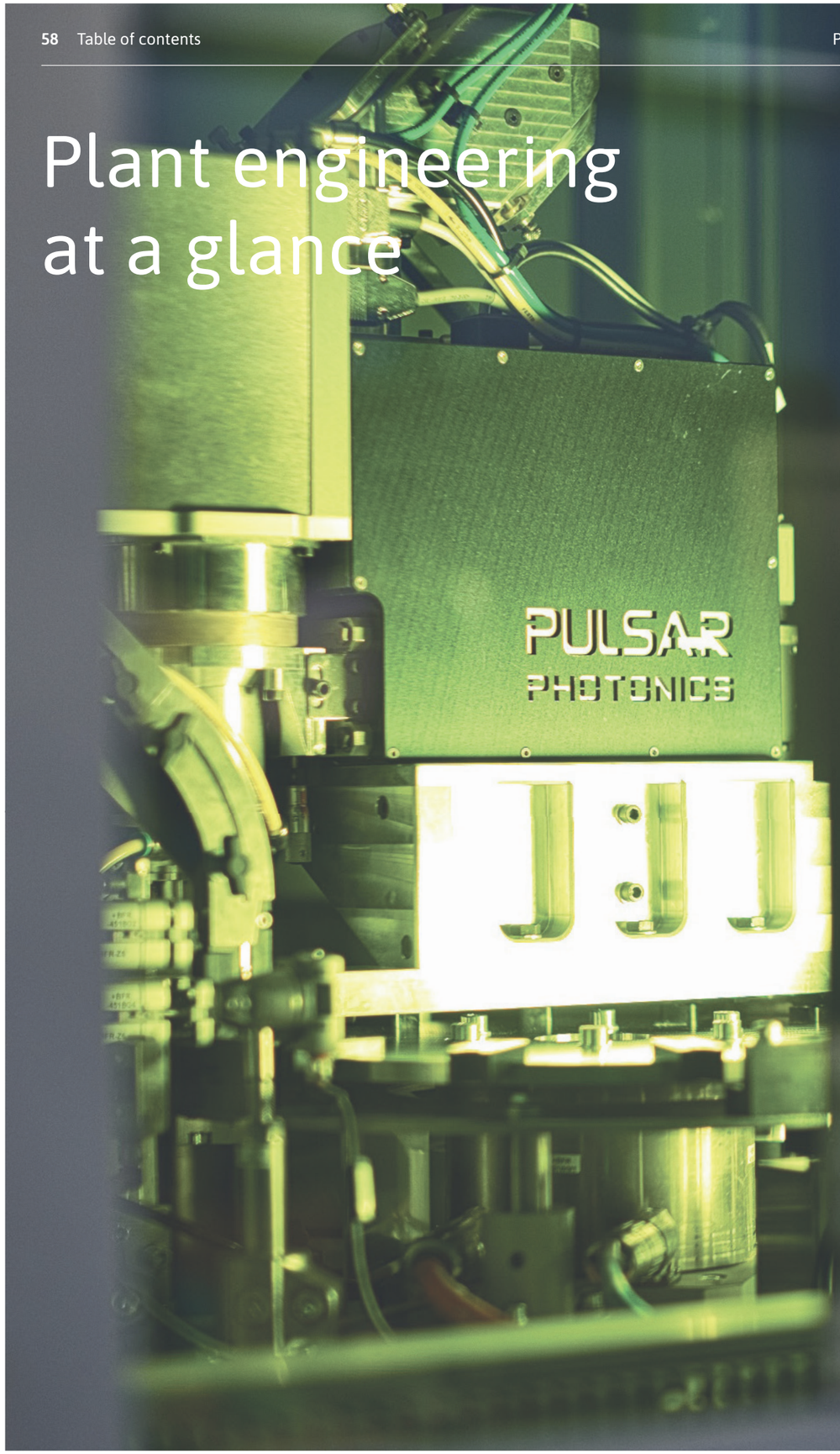
Your **Dr. Michael Leers**, Business Area Manager Plant Engineering

Would you like a personal consultation?

Do not hesitate to call us. Our sales team will be happy to assist you.

+49 2405 495-04-20
machines@pulsar-photonics.de

Plant engineering at a glance



Basic Machines

Industrial Production Machines

Innovative basic machines for highest demands

Our laser basic machines can be recognized from afar by their unmistakable design. But what really impresses is their technology. These production machines impress with their high speed and sophisticated process technology. Since 2016, our RDX machine platform has been setting new standards again and again, whether through the use of high-performance beam sources for UKP material processing or through the integration of beam shaping systems.

Compact base machine: RDX500

The RDX500 is the compact machine solution for entry-level professional laser micromachining.

Automation
Modularity / Extensibility
Suitability for operation in production lines

Flexible laser processing center: RDX800

Modular and powerful: The RDX800 is the machine solution for industrial, high-performance and complex manufacturing.

Automation
Modularity / Extensibility
Suitability for operation in production lines

Combined fiber-laser processing: RDX2Fiber

The RDX2Fiber enables the combination of different power classes and laser types in one machine.

Automation
Modularity / Extensibility
Suitability for operation in production lines

Automated series production: P1000 automatic

The application-specific machine solution in limited quantities.

Automation
Modularity / Extensibility
Suitability for operation in production lines

Laser marking: Pulsar.One

Precise marking & structuring solutions for the highest demands on any material.

Automation
Modularity / Extensibility
Suitability for operation in production lines

RDX500

Your entry into professional laser micromachining

1

Compact basic machine

with a wide range of equipment variants

3

Basic equipment

in dynamic environment

2

User-friendly

with Photonic Elements & highest safety standard

4

High-tech equipment

incl. interior camera for remote support

Even in its basic configuration, the RDX500 is used as a full-fledged UKP laser machine for micromachining. The equipment includes high-quality production-standard components, including the complete RDX safety package for UKP laser processing and the full-featured version of the Photonic Elements machine software.

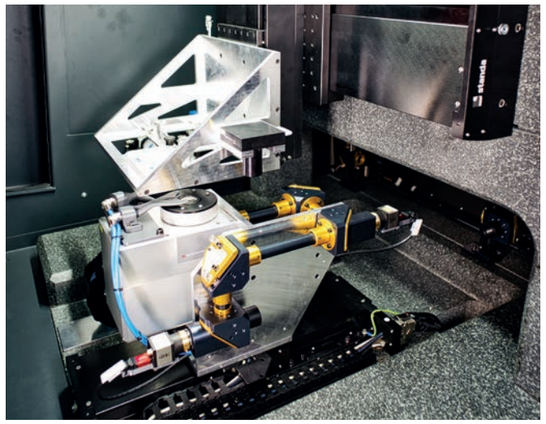
Tip: Configure your desired RDX500 online now!

With just a few clicks you will receive a customized offer.

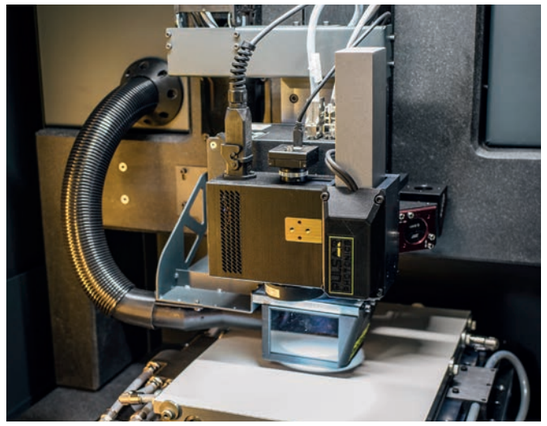
1

Compact basic machine
with a wide range of equipment variants

Thanks to flexible equipment with standardized processing heads and laser beam sources, the system can be quickly configured for special applications such as laser precision drilling and surface functionalization. Thus, RDX500 laser machines are used for processing multilayer high-performance electronics, for tribological surface functionalization, for 2.5D processing or simply as an all-round machine tool in contract manufacturing.



Processing chamber of the RDX500 with inverted scanning system for bottom-up processing



Interior view of the RDX500 with precise XYZ axis system, vacuum clamping table, galvanometer scanning system and measuring technology

2

User-friendly
with Photonic Elements & highest safety standard

Even in its basic configuration, the RDX500 is used as a full-fledged UKP laser machine for micromachining. The equipment includes high-quality production-standard components, including the complete RDX safety package for UKP laser processing and the full-featured version of the Photonic Elements machine software. This positions the RDX500 above laser marking systems and additionally equips it with automatic calibration routines and CAD/CAM solutions, among other things, for demanding applications in small-batch production and process development for R&D centers. Batch production and process capacities in the 100 h range are also possible with the machine.

The RDX500 already offers the highest laser power in the smallest space in combination with high-precision processing systems.

The RDX500 machine frame allows flexible adaptations for the respective application.

The RDX500 is ideal for efficient entry into UKP laser manufacturing. Whether for feasibility development or for the production of small batches with manual assembly. It also offers an attractive basis for compact laboratory systems for research purposes.

Dr. Michael Leers, Business Unit Management Plant Engineering

3

Basic equipment
with maximum adaptation in dynamic environment

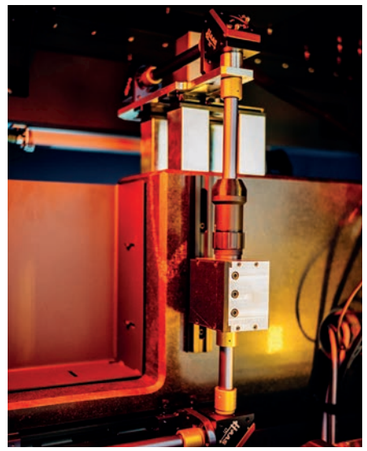
The RDX500 is mass-produced without compromise with a high-quality machine base and equipped to meet specific applications. The compact transport dimensions and a flexible machine layout allow installation even in air-conditioned laboratories and clean production environments. The RDX500 base machine consists of: UKP laser, scanner, XYZ axes and mold clamping system. The machine is optionally expandable with additional machine options. The radiation is designed for one wavelength only.

High quality machine base and flexible configuration

4

High-tech equipment
incl. interior camera for remote support

Like all our RDX machines, the RDX500 has an indoor camera for remote support.



The RDX500 includes the complete RDX security package

Equipment variants
Versatility of the machine is reflected in its equipment variants

- RDX 500 FE
- All-round laser machine for processing with femtosecond laser
- RDX 500nano
- Laser machine with optics module for interference / nanostructuring
- RDX 500microdrill
  Laser drilling machine for precision drilling with very high aspect ratio
- RDX 500 UV
  Laser machine for UV and material processing and micro scanning optics for smallest spot sizes

Technical overview

Basic machine

- Machine frame
  - Supporting steel welded structure
  - Machine bed from natural stone
  - Powder coated sheet steel cladding
- Cartesian axis system XYZ
  - Travel range: 300 mm x 300 mm x 300 mm
- Switch cabinet with machine control
- Stand-alone operator terminal
- Emergency stop system for laser class 1
- Indoor camera for remote support

Laser technical equipment

- Laser beam sources
  - Industrial grade UKP laser, medium power up to 100 W, typ. 30 W
  - Pulse duration: nanosecond – picosecond – femtosecond
  - Wavelengths: 1030/1064 nm, 515/532 nm or 343/355 nm
- Scanning system
  - 2D or 3D galvanometer scanner
  - Focusing unit with fixed focal length (f = 32 - 170 mm)
  - Optional: fixed optics for drilling or interference applications

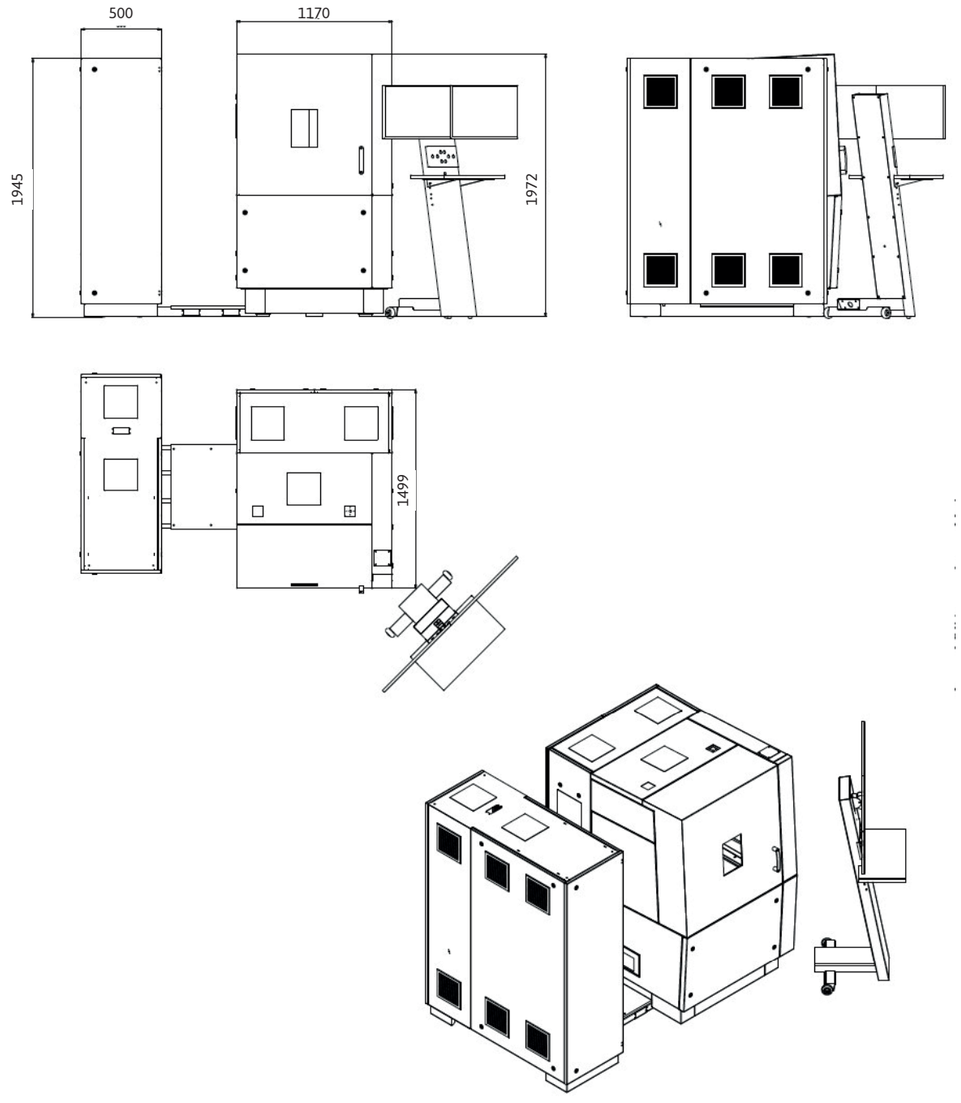
Machine periphery

- Off-axis system camera for workpiece positioning
- 1D measuring system (tactile or optical) for determining the focus position
- Optional: power meter
- Suction and pressure systems

Software

- Machine control software Photonics Elements
  - Control of all machine components & process control
  - Integrated CAD-CAM solution

Technical drawing



Dimensions

- Installation area: typ. 2,000 mm x 3,000 mm
- Total weight: typ. < 3,500 kg

RDX800

The machine solution for industrial, high-performance and complex production

1

Can be automated

in large-format installation space

2

Modern design

with innovative equipment

3

Up to two processing stations

for combined laser process sequences

4

Flexible extension

by 6-axis robotics

and/or roll-to-roll module

The flexible laser processing center, modular and powerful. This machine is our manufacturing specialist of the RDX series, specially designed for laser processing with two process heads in one system. The machine offers installation space for the integration of large-format powerful laser sources.

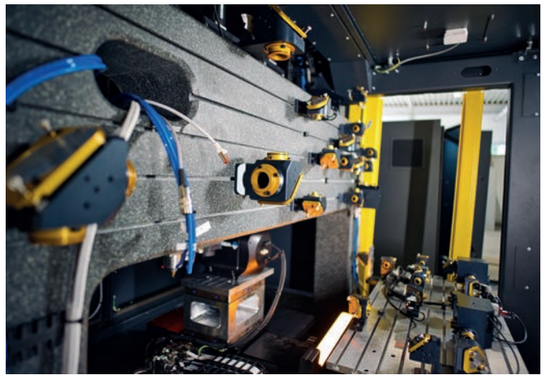
Did you know? Your desired RDX800 can be configured online.

With just a few clicks you will receive a customized offer.

1

Can be automated
in large-format installation space

The RDX800 is the machine solution for industrial, high-performance and complex manufacturing. The machine offers installation space for the integration of large-format powerful laser sources. It has two workstations and long axis travel for the use of fixtures, beam shaping systems, measuring equipment and automation solutions. The RDX800 is powerful in repeat production of component variants and is already ideally prepared for the change from manual repeat production to automatic production.



Interior view of the RDX800 during an assembly of the beam delivery systems

For reduced operation, multi-step process sequences and setting parameters can be executed safely at the push of a button

2

Modern design
with innovative equipment

For reduced machine operation, multi-stage process sequences and setting parameters can be executed securely as complex recipes at the push of a button. In terms of product design, the RDX800 impresses with full access to platform options: power-assisted machine doors, machine air conditioning, integrated measuring technology, UPS solutions or an operator terminal alternative.

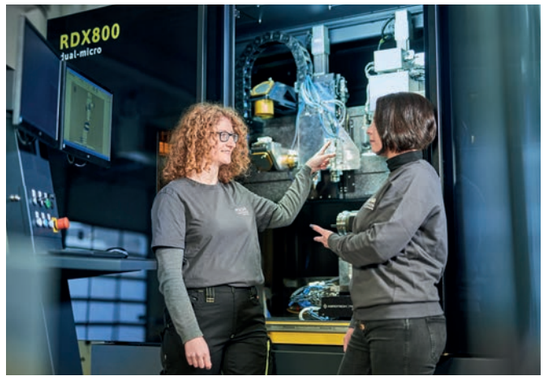
Powerful in the repeat production of component variants, the RDX800 is ideally prepared for the change from manual repeat production to automatic production

The RDX800 laser machine with its elegant design is the production specialist in the Pulsar RDX series.

3

Up to two processing stations
for combined laser process sequences

The RDX800 is used for the serial production of small-format components, e.g. in the batch production of sensors. The large traverse range and the integrated measuring technology allow automatic detection and productive automatic machining in one setup. For 2.5D tube machining or set-up machining, the XY axis system is extended by a precise rotary and swivel unit (AB axis). The machine design is uncompromisingly designed for the use of up to two laser stations (also of different wavelengths) and the machining of large-format components.



You can configure your own machine on our website, we will be glad to help you!

RDX 800 addresses demanding users in industrial single-part and small-batch production

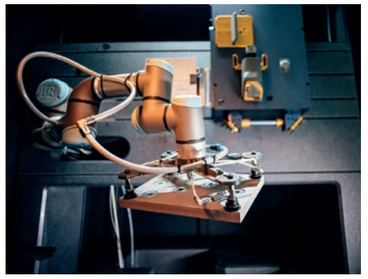
The RDX800 is an uncompromising choice for laser manufacturing. The expandability as well as the multitude of automation options make both the operation for the user and the integration of the RDX800 into own production lines a child's play.

Dr. Michael Leers, Business Unit Management Plant Engineering

4

Flexible extension
by 6-axis robotics and/or roll-to-roll module

As a flexible laser processing center, the RDX800 is loaded manually or expanded with handling systems for 24/7 production. Here, 6-axis robots and selected roll-to-roll or roll-to-sheet modules from system partners are available.



The machine bed of the plant is made of natural stone. To be seen on the picture: Robotic insert in the RDX800

Technical overview

Basic machine

- Machine frame
  - Supporting steel welded structure
  - Machine bed from natural stone
  - Powder coated sheet steel cladding
- Cartesian axis system XYZZ
  - Travel range: 1000 x 400 XY, 2 x 300 mm Z1 Z2, accuracy < 2.5 µm
  - Speed < 500 mm/s, expandable with AB rotary swivel unit
- Switch cabinet with machine control
- Operator terminal (stand-alone or hanging on machine arm)
- Emergency stop system for laser class 1
- Indoor camera for remote support

Laser technical equipment

- Laser beam sources
  - Integration of up to two beam sources possible (fiber laser as well as free beam laser)
  - Embedding of high power lasers possible
  - Different wavelengths in one system
  - Industrial grade UKP laser, medium power up to 200 W
  - Alternative: Fiber laser, medium power up to 6 kW
  - Wavelengths: 1030/1064 nm, 515/532 nm or 343/355 nm
- Process heads
  - Integration of two processing heads possible
  - 2D or 3D galvanometer scanner
  - Cutting head/drilling head as fixed optics
  - Helical drilling optics

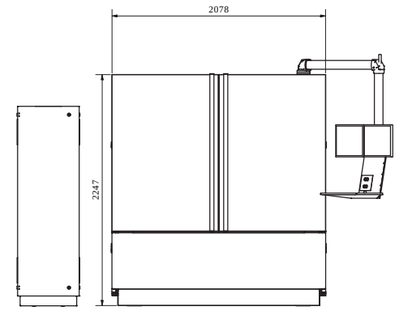
Machine periphery

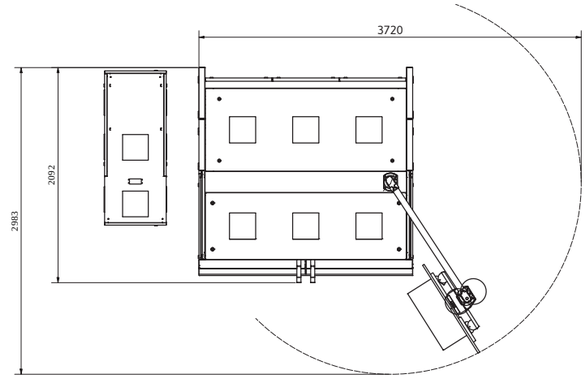
- Off-axis system camera for workpiece positioning
- 1D measuring system (tactile or optical) for determining the focus position
- Extraction and compressed air systems
- Optional:
  - 3D measuring probe
  - White light interferometer
  - Beam Alignment Module (BAM), Powermeter

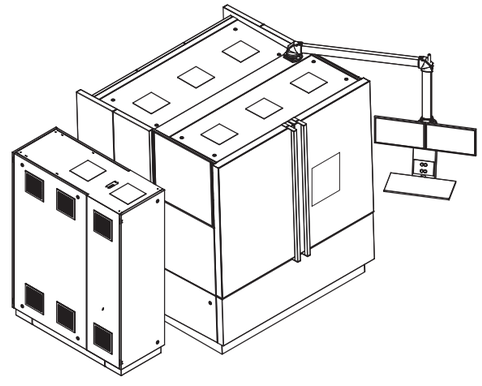
Software

- Machine control software Photonics Elements
  - Control of all machine components & process control
  - Integrated CAD-CAM solution
  - reduced GUI solution as well as connection to ERP-/PLS

Technical drawing







Dimensions

- Installation area: 5,000 mm x 3,000 mm
- Total weight: typ. < 4,500 kg

RDX2Fiber

The machine for combined fiber-laser processing

1

Professional processing with fiber lasers

2

Compact design

with large installation space

4

Metrology

for component position detection and mold monitoring

4

Flexible use

in the workshop as well as assembly production

2

Combi system

for laser welding, structuring and drilling

The RDX2Fiber enables the combination of different power classes and laser types in one system. The changeover from different laser beam sources is fully automated and controlled via a beam switch. The possibility of directly combining different production processes without changing tools or machines opens up further possibilities and increases efficiency.

Design your individual RDX2Fiber online now!

With just a few clicks you will receive a customized offer.

1

Professional processing with fiber lasers

With the RDX2Fiber, Pulsar Photonics addresses the large application range of fiber lasers up to the kW range. A machine solution for a wide range of applications is now available for workshop and assembly production.

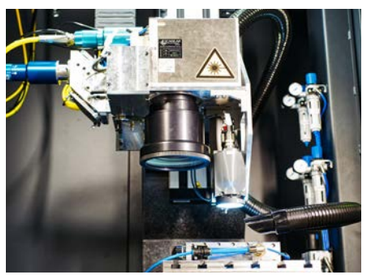
General view of the RDX2Fiber: welded steel construction in a sleek RDX design.

Greatest possible travels and excellent accessibility combined with compact design

2

Combi system
for laser welding, structuring and drilling

In addition to the main tasks of drilling, welding and cutting, drilling processes, laser marking, polishing processes and surface structuring can extend the range of applications, depending on the choice of beam source.

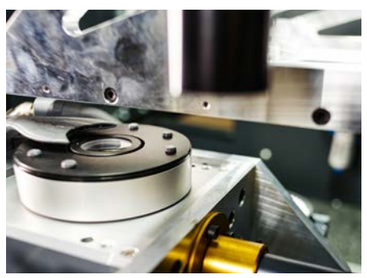


Interior view of the RDX2Fiber with precise axis system, galvanometer scanning system and measurement technology

3

Metrology
for component position detection and mold monitoring

Ideally, the RDX2Fiber is equipped with a high-power beam source in combination with a small-format laser beam source for pulse or pulse/cw operation. With a sensor-supported beam switch, the change of beam sources is supported by the machine software. At the same time, the RDX2Fiber is equipped with additional measuring technology for component position detection and mold monitoring.



Detail view of the interior

The RDX2Fiber combines precise laser manufacturing with pragmatic sample handling while ensuring high process stability. Partial automation and unrestricted accessibility to the machine round off the profile of the RDX2Fiber.

Dr. Michael Leers, Business Unit Management

4

Compact design
with large installation space

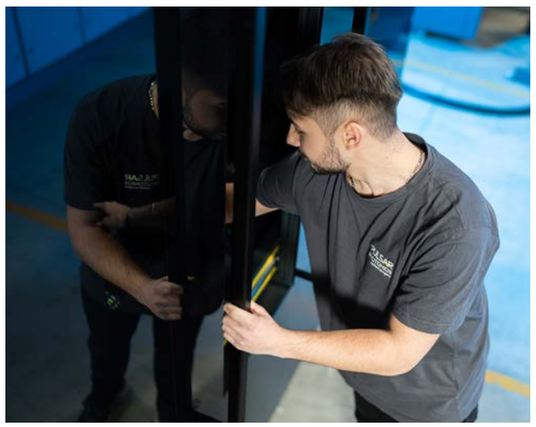
The machine enables the greatest possible travel distances and good accessibility while maintaining a compact design. The RDX2Fiber has a large work envelope designed to accommodate expansive components, fixtures and automation solutions. For 2.5D tube machining or set-up machining, the XY-axis system can be equipped with a rotary or swivel unit. The process guidance can optionally be carried out by galvo scanners or by the machine axes with fixed optics.

The equipment includes the minimum scope of a laser machine

5

Flexible use
in the workshop as well as assembly production

The RDX2Fiber is ideally designed for workshop and assembly production: For micromachining, e.g., with a short-pulsed laser beam source, and for macromachining with (Q)cw lasers. The power assistance of the machine door supports the machine operators in production and simplifies the adaptation of robot loading systems. The machine can be expanded with various machine options.



The RDX2Fiber is expandable with several machine options

Technical overview

Basic machine

- Machine frame
  - Supporting steel welded structure
  - Machine bed from natural stone
  - Powder coated sheet steel cladding
- Cartesian axis system XYZ
  - Travel range: 400 mm x 400 mm x 400 mm
- Pivotable rotation axis 360°
- Pneumatic sliding door
- Switch cabinet with machine control
- Operating terminal suspended from machine arm
- Emergency stop system for laser class 1
- Indoor camera for remote support

Laser technical equipment

- Two laser beam sources
  - Industry standard fiber laser: (q)cw, ns, ps
  - alternatively: combination of different power classes up to kW range
  - Wavelengths: 1030/1064 nm or 515/532 nm
- Process head
  - 2D, 3D galvanometer scanner or fixed optics
  - Focusing unit with fixed focal length (f = 32-170 mm)

Machine periphery

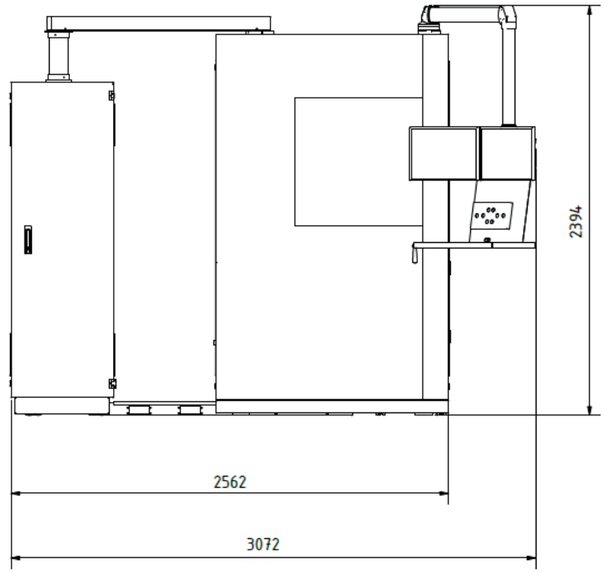
- Off-axis system camera for workpiece positioning and powerful compressed air system
- 1D measuring system (tactile or optical) for determining the focus position
- powerful suction as well as compressed air systems

Software

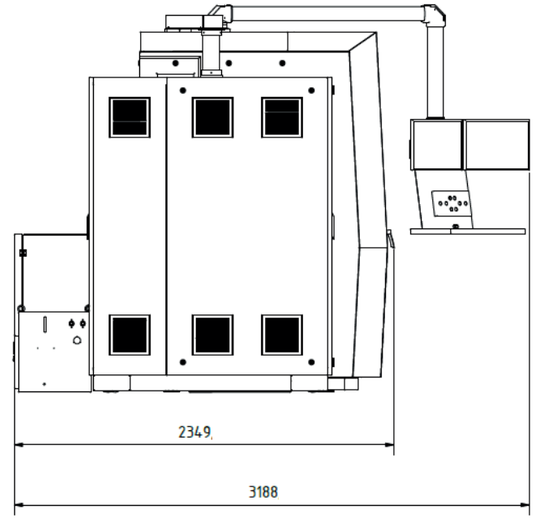
- Machine control software Photonics Elements
  - Control of all machine components & process control
  - Integrated CAD-CAM solution

Technical drawing

Front view



Side view



Dimensions

- Installation area: 3,000 mm x 3,000 mm
- Total weight: typ. < 3,500 kg

Pulsar.One

Precise marking solutions for the highest demands

1

Laser system

equipped with a MOPA fiber laser

2

Compact design

800 mm x 1100 mm x 1900 mm

3

Light & dark marking

4

Flexible use

Labeling of serial numbers, images, logos, QR and barcodes

The compact Pulsar.One laser system is equipped with a MOPA fiber laser, which enables the processing of various materials such as metals, e.g. steel, aluminum, copper and many types of plastics.

More information about our marking solutions

1

laser system
MOPA fiber laser

The compact Pulsar.One laser system is equipped with a MOPA fiber laser, which enables the processing of various materials such as metals, e.g. steel, aluminum, copper and many types of plastics.

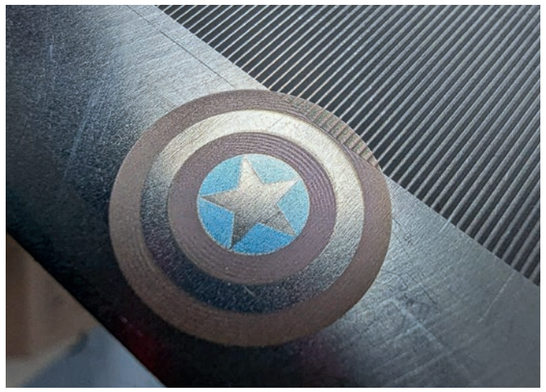
Light and dark marking: The great advantage of the installed fiber laser is its ability to create both light and dark markings on materials. This means that the markings are highly visible, regardless of the color or texture of the component.

Pulsar.One: Outside view of the compact labeling system

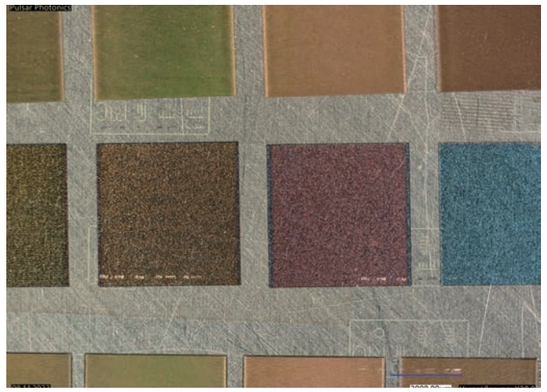
2

Compact design
with innovative equipment

In addition, the surfaces of materials can be roughened, which can be used to improve the adhesion of coatings or to create specific surface effects. 3D-printed SLM components can also be smoothed.
Equipped with a rotary axis, the Pulsar.One processes tubes and rings, making it possible to process cylindrical or ring-shaped objects. The dimensions are 800 mm x 1100 mm x 1900 mm with a weight of 250 kg.



Color marking example



Generated color scale: possible colors on stainless steel

3

Light & dark marking

Eye-catching and durable: Creation of colored markings on stainless steel that are both aesthetically pleasing and highly visible. Eye-catching designs can therefore be easily implemented.

The versatility of our system makes it a valuable tool in numerous industrial and craft applications.

4

Flexible use: Application areas
in various industries

- **Automotive industry:** marking of parts, serial numbers and surface treatment of components
- **Medical technology:** labeling and processing of medical devices, instruments and implants
- **Electronics industry:** marking of printed circuit boards, electronic components and housings

the system is small and compact: the total weight is 250 kg.

The Pulsar One is suitable for cost-effective, precise and long-lasting marking of various materials. The non-contact and digital processing enables fast and flexible adaptation of texts and codes.

Louisa Draack, Technical Sales

- **Jewelry manufacturing:** engraving and marking of jewelry, especially for detailed and colored markings on precious metals
- **Aerospace:** marking of components and surface treatment of materials for better adhesion and corrosion protection
- **Toolmaking:** marking and processing of tools and molds
- **Packaging industry:** labeling and marking of packaging and labels
- **Plastics processing:** labeling and processing of plastic parts and products
- **Watch industry:** engraving and marking of watch parts and cases
- **Construction industry:** marking and processing of construction components and materials

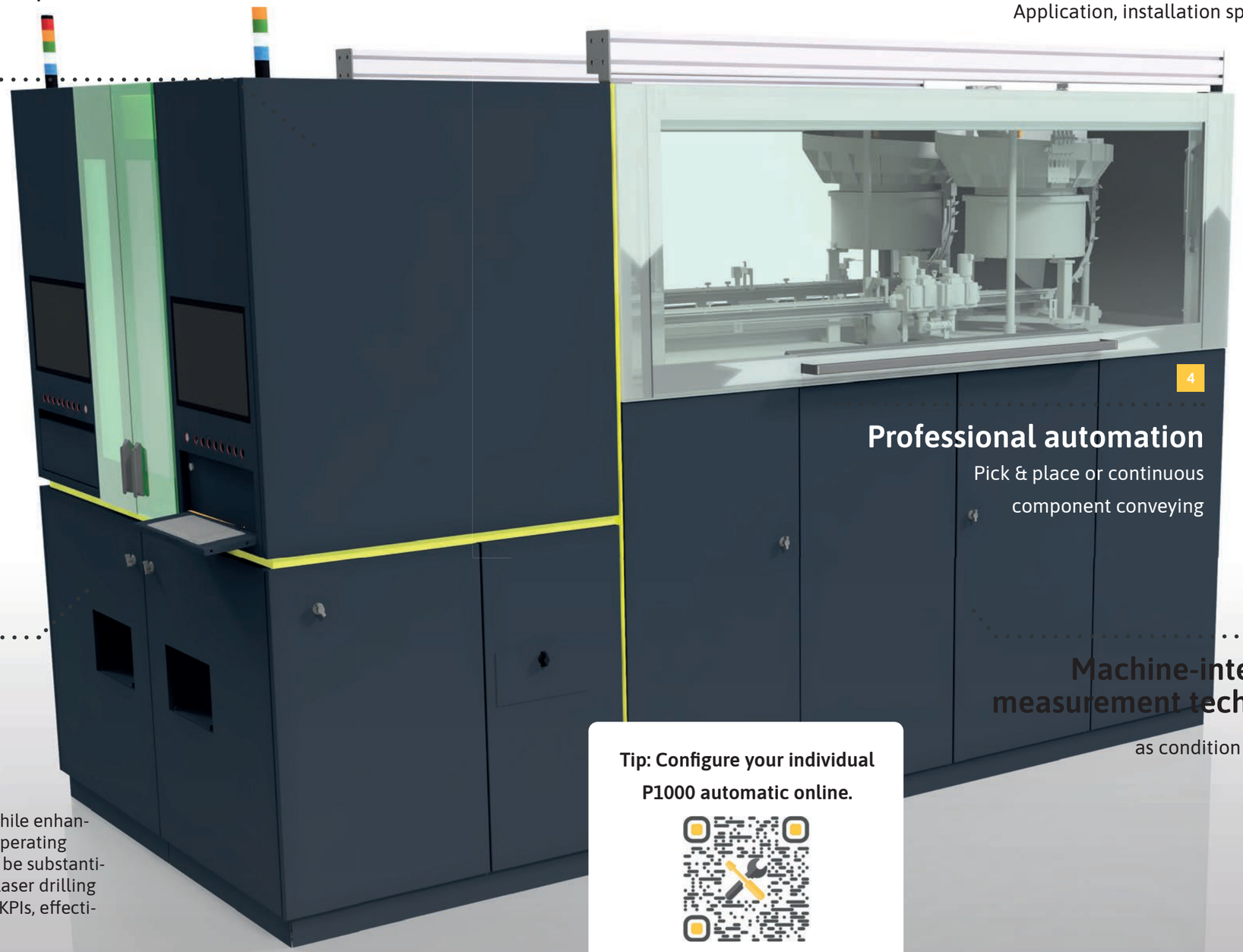
P1000 automatic

Fully automated laser micromachining for series production

1

Special machines for series production

with application-specific software solution



3

Customized

Application, installation space, design

4

Professional automation

Pick & place or continuous component conveying

2

Fully automated component qualification

for combined laser process sequences

5

Machine-integrated measurement technology

as condition monitoring

This solution significantly increases productivity while enhancing machine reliability. At the same time, direct operating costs—particularly in the area of wear parts—can be substantially reduced. In addition, the digital nature of the laser drilling system enables real-time evaluation of numerous KPIs, effectively supporting production control.

Tip: Configure your individual P1000 automatic online.

With just a few clicks you will receive a customized offer.

1

Special machine construction for series production
with application-specific software solution

Possible areas of application for the P1000 auomatic:

- Laser (micro)drilling
- Laser (micro)structuring
- Laser fine cutting
- Surface functionalization
- Scribing
- Marking
- Laser-induced-forward transfer (LIFT) on flat substrates

Interior of the P1000 automatic with rotary indexing table and several machining, handling and measuring stations

2

Fully automated component qualification

By combining the modular laser processing cells of the RDX series, component-adapted feed systems and high-performance measurement technology, special machines are created for the laser-based processing of components and flexible substrates in high volumes, including 100% control of the processing results for seamless tracking.

Customized system with automatic workpiece magazines and an integrated UR robot

3

Customized
Application, installation space, design

The machine configuration is designed and configured specifically for the customer based on the requirements for cycle time, component quality and quality. The series start-up is carried out together with the customer supported by our on-site service.

Production information

Component formats

- Flat substrates
- Small components/sleeves/Round discs
- Flexible substrates
- Strip substrates (plastic film, metal strips)

Automation

- Feeding via articulated arm robot
- Vibratory conveyor system with rotary indexing table
- Roll-to-roll or roll-to-sheet
- Customized feeding solutions
- Machine manufacturing solutions

Throughput and availability

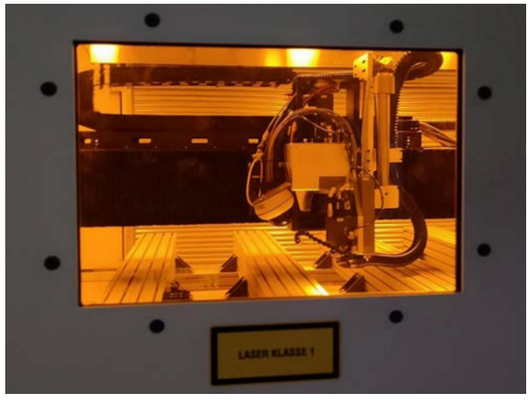
- Up to 15,000 parts per hour depending on automation and process
- Spare parts packages
- Operator training

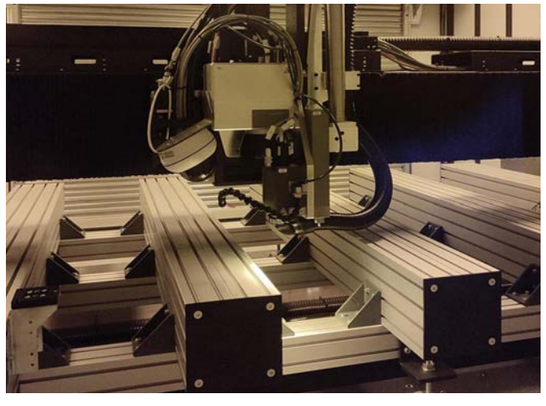
3.1

Examples of customer configurations

The series start-up is carried out together with the customer, supported by our on-site service

Customer plant in air-conditioned large-capacity housing

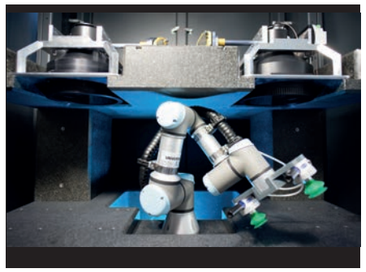




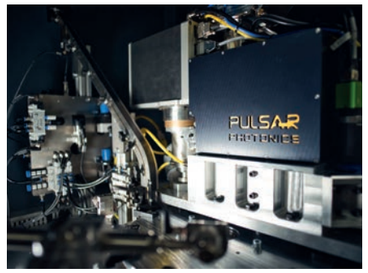
4

Professional automation
Pick & place or continuous component conveying

We have a network of high-performance automation partners who can offer a customer-specific automation solution depending on the component geometry and degree of automation.



Robot-assisted component feeding in a dual-head setup as a configuration example



Rotary indexing table with machining, measuring, infeed and outfeed positions

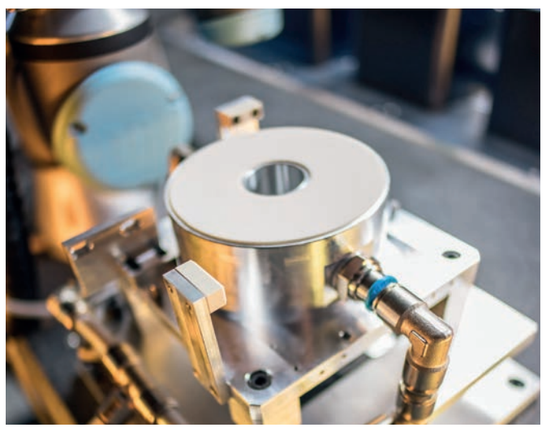
5

Machine-integrated measurement technology
as condition monitoring

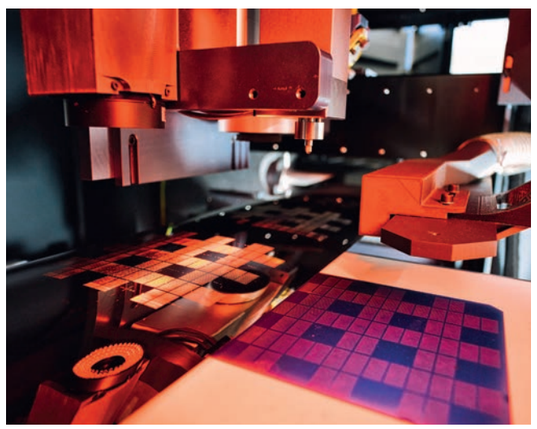
In addition to short production times, achieving the same process results over a long period of time is an essential key to series production with high system availability. Especially in series production and in processes with long process times, continuous monitoring of processing parameters such as beam position and laser beam power, but also of machine condition parameters, is advantageous in order to enable constant processing quality.

The condition measurement of the laser power and the beam profile by optical sensors provides the necessary data for active control, fault diagnosis, the achievement of higher process capability indices, condition-based maintenance or documentation.

The PhotonicElements software enables the processing and visualization of the data. In addition to the measurement data of the sensors installed in the hardware, these are available in combination with the machine and process data recorded by the machine controller.



Machine-specific fixture design for component handling as a configuration example



Process-adapted handling and measuring system as configuration example

Technical overview

Basic machine

- Customized machine frame
  - Supporting steel welded structure
  - Machine bed from natural stone
  - Powder coated sheet steel casing
- Mech. Interfaces for feeding system
- Switch cabinet with machine control system
- Integrated HMI (human machine interface) with touch functionality and NFC user login option
- Emergency stop system for laser class 1
- Indoor camera for remote support

Laser technical equipment

- Laser beam sources: up to two beam sources can be integrated, both fiber lasers and free beam lasers. Integration of high-power lasers as well as different wavelengths possible in one system
  - Industrial grade UKP laser, medium power up to 200 W
  - alternative: fiber laser, average power < 3,000 W
  - alternative: nanosecond laser, medium power up to 100 W
  - Wavelengths: 1030/1064 nm, 515/532 nm or 343/355 nm
- Optics modules: Integration of two processing heads possible
  - 2D or 3D galvanometer scanner
  - Cutting head/drilling head as fixed optics
  - Helical drilling optics

Machine periphery

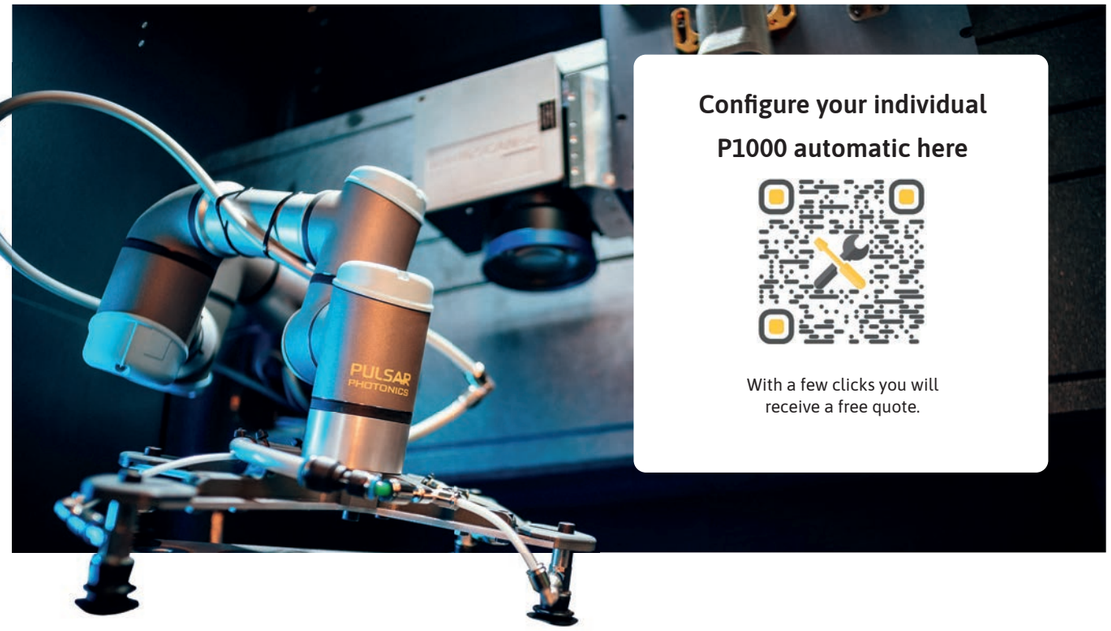
- Off-axis system camera for workpiece positioning
- 1D measuring system (tactile or optical) for determining the focus position
- Optional:
  - 3D measuring probe
  - White light interferometer
  - Beam Alignment Module (BAM), Powermeter

Software

- Machine control software Photonics Elements
  - Control of all machine components & process control
  - Integrated CAD-CAM solution

The tailor-made suit for your application: Machine options

Laser machines from Pulsar Photonics are characterized by their modular design. The machine is configured individually and adapted to the customer‘s application. For this purpose, a number of modules are available, which are centrally combined in the machine software Photonic Elements.
Please visit our website, configure your individual machine and receive a free quotation from us!



Configure your individual P1000 automatic here

With a few clicks you will receive a free quote.

Optics modules
Machining heads for laser machining

- **2D/3D galvanometer scanner**
  Scanning system for lateral or 3D beam positioning and focusing
- **Helical drilling optics**
  Drill head for precision drilling with high aspect ratios
- **MultiBeamScanner MBS-G4**
  Machining head for parallel machining
- **FlexibleBeamShaper FBS-G3**
  Flexible beam shaping system
- **Microscan Extension MSE-G2**
  Special lens for ultra-high resolution editing
- **DLIP processing head**
  Processing head for Direct Laser Interferene Patterning (DLIP)

Laser technical equipment

- **UKP-Laser (30 W)**
  Pico- or femtosecond laser for the classical single beam processing
- **High power UKP-laser (up to 200 W)**
  High power laser beam source
- **Nanosecond laser (100 W)**
- **CW/QCW-Laser**
  Laser beam source for melt-dominated laser processing (kW)

Machine periphery

- **Beam position stabilization**
  Module for automated beam position correction
- **Camera system**
  Module for off-axis observation of the workpiece
- **Condition Monitoring:**
  Sensor system for monitoring the condition of the machine
- **Topography modules**
  Measuring module for determining the surface topography
- **Powermeter**
  Measuring module for laser power measurement
- **Measuring probe**
  Optical/mechanical measuring system for distance determination
- **Camera based 100 % control**
  of quality features with view-up or view-through in high cycle rates

Accessories

- **Rotary-swivel unit**
  AB axis for adjusted laser processing
- **Workpiece clamping device**
  Application-specific clamping system
- **Suction system**
  for the removal and filtering of laser process emissions
- **Beam guidance**
  Guidance of the laser radiation from the laser beam source to the workpiece

RDX1000 LWJ

Waterjet-guided laser material processing for precise cuts with high aspect ratio in brittle-hard materials

1

Precise laser cutting & drilling

at aspect ratios of up to 1:100

3

Intuitive & user friendly software

for generation of CAM-paths

4

Two processing stations

for waterjet-guided & for dry laser machining

2

Machining of brittle-hard materials

of thicknesses up to 20 mm

Waterjet guided laser cutting (LWJ) is a special type of laser cutting technology especially useful for materials which are difficult to machine and use-cases in which a precise laser cut is needed while minimizing heat input. This technology opens up completely new possibilities in precision machining.

More information

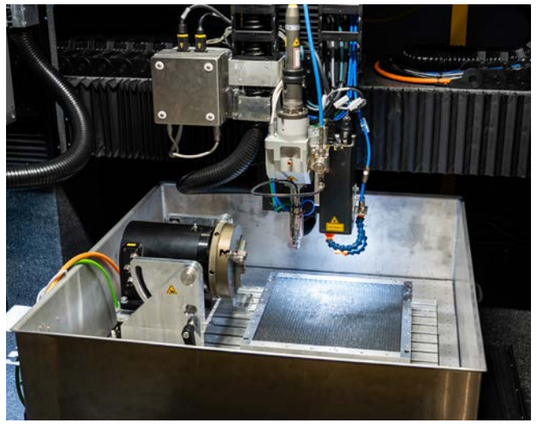
Contact us for a customized offer.

1

Precise laser cutting & drilling

A core component of the RDX1000 LWJ is the state-of-the-art processing head developed by Synova. This not only integrates the patented Laser MicroJet technology, but also enables a high degree of flexibility thanks to an additional dry processing station with a fiber-guided laser. By combining laser waterjet cutting and laser ablation in a single system, even the most complex processing tasks can be completed with high efficiency and precision.

Exterior view of the RDX1000 Laserwaterjet system

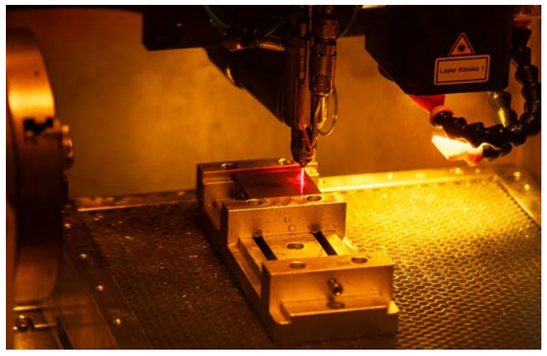


Interior of the RDX1000-LWJ with two process heads

2

Machining of brittle-hard materials
of thicknesses up to 20 mm

Water-jet guided laser cutting (LWJ) is a special type of laser cutting technology especially useful for materials which are difficult to machine and use-cases in which a precise laser cut is needed while minimizing heat input. A key advantage of waterjet-guided laser cutting is the high achievable aspect ratio of up to 1:100. The aspect ratio is the ratio between the width and depth of the cutting kerf.



3

Intuitive & user-friendly software
for generation of CAM-paths

Photonic Elements software: A CAD-CAM interface enables machining directly from CAD data without manual NC code programming. It significantly reduces the programming effort and speeds up the manufacturing process.

Deep hole drilling in technical ceramics (SiSiC, material thickness 10 mm)

The demand for processes that enable fine structures with maximum precision and quality has increased, particularly in ceramic processing. The combination of laser and water jet now opens up completely new possibilities in precision machining.

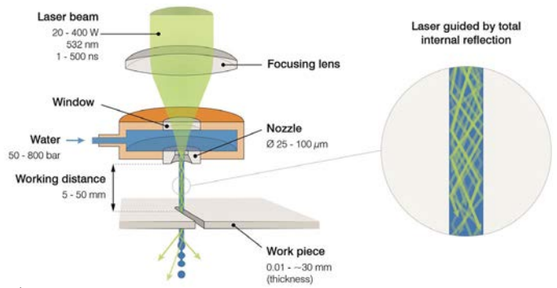
Dr. Stephan Eifel, Managing Director

4

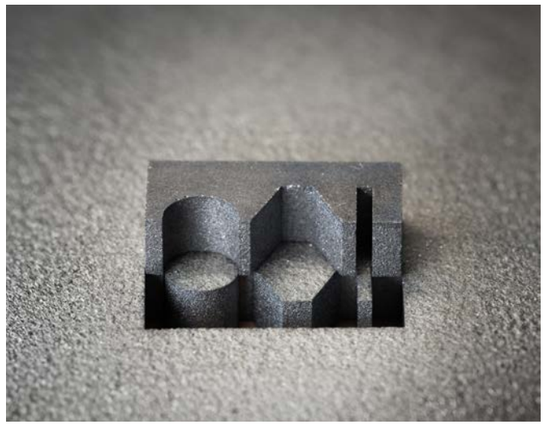
Two processing stations
for waterjet-guided & for dry laser machining

The RDX1000 LWJ combines a modern and user-friendly machine control interface with high-performance laser-cutting optics. The machine is equipped with two processing stations: one for waterjet-guided machining and one for dry laser machining.

Materials
- Metals and hard metals
- Technical ceramics
- Silicon carbide SiC / SiSiC
- Composite materials



© Synova S.A.: Model of the laserwaterjet-technology



Free-form contour cut in 3D-printed SiC-ceramics, material thickness 5 mm

Side view of a laser cut (SiC, material thickness 8 mm)

RDX800 automatic

Fully automated series production of electronic components for medical technology

1

Roll-to-roll + roll-to-sheet

laser manufacturing

3

100 % component verification & audit trail

4

Double-sided processing

with individual software solutions

5

Measurement technology & individual component tracking

2

Combination of various processing steps

e.g. drilling, cutting, structuring

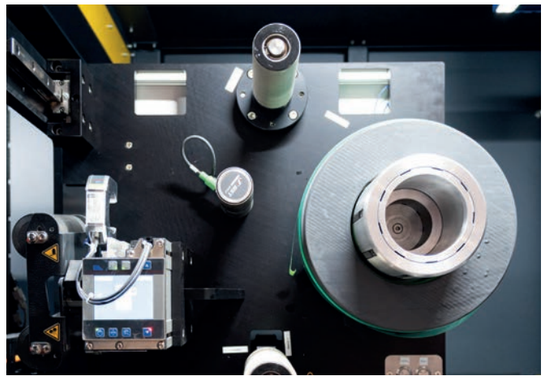
The RDX800automatic is a highly automated laser machine based on the existing RDX system concept and has been supplemented by an extended automation module. With an integrated roller system, robot handling and options for various laser sources (UV, green, IR), it enables fully automated production processes - from material feed to final processing.

1

Roll-to-roll & roll-to-sheet
laser manufacturing

The RDX800 automatic can be provided with various automation functions and has a high degree of autonomy. It has a roller system and a robot. Production and monitoring are fully automated from the moment the roll is inserted. A special feature of the system is that the laser cutting of the roll enables a roll-to-sheet process in which individual components can be produced from a roll.

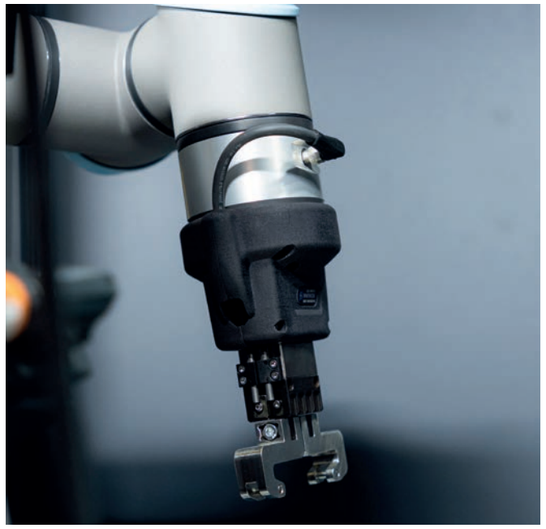
Exterior view of an RDX800 automatic laser system



Highly automated laser micromachining system with integrated robot and roller system

2

Combination of various combination steps
e.g. drilling, cutting, structuring



Robot integration eliminates any manual transfer between the individual process steps

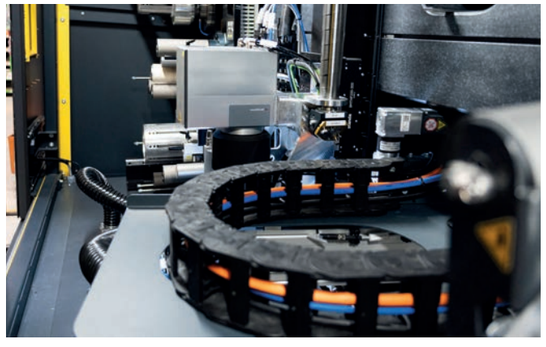
The system combines numerous processing steps (e.g. drilling, cutting, structuring) and off ers maximum precision and traceability thanks to functions such as register mark detection, a z-axis measuring probe and reject detection. With its modular expandability, it can be used fl exibly and achieves high quantities at low cost thanks to automated processes.

The machine exemplifies the combination of laser micromachining and intelligent automation.

3

100 % component verification & audit trail

Thanks to the monitoring and auditing functions and the fully traceable audit trail, the system achieves an excellent process capability index. It combines many process steps and also offers far-reaching advantages in comprehensive component handling. The Pulsar Photonics machine concept enables 100% component inspection with complete traceability of each individual part. The component and belt inspection ensures minimum failure rates. Robot integration eliminates any manual transfer between the individual process steps. The next laser process can begin while the previous component is being removed by the robot. The underlying machine concept and the software solution can be flexibly adapted to the intended application



4

Double sided processing
with individual software solutions

Machining on both sides is also possible. The camera system enables registration mark detection, while an optical measuring probe increases the accuracy of positioning in the z-axis. Thanks to the monitoring and auditing functions and the fully traceable audit trail, the system achieves an excellent process capability index.

„The system combines many process steps and also offers far-reaching advantages in comprehensive component handling. The Pulsar Photonics machine concept enables 100% component inspection with complete traceability of each individual part. Robot integration eliminates any manual transfer between the individual process steps.“

Dr. Joachim Ryll, Managing Director

Machine details

- Roll-to-roll & roll-to-sheet
- Process sequences - various (laser) processes in succession
- Double-sided processing
- Measuring technology & individual component tracking
- 100 % component verifi cation & audit trail
- Individualized production
- Individualized sotware solutions
- Separate sorting of rejects

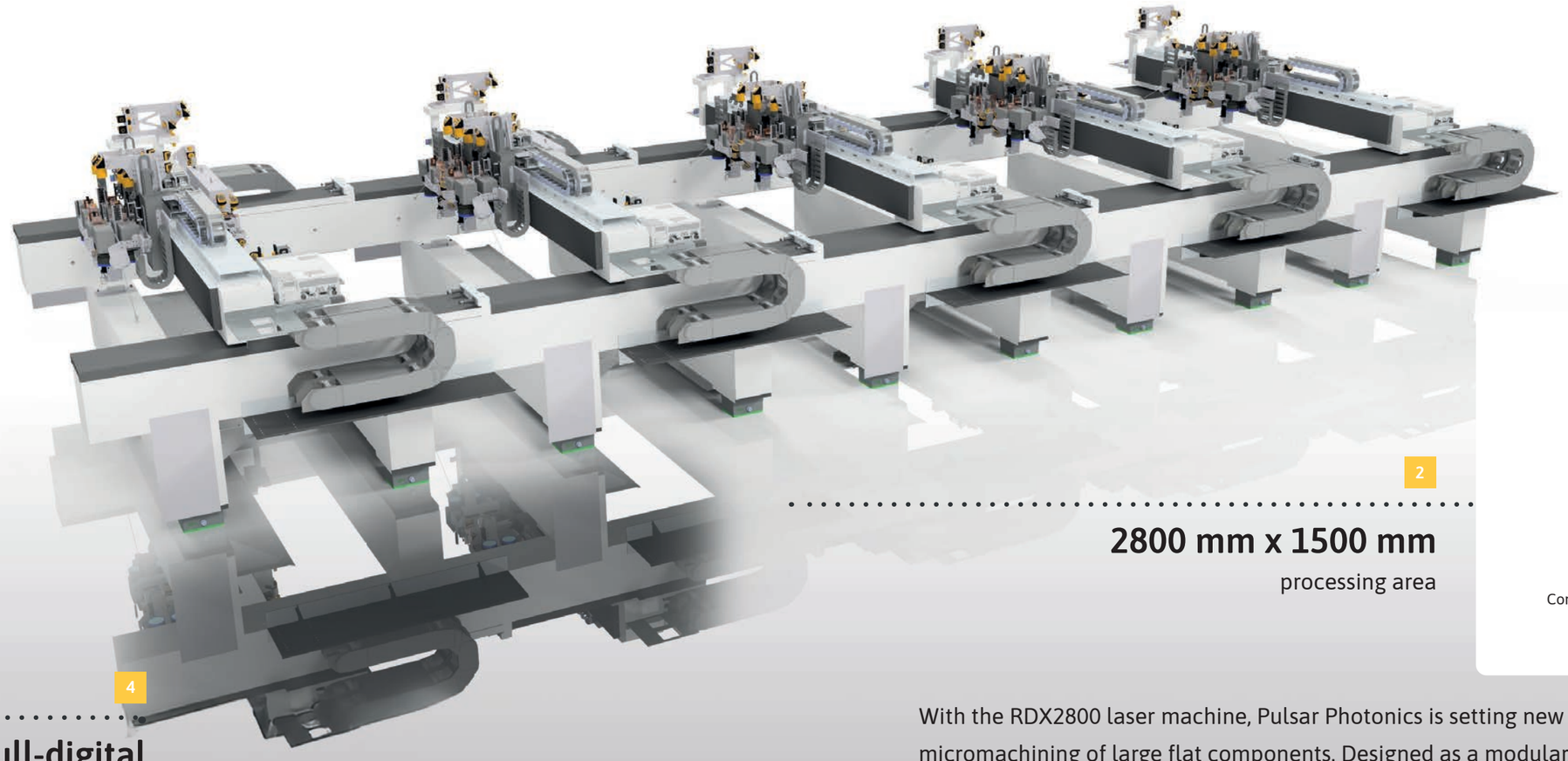
RDX2800

Large-area laser micromachining

1

Environmentally friendly, sustainable production process

Replacing etching processes



3

Efficient large-scale system through parallelization

with multi-scanner & multi-beam processing

2

2800 mm x 1500 mm

processing area

4

Full-digital process chain

from CAM to processed workpiece

With the RDX2800 laser machine, Pulsar Photonics is setting new standards in the laser micromachining of large flat components. Designed as a modular gantry system with a holder for large flat components with dimensions of up to 2,800 mm x 1,500 mm per machine module, the system can achieve full-surface laser micromachining on square meter-sized surfaces, even with ultrashort pulse lasers.

More information

Contact us for a customized offer.

1

Environmentally friendly, sustainable production process
replacing etching processes

Motivated by environmental requirements and regulations restricting the use of chemicals or paints, more and more companies are faced with the task of converting their production processes to more environmentally friendly and/or less energy-intensive manufacturing methods.

Large-area laser micromachining offers a way to replace existing manufacturing processes or to improve coating and cleaning processes.

Exterior view of an RDX2800 laser system

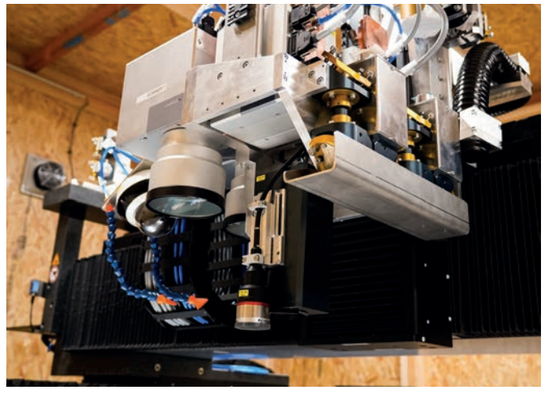
Together with our customers, it is therefore possible to tailor the machine in terms of productivity and process quality

2

Full-digital process chain
from CAM to processed workpiece

The laser-based manufacturing process also opens up scope for new product features and market differentiation thanks to the digital process chain and the combinability of laser processes.

Close-up view of the axle system of the RDX2800 system



RDX2800 equipped with single scan head. Here during construction.

3

Efficient large-scale system through parallelization
with multi-scanner & multi-beam processing

By lining up several modules in series, larger components can be processed, currently for applications with components significantly larger than 10 m^2. Several workstations are used within a machine module, whereby each workstation can be used for individualized single-beam or multi-beam processing, depending on the application. As a result, more than a thousand laser beams can be used simultaneously to process a component. This scaling and multi-beam technology make processing large areas economically efficient.

Demonstrator plate (1000 mm x 1000 mm) for large-area USP laser processing with sample structures for functional surfaces and deep engraving.

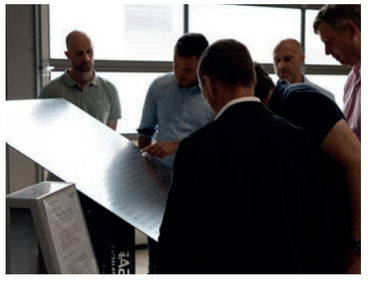
Close-up of the deep engravings in stainless steel plate.

Real-time online monitoring allows us to continuously track how and when the machine is working with specific files. It is an indispensable part of our system, as it enables us to monitor all operating statuses seamlessly.

Dr. Joachim Ryll, Managing Director

Machine details

- Roughening, ablation, marking, polishing
- Replacing etching processes with hard chrome plating
- Component size up to 2800 mm x 7500 mm
- Option for fl exible processing with each machining optic
- Full-digital process chain from CAM to processed workpiece
- Interface to higher-level systems
- Asynchronous process preparation
- Processing of large area CAM-data
- Parallelization & process scaling



Area of application: Large-format flat components in tool technology

RDX2Drill

Laser drilling machine

1

System for single-pulse drilling with high-power QCW fiber lasers

2

Production of metallic sieves

for filter applications

3

Drilling rates up to 80 Hz

More information

4

Integrated extraction unit

for removing melt particles

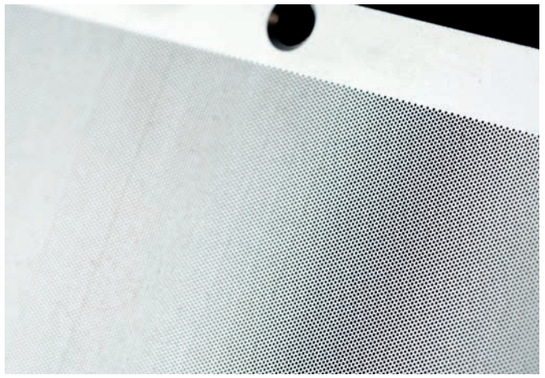
The RDX2Drill is a configuration of the RDX2Fiber machine series and is designed for the production of metallic sieves and filters using melt-dominant laser drilling.
A fiber laser, a drilling process head (fixed optics) and a fast XYZ axis system for positioning workpieces under the process head ensure highly productive drilling processes.

This technology is particularly suitable for the production of filter applications in the field of sustainable manufacturing. Thanks to the software-based control, almost any drilling pattern can be realized.

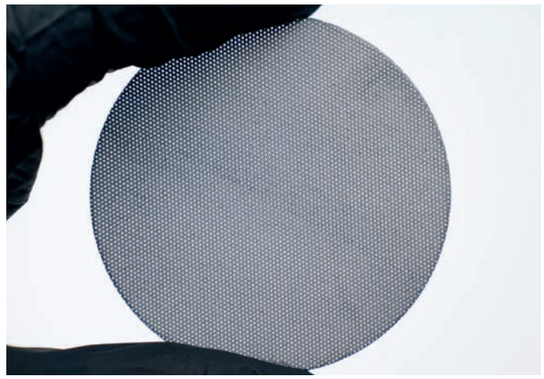
1

System for single-pulse drilling with high-power QCW fiber lasers

The RDX2Drill is a configuration of the RDX2Fiber machine series and addresses melt-dominant laser drilling with fiber lasers. A fiber laser, a drilling process head (fixed optics) and a fast xyz axis system for positioning workpieces under the process head ensure highly productive drilling processes. Measuring technology in the form of a camera and a laser measuring probe enables both the precise positioning of the workpiece before drilling and the monitoring of component deformation during the highly thermal process.



Example of a laser-drilled metal sieve for a filter application. Hole diameter: 150 µm, material thickness: 1.5 mm

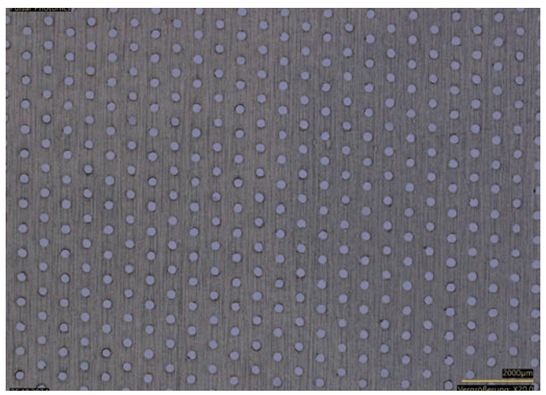


The RDX2Drill series enables the drilling of 100 to 400 micrometer holes in metallic materials with maximum precision

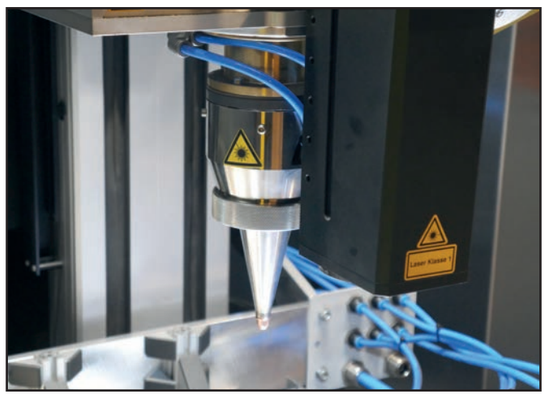
2

Production of metallic sieves
for filter applications

The RDX2Drill is designed for the production of metallic sieves and filters using melt-dominant laser drilling. The system is suitable for a wide range of industrial applications where precision is required for small holes in thick metal sheets: for example, sieves and filters for wastewater filtration, hydrogen production, recycling and energy generation.



Microscope image: Result of a QCW drilling process in stainless steel

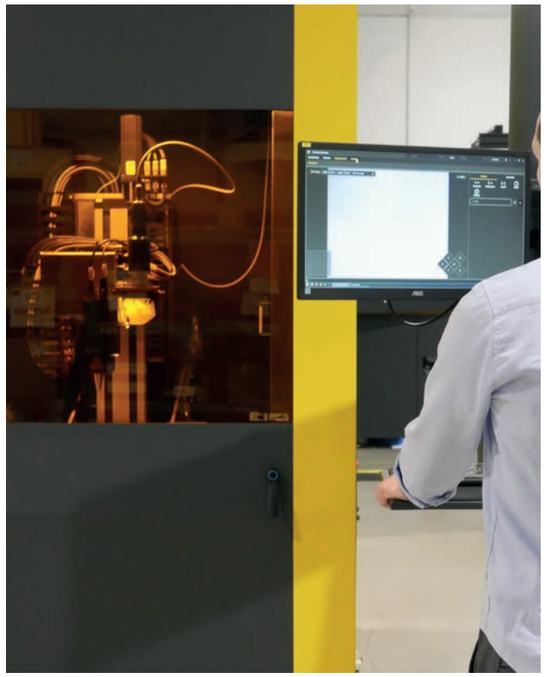


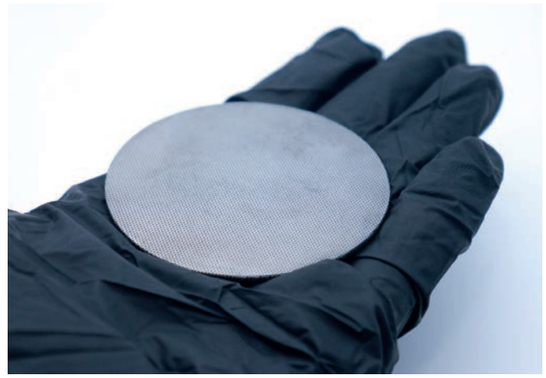
Drilling head of an RDX2Drill laser system

3

Drilling rates up to 80 Hz

QCW lasers are generally used. These have a peak pulse power in the multi-kW range, while the pulse durations are in the order of a few microseconds or often even milliseconds. The pulses have such a high pulse energy that they are suitable for single-pulse drilling. This means that drilling rates of up to 80 Hz can be achieved even with thicker sheets.





Sieve with micro-holes for a filter application

A specially developed control software enables the RDX2Drill series to laser drill thick sheets of metal sieves and filters efficiently. The digital process chain makes it easy to map product variants.

Philip Oster, Head of Laser Application Center

4

Integrated extraction unit
for removing melt particles

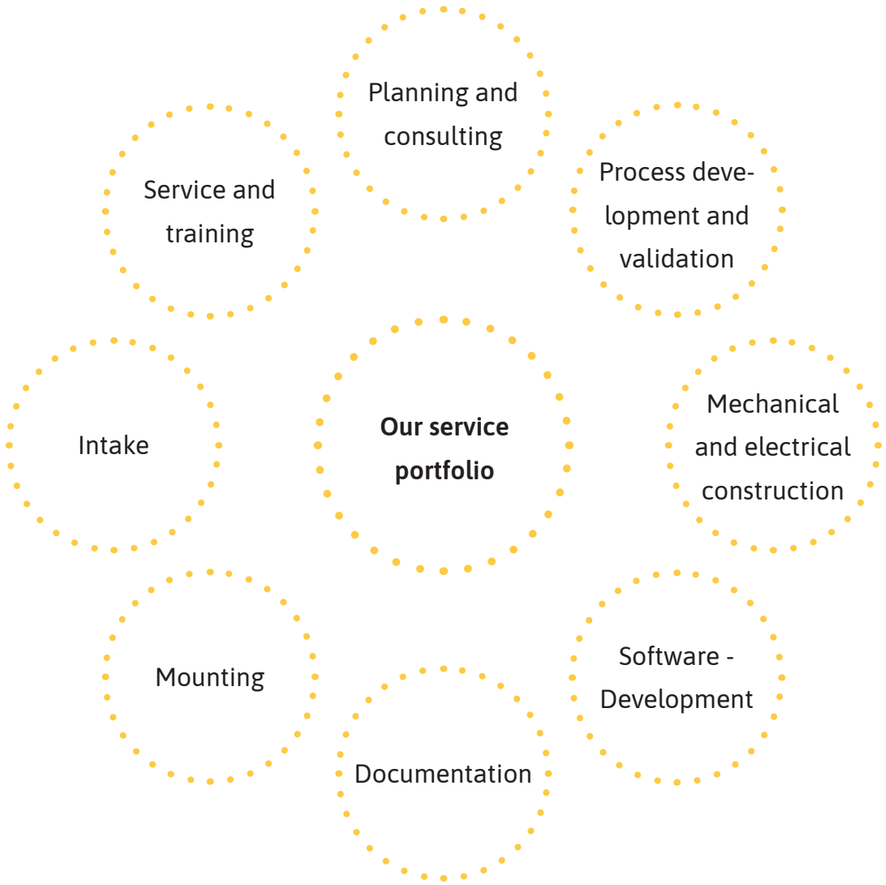
The deformation is compensated for by automatic focus tracking. The integration of an extraction system and a process enclosure above the workpiece allows melt particles to be reliably removed during processing.

Mechanical engineering solutions for your success

I am responsible for plant engineering and will be happy to advise you on the design of an optimal laser system solution for your process. I can be reached by phone and e-mail as follows:

+49 2405 495-04-20
machines@pulsar-photonics.de

Louisa Draack,
Technical sales plant engineering



4. Service

Optimal service for your requirements

Service is a top priority at Pulsar Photonics. Do you have a laser processing system from us? Our Service Team will help you with all questions and problems concerning our laser machines. With the help of our service portal you can easily send your inquiries to the service department. Our Team Service will process your inquiries and will be happy to help you.

In addition to the various service offers such as plant maintenance or operator training, our customers can also arrange an individual service contract with us.

We are happy to support you and keep your production running!

Our reliable services

We offer our customers a comprehensive range of different services. In addition to the ‚classic' on-site and remote service, we also offer training courses. Do you want to upgrade your system? We are also happy to support you in this. Our Pulsar Academy offers you the possibility to dive into the world of laser technology.

1

On-site service for existing customers

We are happy to support you on site. With our own fleet of vehicles, our service team can reach you quickly. Our qualified personnel is trained in troubleshooting and helps you to keep your plant in operation. We do not only support you in troubleshooting, we also gladly take over the maintenance of your plant for you.

1.1

Plant maintenance

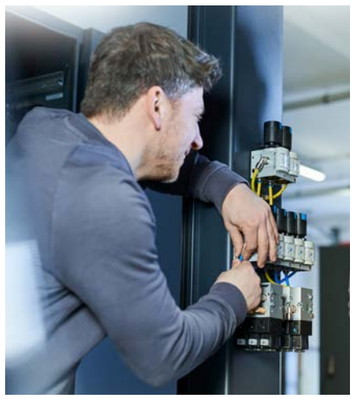
In addition to on-site troubleshooting, we also take care of the maintenance of your plants. Based on an individual maintenance plan, we take care of your plant, check the functions of the individual components and carry out adjustment work. With a regular change of wearing parts, especially for handling systems, we can guarantee the reliability of your plant. A special focus of the regular maintenance is the inspection of the safety and protection devices and a safe operation of the plant.

1.2

Machine relocation

New premises or a changed material flow can make a machine move necessary. We help you to move your laser system and support you. In addition to the dismantling and transport of the system, we also take care of the recommissioning. Please contact us. We are at your disposal for any questions.

On-site service for your laser systems



Professional maintenance:
focus on reliability and safety

1.3

Plant/operator training

Do you have new personnel or would you like to expand existing knowledge of plant operation, maintenance and cleaning? We are happy to be there for you. Our team will come to you and conduct application-oriented training at your site.
We will put together an individual training program tailored exactly to your needs. Our goal is to train your employees to become professionals in the operation of your specific equipment. The scope of the training can be flexibly coordinated and defined by you in terms of time. We adapt to your needs so that the training optimally fits your requirements.

After completing the training, your employees will receive a training certificate attesting to the knowledge and skills they have acquired. This certificate serves not only as recognition for their participation, but also as proof for you as a company.
Our training courses are practice-oriented and application-related. We attach great importance to ensuring that your employees not only acquire theoretical knowledge, but can also apply it in the real working environment. Our training managers are at your employees' side and support them in the practical implementation of what they have learned.

Feel free to contact us to learn more about our customized training programs. We look forward to empowering your employees and making you experts in your equipment.

1.4

Spare parts service

The spontaneous failure of components, especially in interlinked machines, leads to major burdens in industrial production due to material jams and production downtime. These failures cannot be completely ruled out despite predictive maintenance and thus represent an operating risk that must be taken into account. All the more important then is the quick access to the machine, the identification of the affected component and the short-term availability to the listed and stocked spare part.

A high stock of standard components within the RDX machine platform basically ensures a high availability of spare parts and a short downtime. A contingent of control cabinets, operating terminals, PCs, machine doors, guides, extraction systems and many C-parts such as filter inserts, fans, solenoid switching valves, etc. is available here.
In addition to these RDX common parts, Pulsar Photonics has a spare parts inventory of reserved optical spare parts and system technology components for service:

- Beam delivery components with mirror substrates
- Polarizers and focusing lenses
- Camera systems
- Separate spare parts packages are coordinated, tested and stocked for high requirements and critical customer-specific components, these include:
- Customized products with long delivery time
- Wear parts of handling systems
- Scanning systems and special optics
- Laser beam sources, etc.

Together we will find a solution for your concern

1.5

Use of measurement technology

Our wide range of measurement technology enables us to support you in various areas. In addition to common measurements such as caustic and power measurements, we also offer special equipment for pulse duration measurements, thermography and X-ray emission measurements.
n addition, we have an extensive range of measurement technology for component testing. This allows us to test components for various parameters such as dimensional accuracy or surface finish. Our measurement technology enables an accurate analysis and evaluation of the components to ensure that they meet the required standards and quality requirements.

Another important area in which we can support you is occupational safety. Our specialists are able to perform optical sound level measurements and advise you on compliance with the relevant safety standards. Especially in connection with ultrashort pulse laser processing, radiation protection is of great importance. Our employees are specially trained in radiation protection, have carried out the official registrations in a practical manner and can advise you on the subject of X-ray protection at your UKP system.

What measurement do you need? Our experienced team is available to discuss your needs and provide you with customized solutions. Whether you need to optimize your laser technology, test components or ensure occupational safety, we will support you and provide you with high-quality measurement results.

We also support our customers in the event of a machine relocation up to the point of recommissioning

We take over the maintenance of your system on site

Cleanly packaged:
Successful delivery of an RDX800 laser system

2

Remote Support

To provide you with fast and efficient support, we have the ability to connect remotely to your plant. This allows us to access your plant directly and perform a comprehensive evaluation. In addition, with the help of the camera systems in your processing room, we can perform simple tests and make an initial analysis of the error pattern.

The remote connection enables us to respond promptly to any problems that arise and offer solutions without having to be on site. This saves you valuable time and reduces potential downtime of your plant. Our experienced team performs fault diagnosis and provides you with targeted troubleshooting instructions.

Remote support enables effective communication between our experts and your on-site team. We can work together on the solution and ensure smooth operation of your plant. We are ready to help you quickly and efficiently and ensure that your plant is running optimally.

2.1

Distance learning: flexible & efficient

We offer you the possibility to support plant and operator training remotely. Our experienced training team is able to use screen sharing and video transmission to ensure that all necessary information can be shared and your questions answered directly.

If you are interested in remote training or would like more information, please do not hesitate to contact us. We are available to discuss your requirements and find a customized training solution that meets your needs.

3

Our certified quality standard

High quality is what we demand of our products and services. It determines our daily work. The quality management system of Pulsar Photonics is certified according to DIN EN ISO 9001:2015. We are always striving for continuous improvement and also welcome your feedback.

Zertifiziert nach DVS ZERT ISO 9001

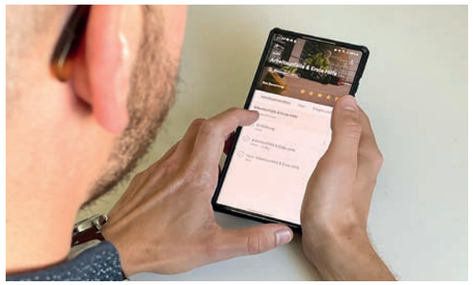
Laser technology made easy. The Pulsar Academy

Pulsar Academy

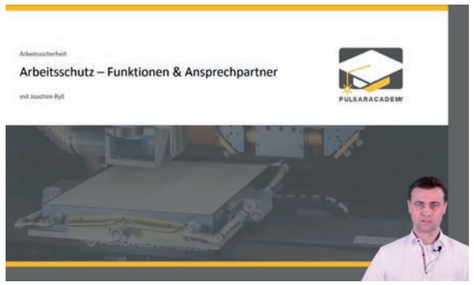
Welcome to the Pulsar Academy - immerse yourself in the fascinating world of laser technology! Our web-based **online learning platform** offers you a wide range of exciting courses and information opportunities on various topics related to laser technology.

In the Pulsar Academy, you will not only receive theoretical basics, but also **system-specific knowledge**. You have the opportunity to ask questions, check your learning progress and be inspired by the almost infinite possibilities of laser technology.

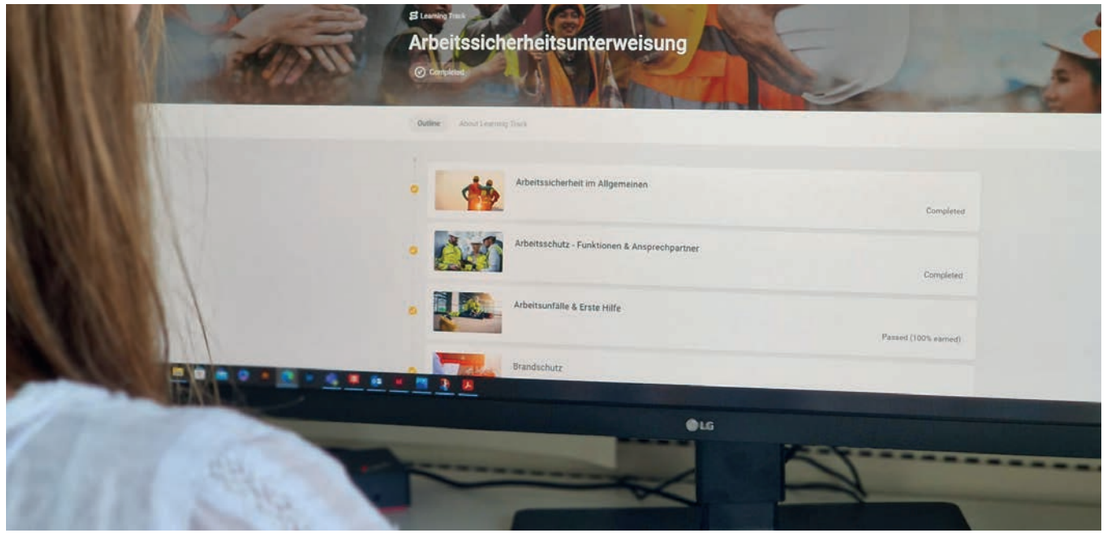
The Pulsar Academy platform offers you various content such as course descriptions, videos, presentations and learning success checks. This content is compiled into learning paths and assigned to different user groups. Each Pulsar Academy participant receives their **own access**, which can be set up individually to meet the specific requirements of each user. Through our intelligent user management, you are assigned to individual user groups and thus receive a customized learning offer.



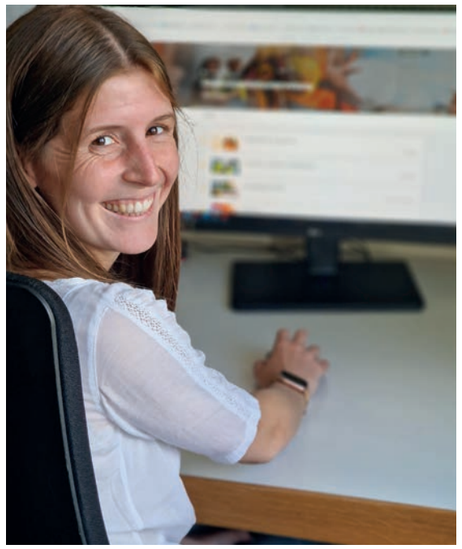
With the mobile app, learning or instruction videos can be viewed flexibly and uncomplicatedly



The learning platform offers a customized learning offer as well as plant-specific knowledge



Discover the world of laser technology interactively



The Pulsar Academy is currently used by Pulsar Photonics for various topics in the area of **occupational safety**, **onboarding**, **technical basics**, and for training **trainees** and **service personnel**. We have our own film studio and employ qualified personnel who provide editorial preparation, film editing and the provision of the educational content on the platform.

As an added benefit, we offer you the option of mobile use via app, so you can access the content anytime, anywhere. Furthermore, there is the option to integrate customer-specific content into the platform to meet your specific requirements.

Immerse yourself in the Pulsar Academy and discover the world of laser technology in an exciting and interactive way. We look forward to accompanying you on your learning journey and providing you with the knowledge you need to succeed in the world of laser technology.

Our Pulsar Academy offers you an exclusive training platform around the topic of laser technology

5. System technology

Optics solutions for your challenges

Since the beginning of the company, our goal has been to provide our customers with machine-integratable optical modules that increase the economic efficiency of laser micromachining or expand the technical limits of laser micromachining. In 2013, Pulsar Photonics' company history began with the development of the MultiBeamScanner. Since then, we have developed an extensive optics construction kit in many customer and development projects. In addition to standardized assemblies for beam guidance and beam shaping, this kit also includes the appropriate measurement technology and software. This enables us to develop industrially suitable, self-aligning optical systems for various applications. Our strength lies in the development of customer-specific laser processes with the optical modules designed by us, in order to adapt the laser technology individually to the requirements of our customers.

Which is the right optic for your production?

Optics modules in comparison

120

Massive process acceleration through parallel machining

MultiBeamScanner MBS-G4

122

The „1µm laser knife" scan objective for ultra-high resolution applications

Microscan Extension MSE-G2

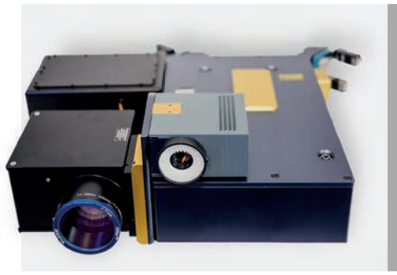
128

Customized optics modules for laser material processing

Customized optics systems

134

Our optics modules in comparison



MultiBeamScanner MBS-G4

Massive process acceleration through parallel machining

Geometric flexibility

Integratability

Suitability level for production

The MultiBeamScanner parallelizes laser processes in which periodic structures are to be produced. A diffractive beam splitting generates a fixed pattern of laser foci in the working plane, which can be moved collectively with the scanner over the workpiece.

Microscan Extension MSE-G2

The „1µm laser knife" scan objective for ultra-high resolution applications

Geometric flexibility

Integratability

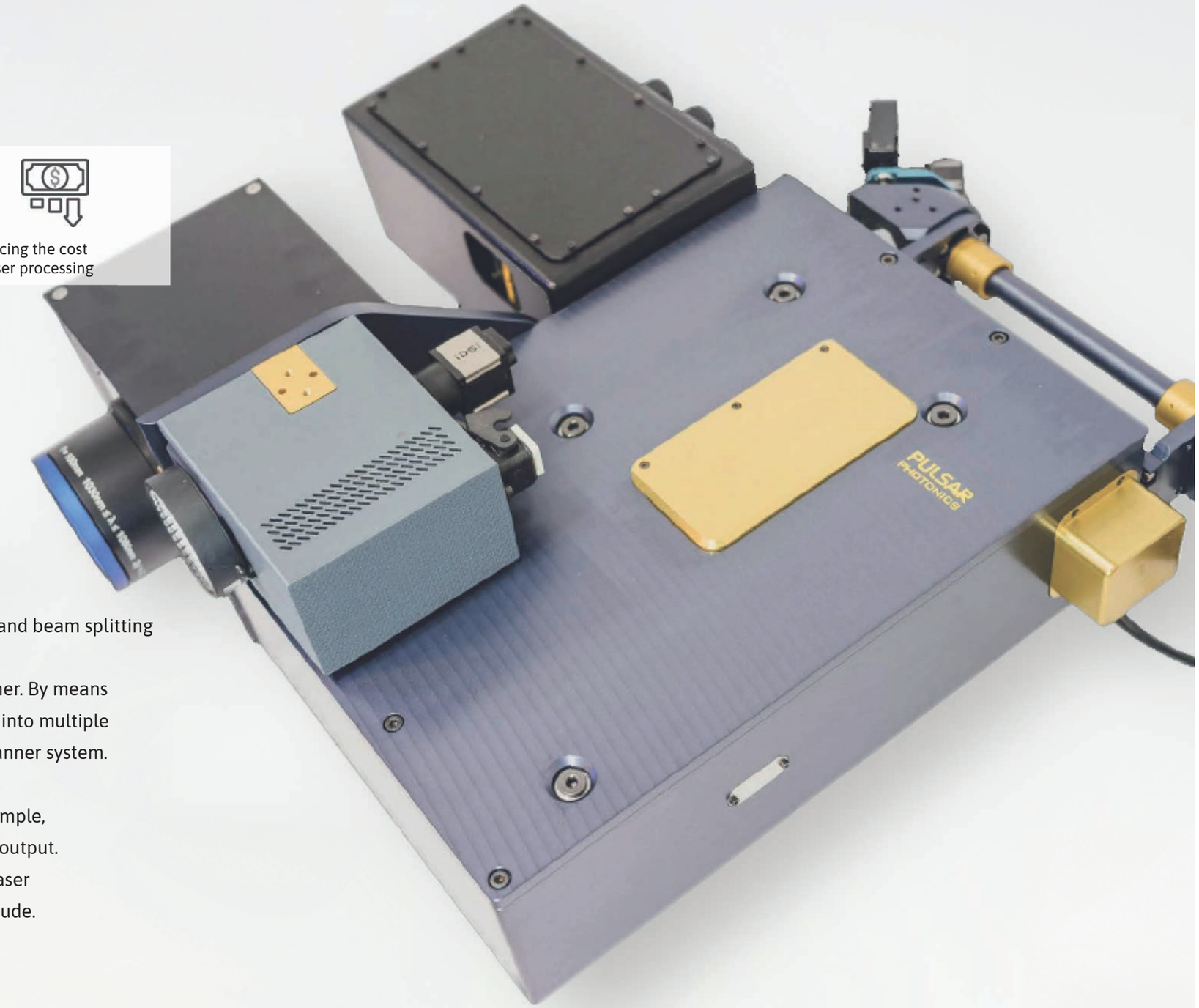
Suitability level for production

The Microscan Extension extends the resolution limit of galvanometer scanning systems by up to one order of magnitude.

With spot sizes in the single-digit micrometer range, structures can be produced down to below the sub-µm limit.

MultiBeamScanner MBS-G4

Massive process acceleration through parallel machining



- Drills up to 14,000 holes per second
- Up to 100 x faster than with a single beam
- Reducing the cost of laser processing

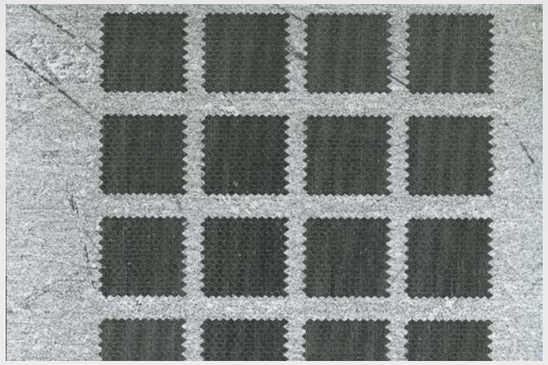
The unique combination of a precise galvanometric scanning system and beam splitting in one system makes it possible to parallelize laser cutting, drilling or ablation processes without losing the geometric freedom of the scanner. By means of diffractive optical elements (DOEs), the incident laser beam is split into multiple beams that create multiple laser spots in the working plane of the scanner system.

In this way, periodic structures can be processed in parallel or, for example, complex cutting patterns can be realized, multiplying the production output. The MultiBeamScanner is the solution to reduce production costs in laser micromachining of peridodic structures by up to two orders of magnitude.

MBS-G4

Laser drilling at high speed

Multi-beam laser processing is the ideal solution for drilling or trepanning a large number of precise holes in metal or ceramic foils by multiplying the drilling speed. With drilling speeds in the multi-kHz range, the system is ideal for large-area applications. Drilling speeds of up to 14 kHz have already been demonstrated.



Application example: Again and again, nature provides optimization approaches for challenges from industry. In the so-called sharkskin, tiny structures are introduced into surfaces in order to reduce flow resistance. Possible applications range from reducing the fuel consumption of ships to optimizing wind turbines. Pulsar Photonics is developing beam splitting optics with which such structures can be produced economically by means of parallelization.

Surface functionalization

Micro- or nanostructured surfaces can extend the functions of a workpiece by providing additional optical, hydrodynamic or wetting properties. These functional surfaces often consist of periodic structures (e.g. dimples) distributed over the surface of the workpiece.
Especially in production environments with short cycle times, the Multi Beam Scanner can reduce processing times and thus provide economical ways to achieve high-quality laser ablation.

Parallel processing of multiple parts

The unique combination of precise galvanometric scanning and beam splitting in one system allows to multiply laser cutting, drilling or ablation processes without losing the geometry freedom of the scanner. For example, multi-part parts can be processed in parallel or complex cutting patterns while simultaneously multiplying the production output.

Technical overview

Dimensions

- Max. Dimensions: (L x W x H): 638 mm x 586 mm x 185 mm
- Addressable area with DOE: Max. 5 mm x 5 mm @ f = 100 mm

Galvanometer scanner

- Manufacturer: e.g. Scanlab, Newson, Raylase
- Spot distributions: e.g. 2 × 2, 4 × 4,... 8 x 8, free distributions

Laser

Wavelengths:
- IR (1030 - 1070 nm)
- VIS (515 nm/532 nm)
- UV (343 nm - 355 nm)

Suitable pulse lengths:
- Nanosecond / picosecond / femtosecond
- Max. Power: 150 W
- Max. Pulse energy: 1 mJ @ 1 ps

Functions:
- Masking of higher orders
- Integrated beam position stabilization to ensure alignment
- Beam distribution rotation
- Fine adjustment of the spot distance
- Switching between single-beam and multi-beam processing

Spot position error in the center of the scan field:
- < 3 µm @ f = 100 mm

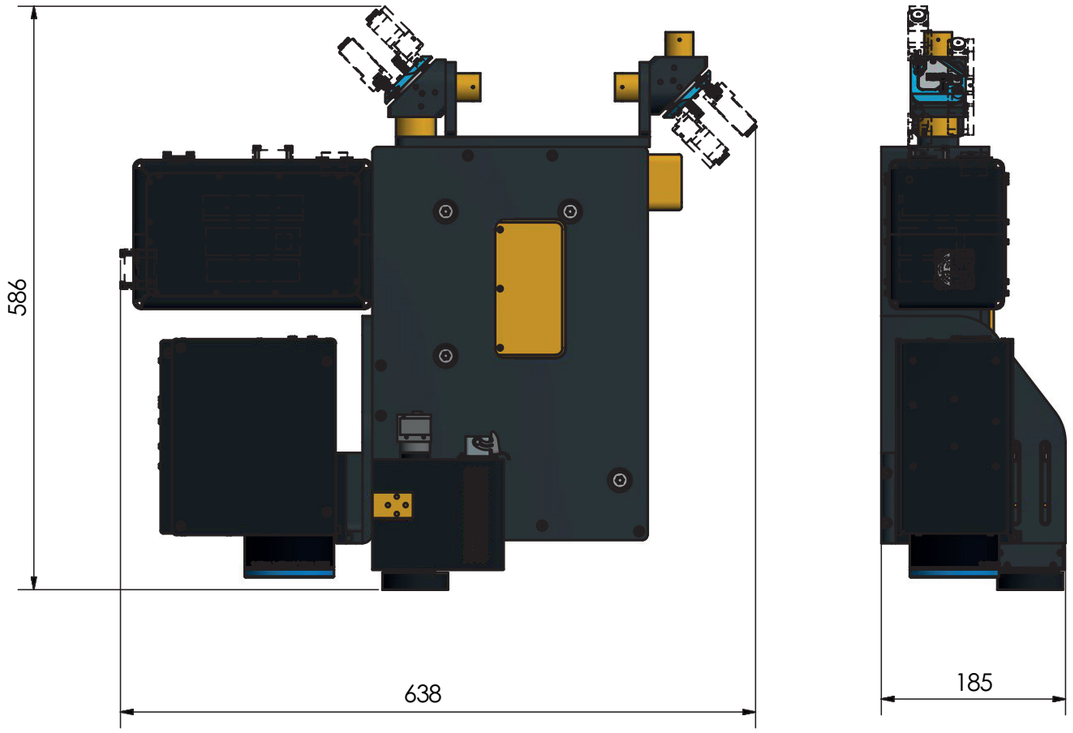
Additional options

- Ext. camera system for intensity measurement

Control software: Photonic Elements

- Software for setting, calibration and control of the system
- Camera-based adjustment and calibration

Technical drawing



Microscan Extension MSE-G2

The „1 µm laser knife“ scan objective for ultra-high resolution applications

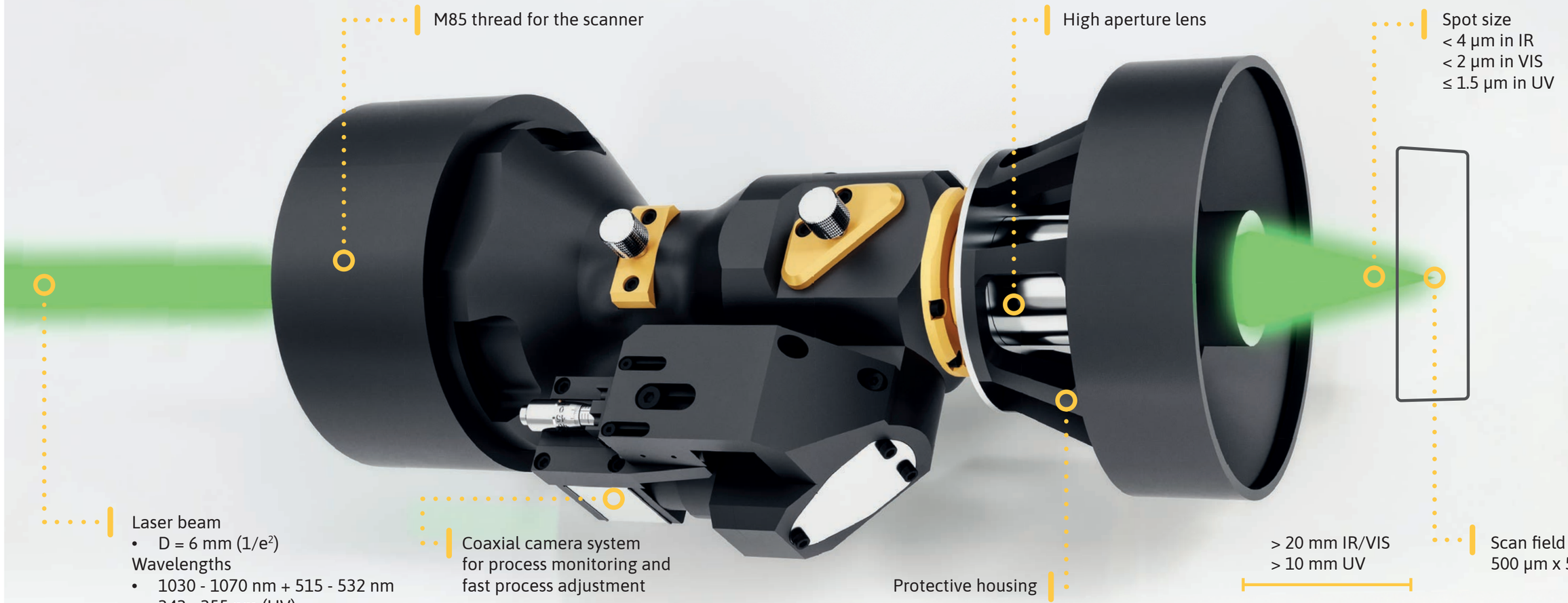
Spot diameter
up to 1 µm in UV

Expand your machine
to a Microscan system

compatible with a wide range
of galvanometer scanners

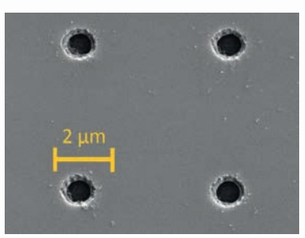
With the Microscan Extension MSE, Pulsar Photonics offers a simple but powerful extension for any galvo scanning system. By simply replacing a conventional scan lens with the MSE-G2, users can convert their machine into a microspot scanning system. The combination of the galvanometer scanner and MSE-G2 enables high-precision processing with a focus diameter of less than 4 µm. This enables the production of the smallest structures with unsurpassed accuracy and detail. We offer the system for IR, VIS and UV wavelengths.

MSE-G2



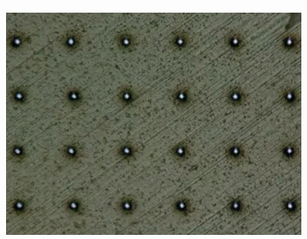
Application examples

Production of micro apertures



Microapertures with diameters
down to 1.6 µm

Microdrilling of thin foils

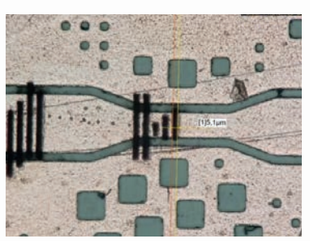


High-precision drilling with
diameters close to the sub-µm range

High resolution micro marking

High resolution QR code
with dimensions 300 µm x 300 µm

Electronics repair – microablation



Creation of isolation trenches
in electronic circuits

Technical overview

Dimensions & Mechanics

- Max. Dimensions: (L x W x H): 245 mm x 145 mm x 120 mm
- Working distance: > 20 mm (IR/VIS), > 10 mm (UV)
- Scanning field size: typ. 500 µm x 500 µm
- Mounting thread: M85 x 1 (standard galvo scanner) Integrated collision protection

Product versions

- IR/VIS version: MSE-G2 IR (1030 - 1070 nm) + VIS (515 nm - 532 nm)
- UV version: MSE-G2 UV (343 - 355 nm)

Optical properties

Spot sizes (for laser beam source with $M^2 < 1.3$):

- IR + VIS version:
  - < 4 µm in IR
  - < 2 µm in VIS
- UV version:
  - < 1,5 µm

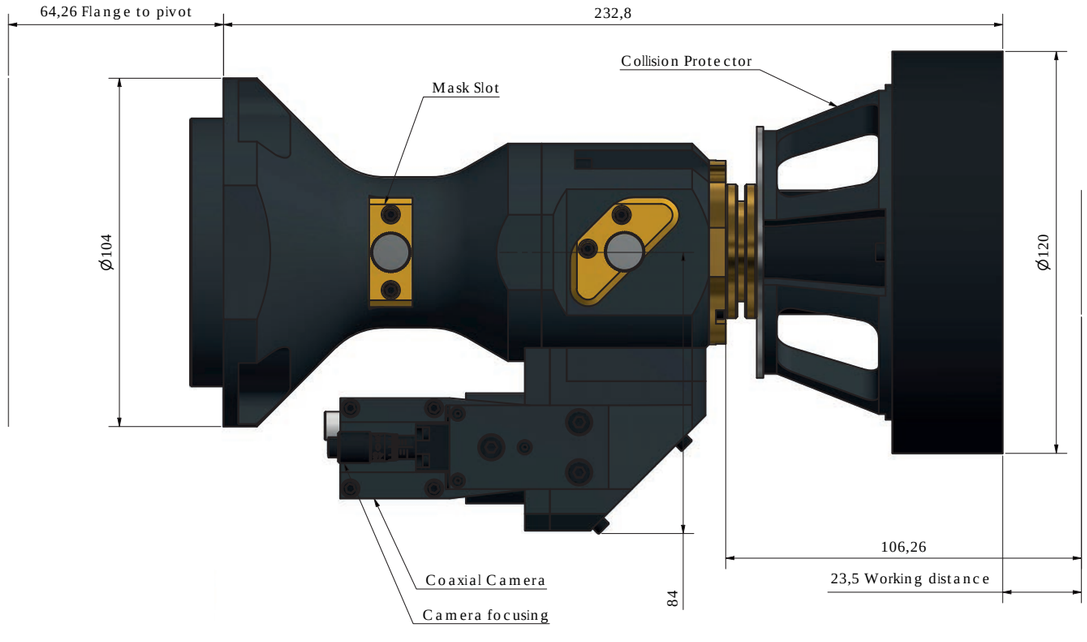
LIDT coating

- @ 355 nm; 10 ps [mJ/cm²] < 0,5 LIDT coating
- @ 532 nm; 10 ps [mJ/cm²] < 3 LIDT coating
- @ 1064 nm; 10 ps [mJ/cm²] < 6
- Only suitable for low medium laser powers and pulse energies

Metrology

- Integrated coaxial camera
- FOV: > 500 µm x 500 µm
- for fast process setup and lateral as well as axial alignment of the focus position

Technical drawing



Customized optics systems

Customized optics modules for laser material processing

Customized optical modules for your applications

Pulsar Photonics develops and produces optical systems for laser material processing. Based on many years of experience in beam shaping, optical design, metrology, construction and process development, Pulsar Photonics creates machine-integrated optical modules that perform complex dynamic beam shaping tasks.

We develop systems for guiding and shaping laser beams and for process-specific procedures. Pulsar Photonics uses a self-developed modular system for this purpose, with which complex optical systems can be easily assembled and built. Module-integrated measurement technology supports beam alignment and leads to a stable beam position even in high-end applications.

Our service for you

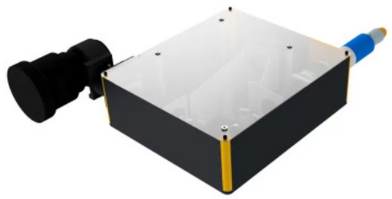
- Concept studies for the design of optical systems for laser material processing
- Optical design for beam shaping systems, especially multi-beam systems
- Mechanical design of optical modules
- Integration of measurement systems
- Software development for module control
- Characterization and process validation of optical systems

Applicable technologies

- Diffractive optics
- Spatial light modulators
- Acousto-optics
- Spherical optics
- Scanning systems

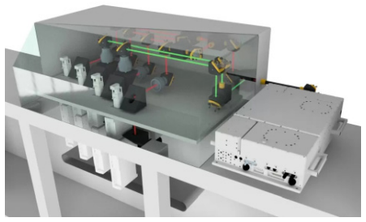
Customized optics systems: Examples

DynamicBeamShaper (Ultrasurface)



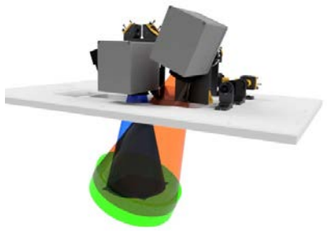
Processing head for dynamic beam shaping in laser scanning with multi-kW-cw lasers based on diffractive beam shaping in combination with a deformable mirror.

Multi-jet system for roll-to-roll processing (MBS-LA)



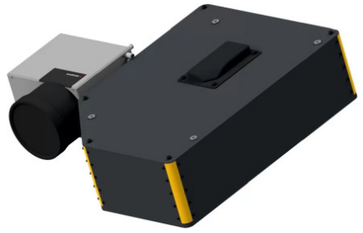
Optics module for massive parallelization of structuring processes for roll-to-roll processes, where the laser beam is distributed to four scanner systems and split into partial beams by means of diffractive elements.

Multi-scanner system for process-synchronized workpiece irradiation (ATSM)



Optical module with two combined galvanometer scanners and a focus shifter to compensate for field tilt.

MultiBeamScanner with dynamic distortion correction (MBSS)



Multi-beam scanning system with dynamic distortion correction for imaging larger scan fields during multi-beam processing.

This is how we take care of your request

Your request

We determine together what kind of special optics you need (e.g. micro-machining, special beam shape, multi-steel machining)

feasible with standard components?

yes

We have a large repertoire of components with which the majority of laser manufacturing processes can be mapped.

no

Test of optics and sale

Within days you can test and purchase the proposed special optics in your laser facility.

Development-project

If your requirements call for a customized special optics, we start with the development of the optical system, the software and the manufacturing process – from initial modeling to final assembly and commissioning.

6. Software

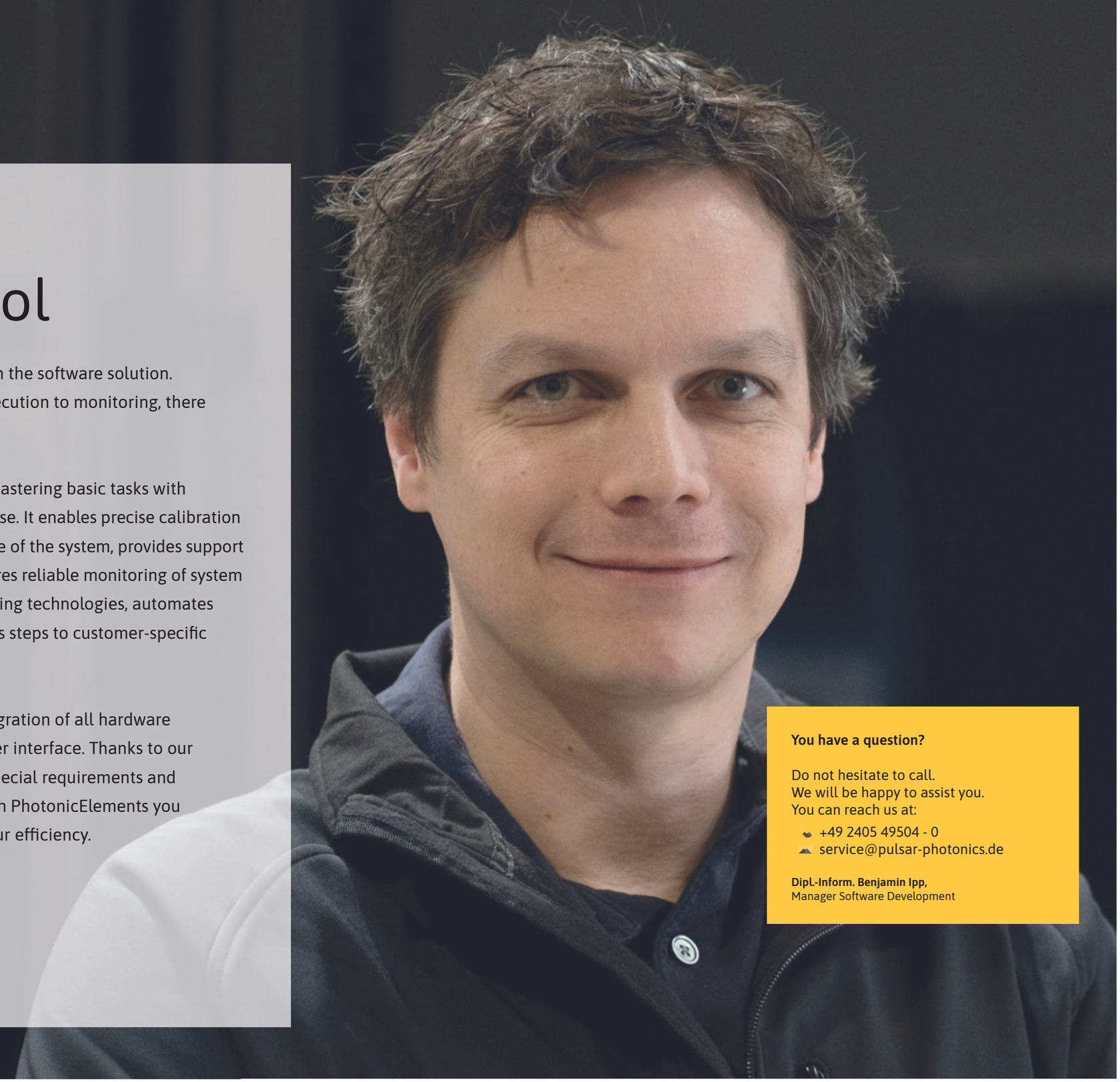
Photonic Elements: Intuitive laser control

The control of laser systems requires a high level of performance in the software solution. Beyond the basic requirements such as laser process setup and execution to monitoring, there are many more specific challenges that need to be addressed.

Our software, PhotonicElements, stands out in this area, not only mastering basic tasks with flying colors, but also handling more complex requirements with ease. It enables precise calibration and positioning of workpieces, ensures calibration and maintenance of the system, provides support for the setup and configuration of hardware components, and ensures reliable monitoring of system and process safety. In addition, it integrates modern image processing technologies, automates processes and allows individual adaptation of modules and process steps to customer-specific production environments.

With our modular software approach, we ensure the seamless integration of all hardware components and individual requirements in a uniform, intuitive user interface. Thanks to our flexible architecture, we can react quickly and cost-efficiently to special requirements and customer wishes and thus always keep our finger on the pulse. With PhotonicElements you get a software solution that masters complexity and maximizes your efficiency.

Your **Dipl.-Inform. Benjamin Ipp**, Head of Software Development



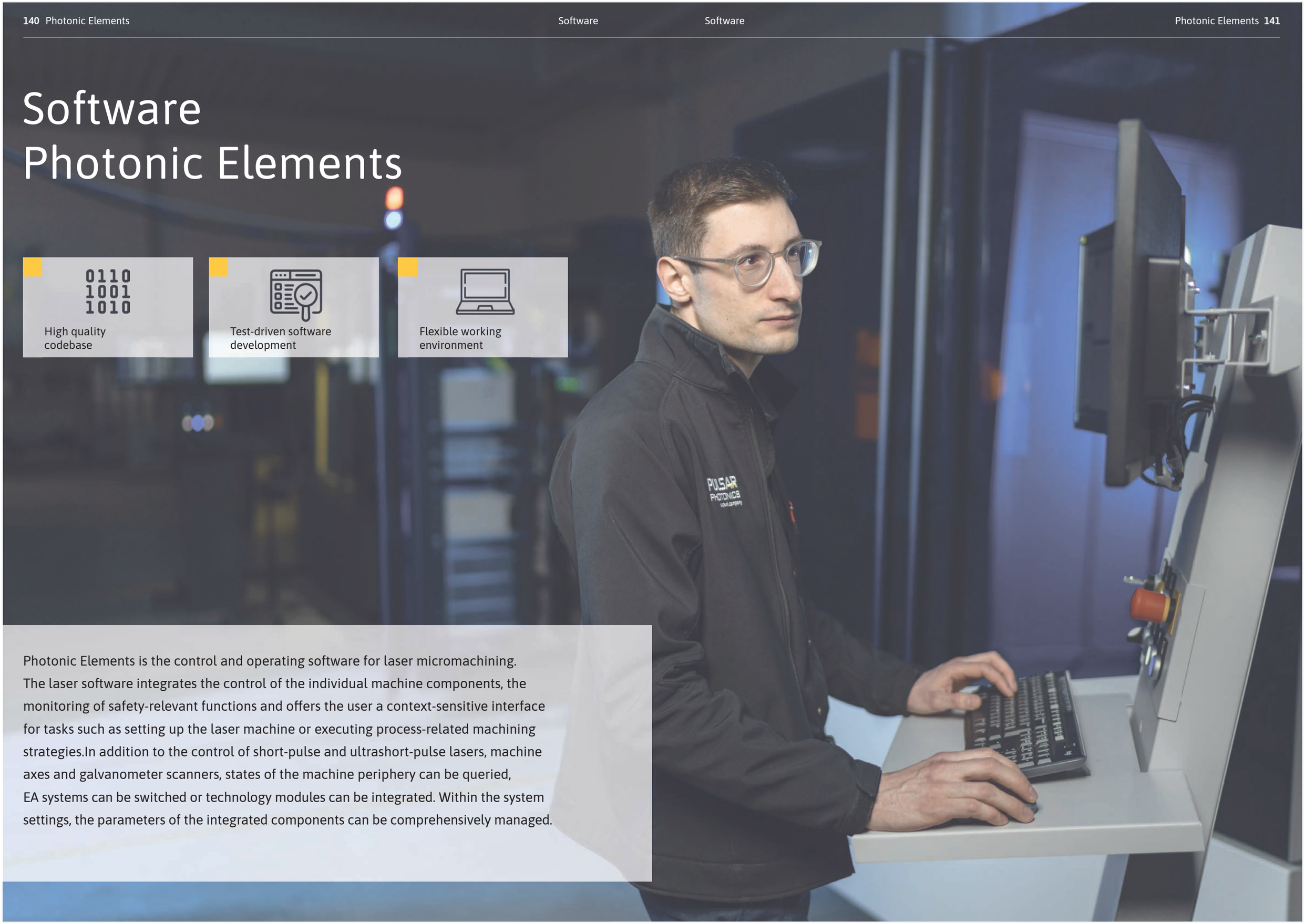
You have a question?

Do not hesitate to call.
We will be happy to assist you.
You can reach us at:

+49 2405 49504 - 0
service@pulsar-photonics.de

Dipl.-Inform. Benjamin Ipp,
Manager Software Development

Software Photonic Elements



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High quality codebase

Test-driven software development

Flexible working environment

Photonic Elements is the control and operating software for laser micromachining. The laser software integrates the control of the individual machine components, the monitoring of safety-relevant functions and offers the user a context-sensitive interface for tasks such as setting up the laser machine or executing process-related machining strategies.In addition to the control of short-pulse and ultrashort-pulse lasers, machine axes and galvanometer scanners, states of the machine periphery can be queried, EA systems can be switched or technology modules can be integrated. Within the system settings, the parameters of the integrated components can be comprehensively managed.

Photonic Elements

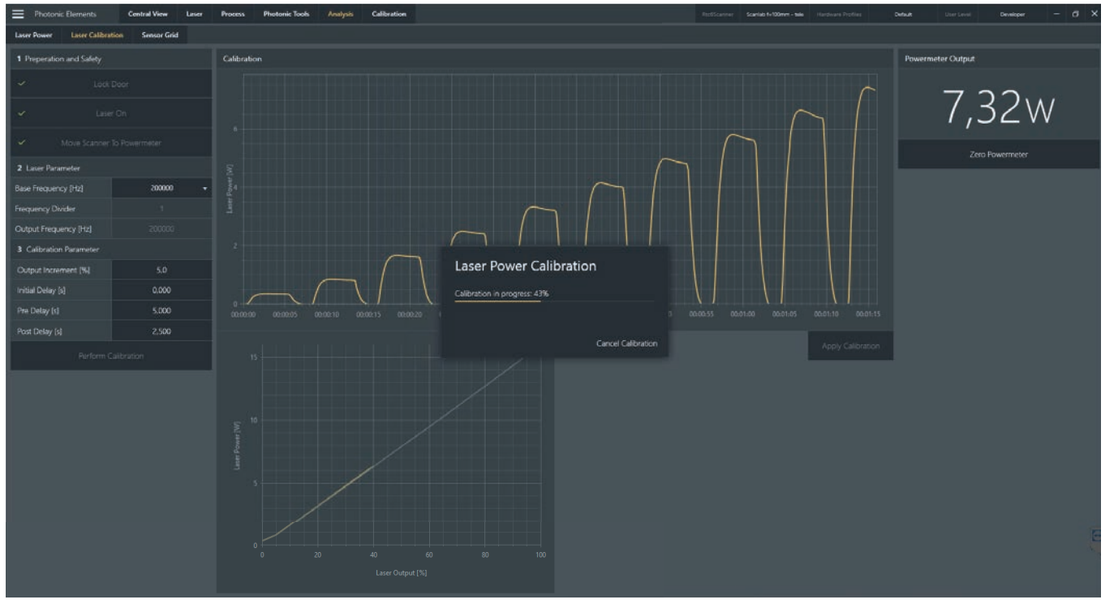
What is Photonic Elements?

With Photonic Elements' intuitive, modern user interface for laser system control, we offer you a solution specifically designed to meet the most demanding industrial laser machine requirements.

We have made it our mission not only to give you comprehensive control over your laser systems, optical modules and measurement technology, but also to provide a uniform and consistent user experience. Regardless of the different hardware modules and their specific functions, you can be sure that you will always encounter familiar terrain in menu control and design. This ensures a high level of recognition and efficient operation, even if you should change your hardware configuration.

Our software includes a number of powerful standard modules: The control of short-pulse and ultrashort-pulse lasers, a CAD-CAM process editor and I/O interfaces for monitoring safety and process-relevant functions are part of Photonic Elements' basic offering. The core is formed by hardware modules around the scanner control. This is responsible for the highly dynamic and precise process control. We invest in development to deliver highly professional technology and are in close exchange with OEMs for this purpose.

But Photonic Elements is more than just standardized software. Its strength lies in its flexibility and adaptability. We develop and design individual production interfaces that are specifically tailored to your requirements and workflows. In addition, we offer the possibility to develop and implement customer-specific solutions for special requirements. Photonic Elements provides you with laser control software that is not only powerful and reliable, but also adapts to your needs.



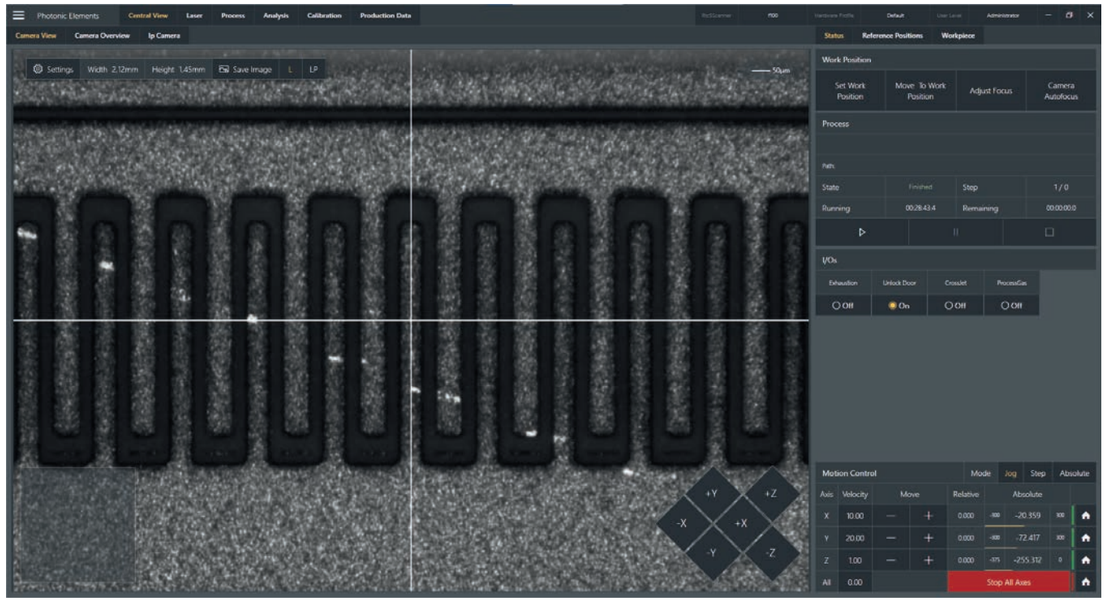
Continuous calibration of the laser power: A calibration curve is created for a specific set of parameters and stored in the database

Everything in view and under control

With Photonic Elements, you have a firm grip on machine control in contract manufacturing while enjoying unprecedented control over your laser equipment.
Our central view, specially optimized and with large camera image, enables efficient process preparation, precise workpiece alignment and direct visual assessment of process results. Supported by our automated routines, Photonic Elements ensures a seamless equipment setup process, speeding up process preparation.

In the intelligently designed workpiece calibration, you measure workpieces by defining shapes such as circles, rectangles and lines. This flexibility makes it easier to align workpieces with large dimensions and saves you valuable time. You can also save individually named „reference positions" to approach recurring positions quickly and efficiently.

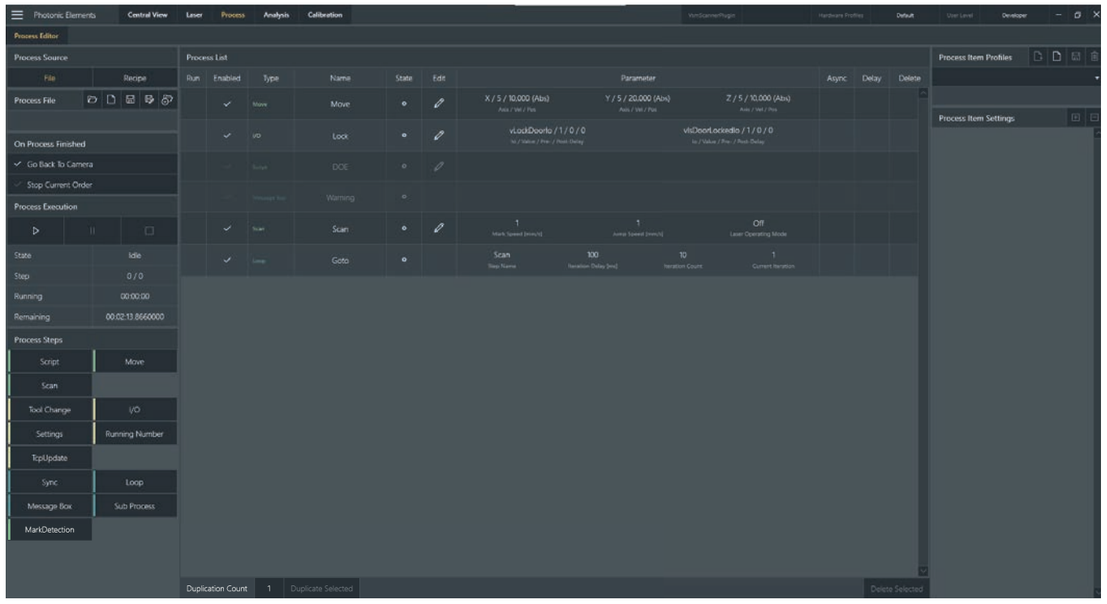
Photonic Elements is characterized by outstanding adaptability. Adapt parts of the central view to your specific requirements without any programming effort, for example to switch important outputs manually or to keep certain input values always in view. The intuitive interface allows you to start, stop or pause processes while the camera image remains visible.



The central view for process preparation and inspection. The process can also be started directly from this view

Thanks to the integrated **CAD-CAM process editor**, you can seamlessly combine individual steps into a complex overall process. Whether moving axes, switching I/O interfaces or defining scan geometries - Photonic Elements makes it easy. Managing tool offsets, scan lenses, speed parameters and the general machine configuration becomes child's play.

For specialized requirements, Photonic Elements offers the possibility to program production recipes using scripting. This allows you to design your processes entirely according to your needs. Photonic Elements is your reliable partner for unsurpassed control and flexibility in laser system control.

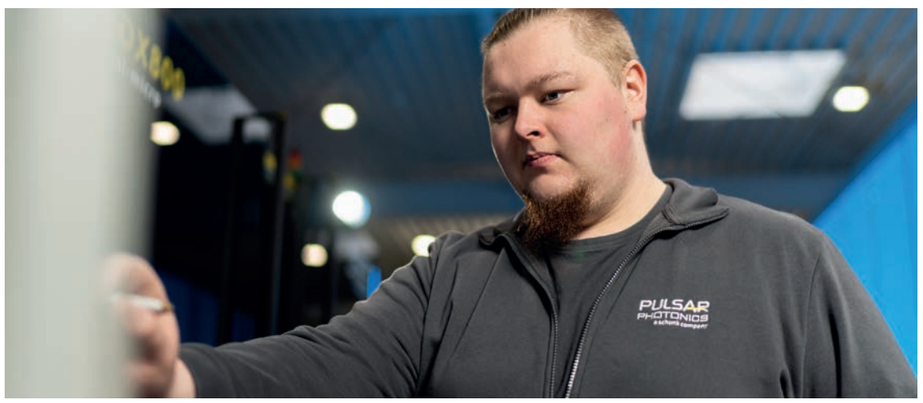


The process editor with drag & drop function. All process steps with the associated settings are clearly managed

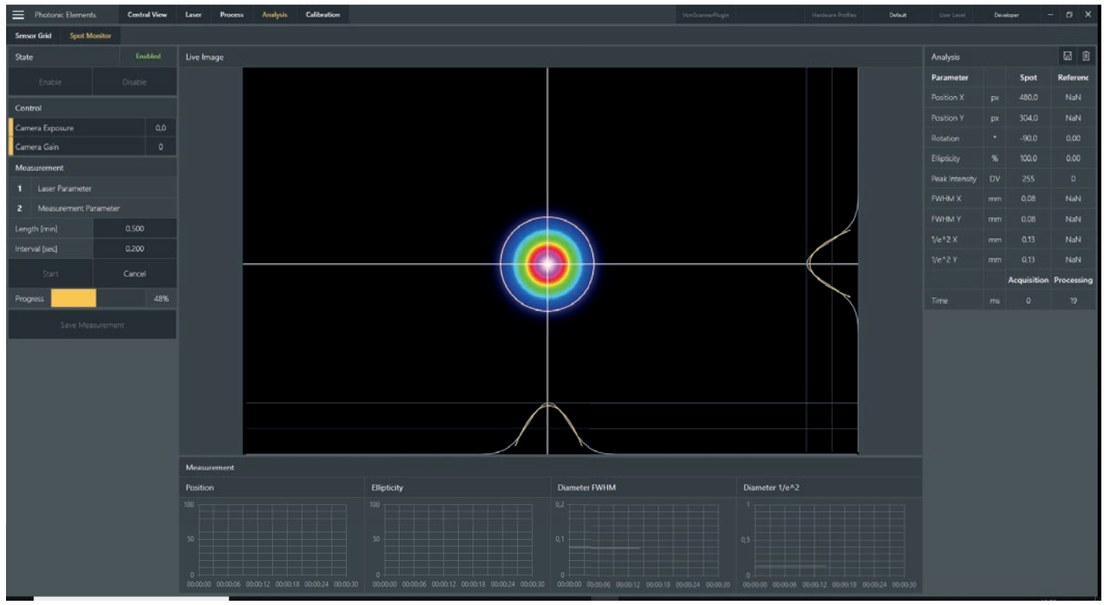
Flexible extensibility

Our software has already been designed with future developments in mind. Due to its modular design, Photonic Elements can be easily extended with additional functions. Whether you want to monitor and correct the beam position of your laser source, measure and calibrate laser power, integrate topographic sensors for precise workpiece gauging or evaluate process results - Photonic Elements is your solution. We also support integration with customer-specific ERP systems, enabling a holistic process landscape.

We believe in interoperability and openness. Therefore, Photonic Elements enables the connection of external software via our programming interfaces. Access sensor data, query the process status or control the process yourself right away. Our interfaces are defined and documented in a machine-readable way according to the OpenAPI standard to enable the use of code generators for numerous programming languages. This means that PhotonicElements can be easily extended with your own software, giving you the highest possible flexibility. With Photonic Elements, you are always in control and remain flexible, while at the same time fully exploiting the possibilities of your laser systems.



Photonic Elements has a clear and easy to use interface



View of the „Spot Monitor“ component for analyzing the beam profile (position and characteristic values)

Our software development: innovative, adaptable & quality-oriented

Our software development: Innovative, adaptable and quality-oriented. In software development at Pulsar Photonics, we take a **forward-looking approach** by combining agile and classical methods. This allows us to keep our finger on the pulse by providing new features and updates and responding efficiently to project changes. At the same time, we always keep our long-term goals in mind regarding further development.

Our software remains constantly at the **cutting edge** of technology, supported by the latest programming languages. At the same time, we are constantly working to improve the flexibility and expandability of our software in order to adapt it optimally to the needs of our customers. When developing new modules and integrating new hardware, we rely on proven programming paradigms such as SOLID and GRASP to ensure the modularity and extensibility of our software.

For us, **high software quality** is not a luxury, but a matter of course. That is why we use the 4-eyes principle when merging program code and carry out intensive unit and integration tests. PhotonicElements is the software solution that is constantly kept up-to-date, adapted to your needs and meets the highest quality standards.

Intuitive and modern: our software is integrated in every Pulsar plant

Our network: Synergies for innovation

Regional network for rapid growth - joint projects and benefits for our customers

LASER.region.AACHEN: Together innovative into the future!

Let's network – We are an official partner of the Laserregion Aachen. The innovation cooperation for laser-based production technologies, LASER.region.AACHEN, is an Aachen-based association of partners from industry, research and society with the aim of developing new products, processes and services.

By bundling know-how in the field of laser production in the Aachen region, new technologies as well as training and career opportunities are created together. The cooperation of laser technology companies and inventive suppliers with leading universities and research institutions offers optimal opportunities for this. For the region, this results in an active and sustainable shaping of structural change, while the partners benefit from ideas and synergies as well as new products and combination possibilities. The people in the region will gain numerous new jobs and increase their attractiveness and prosperity.

Customers benefit from bundled expertise, rapid solution finding and sustainable implementation by local providers.

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Further information

The UKPL – Innovation Network

UKPL technology: Together for innovation and progress – the gecko as a network symbol

Promotion of UKP technology as a key technology

Pulsar Photonics is one of 29 partners in the world's largest innovation network promoting UKPL technology. Although ultrashort pulse laser technology initially struggled to gain a foothold in commercial material processing applications, it has since developed strongly and plays an important role in certain niches.

Companies active in areas such as semiconductor manufacturing, precision cutting of glass or the production of microbores for nozzles have recognized the advantages that the use of ultrashort pulse laser technology offers in terms of competitiveness and efficiency. For high-tech applications, it is impossible to imagine manufacturing processes without UKPL technology. The goal of the network is to initiate the emerging path to success for UKP processing and to further promote it with the help of all partners, the federal government and the EU. The network creates awareness and security in this subject area.

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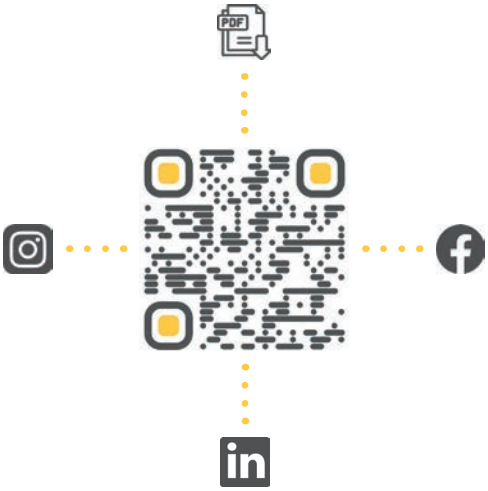

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