



Enlightening the industry

Microlenses from technology leader

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“If there’s a way
to do something better: find it.”

Thomas Edison

One of the biggest and most important challenges facing our world is climate protection. Photonics and its innovations can make an important contribution to this. They make it possible to improve air quality, control the control particulate matter and save climate-damaging CO₂.

According to the German industry association Spectaris, the use of photonic technologies already reduced CO₂ by around 1.1 billion tons in 2021. A further reduction of three billion tons is forecast by 2030, which corresponds to approximately 11 percent of the agreed CO₂ reduction targets of the Paris climate protection agreement.

Light-based products and applications can promote sustainability in many everyday and industrial areas, making production processes more efficient and reducing energy consumption and associated emissions. Optical technologies are already being used to improve air quality and increase the yield of wind turbines and solar panels, to name just a few examples.

GD Optics also wants to contribute to promoting climate protection directly and indirectly. On the one hand, by setting the highest standards for the energy efficiency and sustainability of our production, and on the other hand, also for the way the products we manufacture work.

With our new plant, we are taking a major step in this direction. Not only by expanding our production capacities while increasing energy efficiency, but also by optimizing our processes, such as the production of (micro)lenses in the clean room.

Our goal is to pave the way for new effective applications in industry, production and technology with customized photonic developments - and thus to change our world in a positive way. We work on this every day with the highest motivation, all our knowledge and our concentrated innovative power.

Where do you need optimization, what would you like to change or improve? We look forward to supporting you in your goals and challenges with our problem-solving expertise.



Yours Winfried Czilwa
Managing Director

GD Optics is one of the world's leading companies in the field of optical technologies.

Our core competencies lie in our innovative strength and the production of micro optics with radii of curvature and free apertures of the lenses below 0,2 mm.

Light in progress

Enabling Technologies for the industry

The history of our company is firmly linked to the development of modern industry. As a manufacturer of innovative photonic components, we have been pioneering innovations in mechanical engineering, production and electrical engineering as well as information and communication technology for many years.

We support complex development processes with seamless consulting, from conception to planning and manufacturing. We have many years of experience in developing technological solutions for a wide range of industries, whether sensor and measurement technology, energy and laser technology, automotive and safety technology or LiDAR.

Thanks to our flexible production processes, lenses of various geometries can be manufactured in a very short time, whether round or square or in other complex shapes. These can then be coated with optical coatings on request.

Development depth and manufacturing competence

What particularly distinguishes us is not only the know-how and experience to develop real innovations, but also the manufacturing expertise to produce them with consistent functionality. Thanks to our flexible production lines, we achieve the maximum in quality and cost efficiency for our customers - whether it's small quantities or large-scale production. No matter if products with extreme tolerances e.g. biconvex lenses or microlenses with maximum miniaturization or standard - we realize a fully scalable reliable production just in time.

With our competence for new developments we set standards on the markets of today and tomorrow. Research and development play a key role in our corporate strategy, as for example in our successfully completed research project EFFICIENTlight which aims at a drastic cost reduction in monomodal fiber-chip coupling.

Work in progress

The most important pillar of our company is the continuous improvement of our processes and procedures. Starting with the expansion and optimization of our non-isothermal rod molding process through progressive automation, through the increasing diversity of lens assemblies and the progressive optimization of surface qualities, to new processes for tool coating.





We create the right product for you

Photonic components from GD Optics are the key elements of many modern technologies. The production of optical components ensures progress. We fully cover the entire process chain, from conception and development to production and delivery of the production and delivery of the optics.

High-tech components to measure

More and more areas and applications require a multitude of photonic components with a wide range of optical functionalities. They determine the technical logical level of an abundance of products.

The product range of GD Optics is comprehensive and universal. Whether aspheres, free-form optics, segmented lenses and line generators, cylinders and A-cylinder lenses or diffractive elements - our products are characterized by highest qualities and maximum reproducibility.

Unique problem solving competence

Capturing complex requirements and transforming them into functioning optics is what drives us. With state-of-the-art technology, inventiveness, many years of expertise and interdisciplinary exchange among our specialists, we transform ideas into practical solutions for process-safe series production.

As a committed production partner, we support our customers in the production of customized optics. Our competence team accompanies the manufacturing process all the way to series-ready production of the components. Precision optical components must meet special requirements in terms of quality, shape and dimensional compliance, and surface finish. We ensure that all parameters are correct and offer maximum customer orientation. Our way of working is fully geared to your needs. We take over the complete development or support you in individual steps of your development process.



New technologies

Development at GD Optics focuses on technologies such as diffractive optics for laser materials processing, technology-based guidelines for efficient production of the next generation of glass optics, research into (secondary) optics in the field of concentrating photovoltaics, and rapid hot stamping processes for high-quality micro-optical components.

100

Percent know-how
in product development make us
make us one of the leading international suppliers
of precision optics.

3.5

Million lenses
GD Optics delivers per year to its
national and international customers.



0.18^{*}

Worldwide solutions for your success

Whether microoptics, laser beam shaping, diffractive optics or aspheres - with the consistent quality of our products, we meet the highest demands for modern high-tech components.

We offer our customers a wide range of specification options, in order to adapt the components perfectly to your requirements up to cost-efficient to cost-efficient solutions in the smallest format.

* millimeter
is the radius of curvature of the
the world's smallest lens that we produce.

Highest product maturity in the smallest format

01

Microoptics

We manufacture microoptics with state-of-the-art technologies in reliable precision and in large quantities. Thanks to comprehensive control and numerous measurement procedures, we ensure reliable quality for our customers at all levels of the manufacturing and coating processes. Our special solutions in the production of microoptics are geared to individual customer requests.

02

Laser beam shaping

Laser beam shaping generates optimized intensity distributions of the light for different requirements and thus opens up a variety of applications. Special beam shaping opens up an enormous variety of laser applications. In materials processing, beam shaping has made numerous innovative applications possible. As a result, more and more applications for lasers in industry and technology are being developed. GD Optics produces the appropriate lenses for these applications.

03

Diffractive optics

With diffractive optics, we can direct light beams specifically according to special requirements. Thanks to their high functionality, several optical functions can be integrated simultaneously in one element. GD Optics develops DOEs in unique qualities, most of which are used in high-power lasers for industrial applications.

04

Aspheres

Aspheres have much more precise imaging properties than spherical lenses. This is due to their surface geometry. Thanks to this, spherical aberrations can be eliminated. Aspheres can reduce the number of lenses used in optical systems. GD Optics produces precisely molded aspheres - customized or in standard formats.

05

Acyylinder lenses

We manufacture A-cylinders in the range from 0.3 mm to approx. 50 mm. In close dialog with our customers, we develop solutions for a wide range of applications. The most important application of Acylinder lenses is diode laser collimation, also in the field of LiDAR. Powell lenses also fall into this category. GD Optics offers a particularly efficient manufacturing process compared to common processes.

06

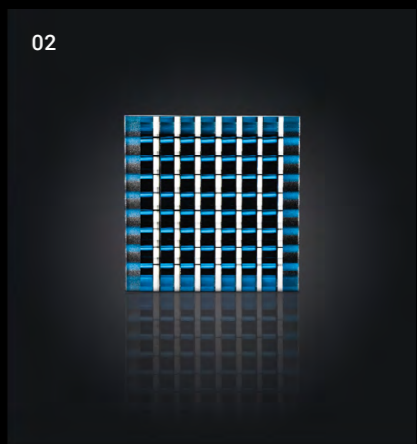
Lens arrays

Lens arrays combine a wide variety of spherical lenses with a broad parameter field of lens radius, lens height and lens pitch. GD Optics has the know-how, solution expertise and product technologies to produce high-precision microoptics and lens arrays for a wide range of applications in large quantities.

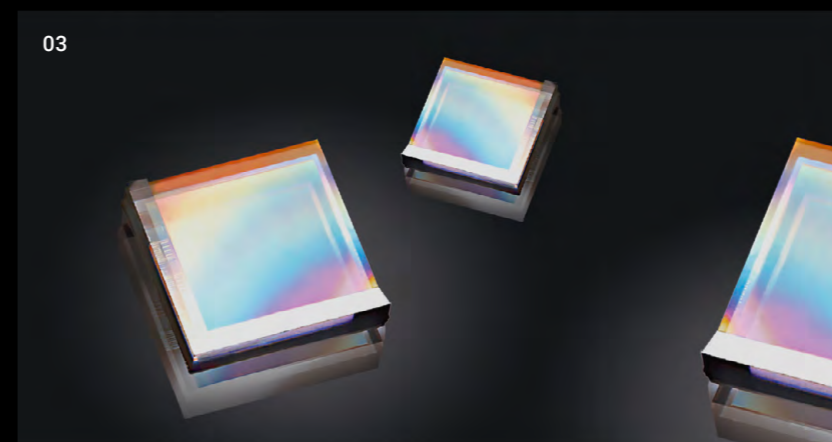
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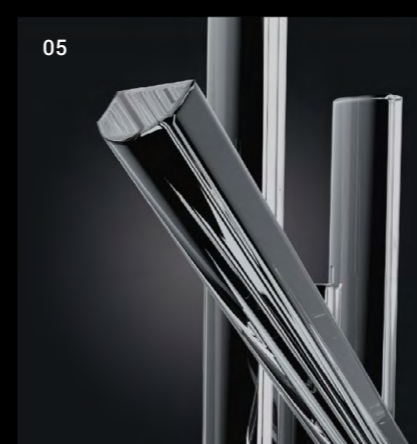
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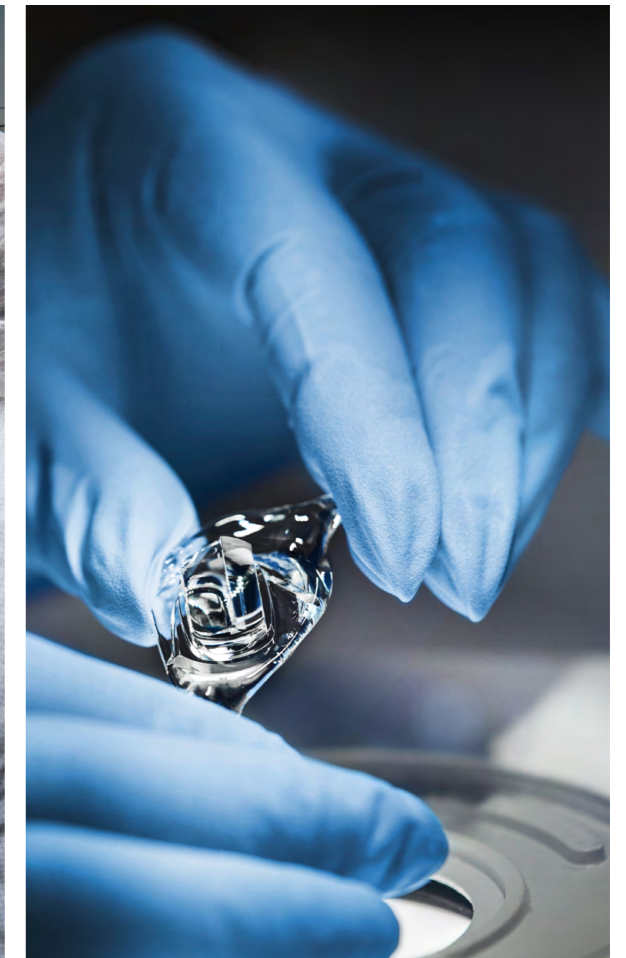
07



07

LiDAR

As one of the leading photonics manufacturers, we develop individual lenses for LiDAR applications for the automotive, industrial automation and safety technology sectors, among others. Our range of services includes customized optical components for all types of LiDAR sensors and demanding applications.



Plan with us as problem solver

Individually scalable production lines

GD Optics sees itself as an enabling company at the interface between industry and photonics. We offer highest manufacturing competence for the development of customized photonic components - and that in-house.

Thanks to our various production processes, we have a high degree of flexibility to respond promptly to special and highly complex customer requirements. For special problems, we can convince with variable solution approaches. With our production lines, we create fully scalable processes that ensure maximum planning reliability and cost efficiency.

Our goal is to find the most economical and qualitatively reliable solution for your requirements. With our technologies and technical equipment, we can meet all requirements for state-of-the-art photonic components down to the smallest format. We produce optics for a wide range of industrial applications in variable quantities. Depending on geometry, precision requirements as well as the required number of pieces, we can use different technologies, which are particularly advantageous.

Innovative rod molding process: Cost-effective, high-quality, accurate

High-quality and precise production of optical components in just one process step is made possible by GD Optics' innovative rod molding process, which we have further developed and optimized ourselves. The so-called Rod Glass Molding (RGM) allows the production of complex glass optics in a variety of geometries, e.g. aspheres or segmented optics.

In terms of quality and precision, RGM is in no way inferior to precision molding. An additional advantage is the speed of the process, which is completed in seconds. Of particular interest are the flexibility and cost efficiency of the rod molding process in terms of quantities, whether a few hundred or 100,000 units are required.

Precision, variety, flexibility

New location - new opportunities

GD Optics' isothermal molding process enables the cost-effective production of single lenses and wafers. The wafers can be further processed separately or processed into assemblies at wafer level and then separated.

At the same time, the new location of GD Optics an increase in qualities and capacities.

The isothermal process can be used to produce a large number of finished lenses that do not need to be machined afterwards. With its unique know-how in tool making, GD Optics can use the isothermal molding process to produce A-cylinder lenses, aspheres and spheres in a very wide range and in the highest quality. This includes particularly small microlenses with focal lengths $\geq 250 \mu\text{m}$.

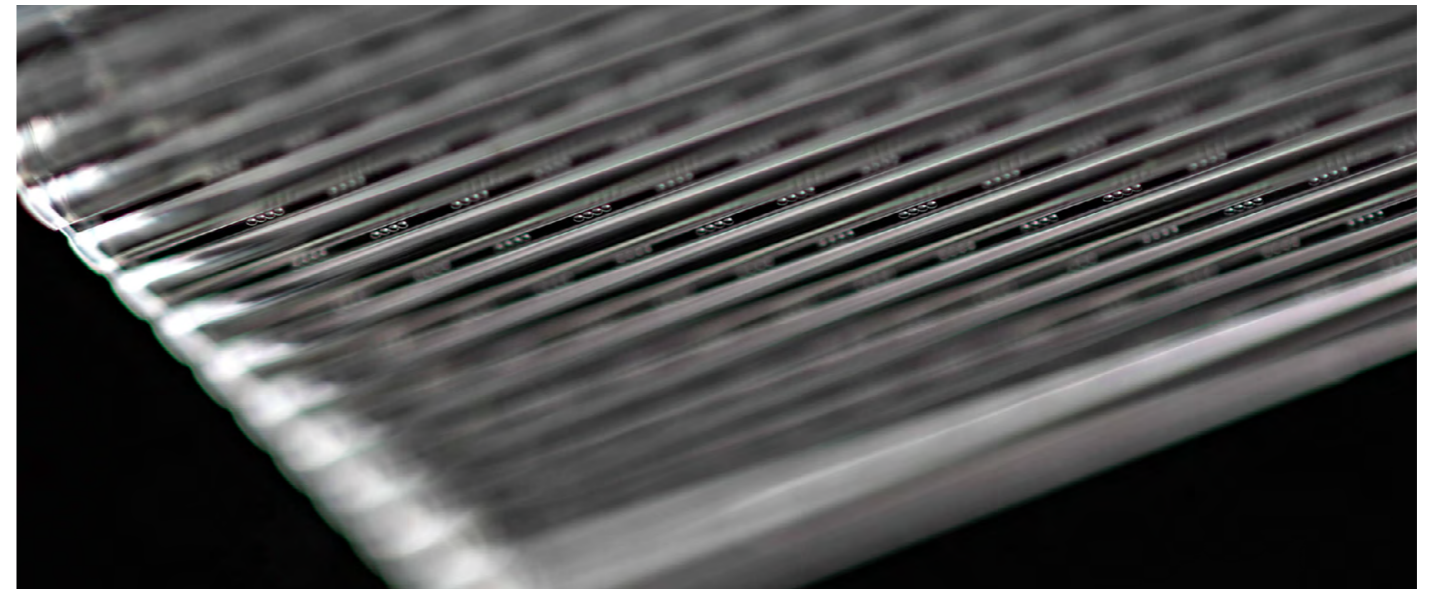
The precision delivered by GD Optics is very high. Small shape deviations in the range of 100 nm are possible. Surface roughnesses also meet high optical standards ($R_a < 3\text{nm}$).

Thanks to our new facility, we can ensure even higher cleanliness requirements in production, as manufacturing takes place in a clean room. Here, the concentration of airborne particles is kept very low so that particles present in ordinary ambient air cannot contaminate the optics.

Due to the special process engineering feature that GD Optics develops and builds both the tools and the molding machines itself, both can be optimally matched to each other. This not only ensures higher quality and maximum flexibility in the process, but also a wider range of customized options.

Depending on our customers' requirements in terms of product quality or the quantity to be produced, the non-isothermal rod molding process may be more suitable in some cases, and the isothermal molding process in others.

With both processes together, GD Optics covers the maximum range of manufacturable shapes.



Efficient Light research project



Efficient fiber-PIC coupling via glass forming on wafer scale

The groundbreaking research project of GD Optics aims to drastically reduce the cost of monomode fiber-chip coupling.

Due to the introduction of new data transmission standards, monomodal systems will be used in the future, in which data transmission can be reduced to a single light mode. Optical transceivers based on photonic integrated circuits (PICs) are increasingly being used for this purpose.

The core of the research project is the efficient monomodal connection of the optical fiber to PICs or to other optical systems. In particular, a new performance- and cost-efficient monomodal optical fiber coupler technology based on glass precision molding is investigated. The couplers should not only be molded onto glass wafers in large quantities, but also be compatible with an automated setup. Various applications of PIC fiber coupling require the separation of differently polarized light into two channels. Polarization beam splitters are used for this purpose.

The concept developed in the project allows polarization-splitting layers to be integrated into the couplers. This saves an additional optical element (separate polarization beam splitter), which means a further increase in efficiency and cost savings.

Innovative glass blanking and automated assembly

The targeted monomodal fiber optic couplers are micro-optic systems manufactured using the innovative technology of glass blank molding. For this purpose, glass blanks are formed into the desired shape in a hot forming process.

The main goals of the project are to research the power-efficient glass fiber coupling on different receiver modules and to evaluate the cost-efficient production by wafer processing of the couplers.

For this purpose, all necessary sub-steps, from the optical and electrical design of the couplers and PICs to the process technology and tooling, as well as the assembly technology and the application in the system are covered in the network.

In addition to fundamental questions on system architecture, process design and tool manufacturing, practical questions regarding module integration are also solved.

Efficient Light Project Partners

RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN | FRAUNHOFER-INSTITUT FOR PRODUCTION TECHNOLOGY, AACHEN | AIXEMTEC GMBH, AACHEN | SON-X GMBH, AACHEN | AIXSCALE PHOTONICS UG, COLOGNE (ASSOCIATED PARTNER) | MELLANOX TECHNOLOGIES, LTD., ISRAEL (ASSOCIATED PARTNER)

39

Billion euros in sales*

The approximately 1,000 German photonics manufacturers with their approximately 138,000 employees in 2019.

*statista

Light research - high-tech industries

Photonics is one of the most innovative high-tech sectors and makes a significant contribution to development in many industries and sectors. Photonic components serve as enablers for solving technological challenges in shaping our future.

The latest trends are changing our world for good. With current research and development, GD Optics proactively participates in driving these innovations forward.

11

Percent global CO₂-savings

enables photonics from 2030.

Recent studies show the great importance technical applications of light for the realization of the the Paris climate protection agreement.

industries

Metrology

Precision with high speed

Optical metrology has long since overtaken measurement technology in many areas. This results in great advantages in measuring speed and quality.

Optical components for industrial metrology

Optical measurement of components in a matter of seconds enables one hundred percent accurate "just in time" production control. This brings reliable and cost-efficient production with the lowest possible error tolerance within reach.

Photonic future technologies

Particularly powerful in this context is the spatial recording and measurement of serially produced components. With automated 3D measurement technology using optical processes, tolerance deviations can be detected immediately and corrected accordingly. These methods require photonic components that are precisely matched to the processes.

Our goal - the sustainable improvement of processes and workflows

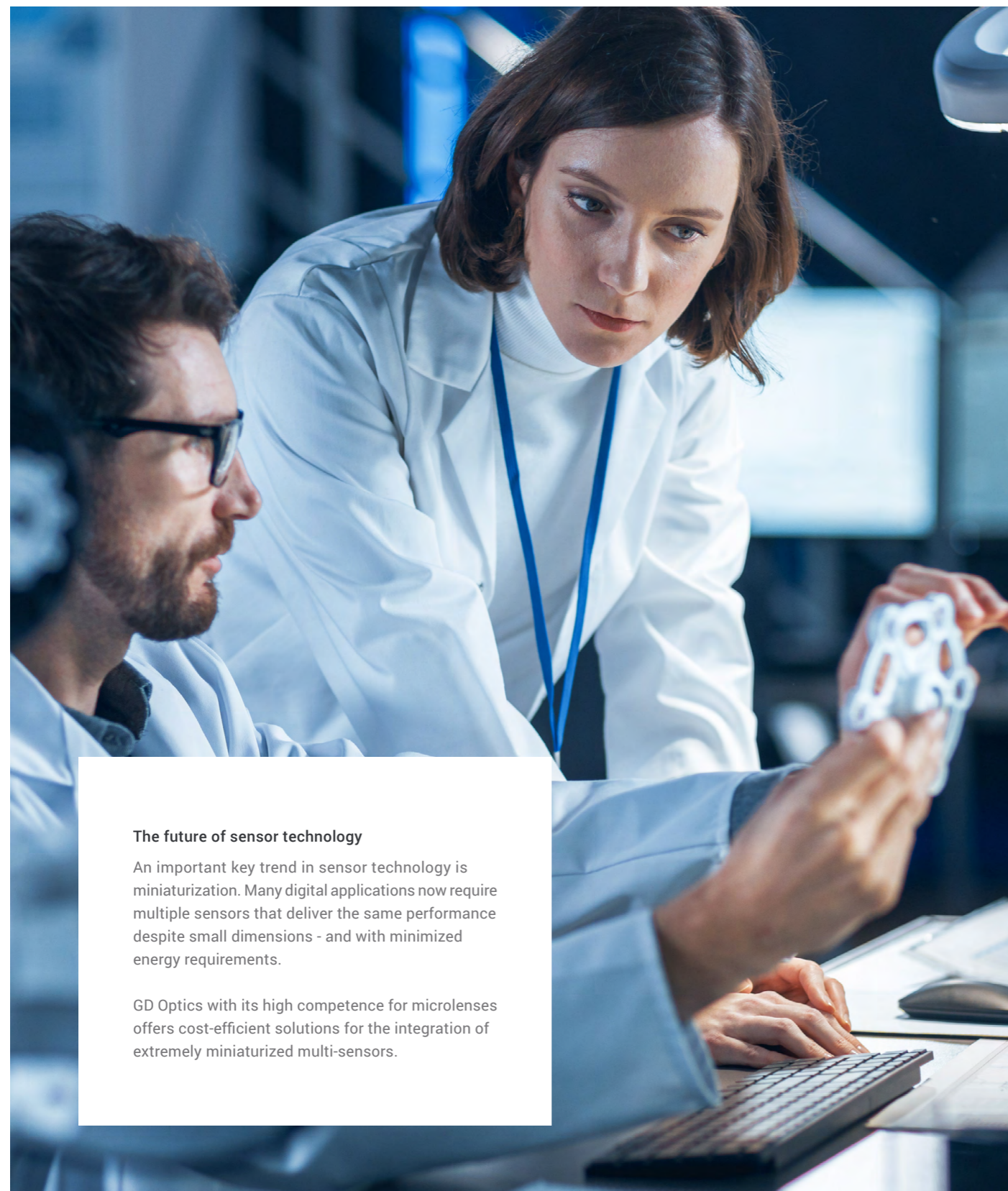
As one of the leading international developers, manufacturers and key suppliers of photonic components for metrology, GD Optics offers a wide range of services with solutions precisely tailored to your needs. Thanks to our comprehensive know-how and decades of experience, we know exactly what our customers want and need.

Together with you, we will find the right solution - let our experts advise you.



Optical measurement: fast with high data density

Optical measuring systems capture the measured object completely contactless with the help of sensors. Complex workpieces are digitized in a matter of seconds. Optical 3D measurement technology is increasingly being used in the automotive sector in particular; from process planning and quality control to process optimization in final assembly. Such high-precision measurement technology also requires high-precision components. GD Optics as a manufacturer sets qualitative standards.



The future of sensor technology

An important key trend in sensor technology is miniaturization. Many digital applications now require multiple sensors that deliver the same performance despite small dimensions - and with minimized energy requirements.

GD Optics with its high competence for microlenses offers cost-efficient solutions for the integration of extremely miniaturized multi-sensors.

Sensors

Smart Data and Digitization

Modern sensor technology is an essential cornerstone pillar for industrial digitization. Without measurement data and their digital processing, networked production is not possible.

Key technology for industrial progress

As a cross-sectional technology, sensor technology represents the fundamental basis for many other technologies. It is considered a key technology for measuring, controlling and regulating mechatronic systems in automation - and thus for Industry 4.0 applications. Optical sensors have come more and more into focus and have increased their market share. Today, hardly any industry can do without sensors, from mechanical and plant engineering, agriculture and automotive engineering to medical technology. The demands on sensor technology are - depending on the area of application - highly complex.

Changing the world with intelligent sensors

Sensor technology is currently experiencing a comprehensive transformation towards more and more sensor intelligence. In general, the focus is on ever higher measurement resolutions, increasing miniaturization of measurement technology and integration into digital signal chains. Increasing requirements, higher resolutions and special solutions in micro format are only possible with the help of

the right optical components. Rely on GD Optics as your partner for customized sensor components developed in close customer dialog. You need a cost-efficient special solution? We manufacture it and make it ready for series production.

Industry outlook and development

The big topics in sensor technology will remain digitization and the Internet of Things in the coming years. According to estimates, 20 billion devices are expected to communicate with each other on the network in the near future. This will create a flood of data that can be transformed into smart data thanks to self-learning algorithms. Relevant information on energy consumption, investment decisions and the detection of hacker attacks can be determined at lightning speed.

Photonics plays a fundamental role in all these developments. As a German quality supplier with many years of industry expertise, we offer invaluable know-how in the implementation of new technologies.

Energy

Photonic technologies open up new approaches

In order to meet the steadily growing demand for energy and at the same time reduce the associated CO₂ emissions, new solutions are needed. The expansion of renewable energy sources, especially wind energy and photovoltaics, wind energy and photovoltaics, is a key factor and the demand for renewable energy sources is constantly increasing.

Power enhancement for photovoltaic systems

However, the performance of the equipment currently on the market often does not keep pace with this development.

GD Optics is working on processes to produce secondary optics for concentrating photovoltaics and lenses for efficient LED lighting. Concentrating photovoltaics has the potential to greatly increase the efficiency of photovoltaic systems. LED lighting can reduce power consumption for lighting purposes. Faster data transmission (see EFFICIENTlight) can also save a lot of energy.

Yield analysis and site search with LiDAR technology

Before a wind farm is planned, the wind conditions on site must be precisely recorded. For this purpose, flexible and cost-efficient LiDAR systems are increasingly used, which, unlike masts, can be operated without a building permit. From the ground or at sea, these systems record wind speeds, wind direction and turbulence. Even where measurements are still made with masts, LiDAR technology is in demand, especially for higher air layers.

Take advantage of our expertise in manufacturing the appropriate components for the realization of LiDAR systems.

Progress in photovoltaics

In photovoltaics, lasers and optical technologies are effective drivers of progress. Manufacturers of modern organic thin-film solar cells use ultra short pulse lasers for the gentle μm -fine structuring of the active layers of their solar films.

Ultra short pulse systems also contribute to increasing the efficiency of conventional silicon cells: in order to maximize the absorption of sunlight, they introduce extremely fine structures into their surfaces. As a supplier of high-precision photonic components in the field of sustainable energies, GD Optics supports the efficient further development of such technologies.



Better understanding diseases

Photonics has revolutionized medicine. Optical and photonic methods make it possible to follow processes in cells and tissues down to molecular dimensions. Correcting visual impairment with a laser has long since become standard practice. There are always new developments: With "laser tweezers," for example, the smallest bacteria, viruses and cancer cells can be studied more precisely than ever before. Scientists have recently developed a laser that can detect skin cancer in seconds.

Medical technology

How light illuminates medicine

Light and optical technologies are important driving forces in medicine. At the interface of photonics and medical technology, rapid developments can be observed in many medical fields for better prevention, more precise diagnostics and more effective therapy of diseases.

Laser technology, endoscopy, 3D printing

For example, photonics allows a direct view into the cell, for example for the early detection of cancer. Highly efficient laser technology is used in surgery. Especially when cutting and ablating soft tissue, lasers are vastly superior to other technologies such as electricity or sound waves. Photonic technologies are essential for minimally invasive surgery.

Endoscopy, which also uses optical instruments, makes it possible to look inside the body. High-resolution microcameras can be positioned directly at the tip of an endoscope. This eliminates the need for complex optical transmission systems and fiber optic bundles for transmission to an external image acquisition system.

Research and clinical applications

Whether microlenses, aspheres or free-form optics for medical and optical applications. Even complex microoptics in series production can be manufactured by us reliably and at competitive prices. GD Optics offers optimal, clean production conditions that medical products require, rounded off by comprehensive quality management.

Growth markets in optical medical technology

Modern medical technology would often be inconceivable without innovative photonics. This is where two growth markets meet. The most important market segments in which photonics already plays a significant role today include in-vitro diagnostics, diagnostic imaging, general and plastic surgery, endoscopy and dental technology.

Microlenses for endoscopy

Chip-on-tip endoscopes are smaller than conventional endoscopes. GD Optics can supply the small aspheres with < 1 mm diameter required for this purpose. Lenses for medical laser treatment, for example for eye surgery and other surgical lasers, are also part of our product range. This also includes cosmetic applications such as hair removal.

Are you researching new medical procedures or treatments? Rely on GD Optics as a strong partner in enabling photonic medical technology.

Automotive

New applications - new opportunities for the automotive market

The importance of photonics for the automotive industry has changed fundamentally. Whereas it used to focus more on light or illumination functions, it has become a unique enabler for intelligent functions used in operation, driver assistance systems, autonomous driving, and safety-relevant sensor technology and imaging.

LiDAR systems for autonomous driving

LiDAR systems for autonomous vehicles in particular are continuously gaining in importance. LiDAR (Light Detection and Ranging) laser systems are already being used for applications in speed control, collision avoidance and driving in bad weather. In future applications, LiDAR will become the eye of self-driving vehicles and enable 360-degree vision.

GD Optics is your innovative automotive partner for the development of cost-efficient optics made to measure. Rely on our expertise and experience when it comes to groundbreaking developments. As optical sensor technology produces terabytes of data every hour, development is moving in the direction of intelligent sensor systems. These decide themselves, through their own data evaluation, which data they forward to the on-board computers. This is made possible by photonics. The computing power required for this and the efficient data transmission would be inconceivable without laser technology and optical inspection in the semiconductor industry.

Electromobility and laser technology

Current market analyses predict that in the next three years, one in four new cars in the world will be electrically powered. This change means enormous challenges for the automotive industry in terms of manufacturing technology. In order to produce safe, reliable and affordable electric vehicles in large series, new process lines must be implemented. The manufacturing effort for high-voltage batteries is extreme. Already today, all welding operations and a growing number of cutting and structuring tasks in battery factories are performed by lasers. This process chain alone accounts for one third of the added value of e-vehicles.

Photonics - and above all GD Optics with its high flexibility and innovative strength for new processes and applications - can make a major contribution to this. With its strong expertise in the automotive sector, GD Optics is at your side for all challenges.



Outlook Automotive

Battery cells, e-motors, battery management, process sensor technology, artificial intelligence, lightweight construction, autonomous driving, flexible manufacturing concepts - in perspective, the automotive industry promises to develop into an exciting photonics user market. Not least due to the strong increase in optical sensor technology in vehicles. LiDAR systems in particular are increasingly being installed in vehicles for autonomous control, but not only there.



Telecommunications

Communication at the speed of light

For the advancing digitalization of the economy and economy and society, efficient information processing, distribution and storage is indispensable. Microelectronics is developing rapidly.

Photonics is a key pacemaker in processor technology, data communication and sensor technology.

Photons as high-speed data carriers

Optical components and transmission media offer several important advantages over electrical variants: Compared to copper cables, the use of optical fibers is lighter, more flexible, space-saving and more secure. The almost unlimited bandwidth of fiber optic applications (80 tbit/sec) exceeds electrically based communication many times over (50 mbit/sec). In addition, multiple, independent data channels can be operated over long distances with low loss rates.

Electronics and photonics - the technologies of tomorrow

Rapidly increasing data rates and new applications such as machine vision, LiDAR and quantum information processing increasingly demand the use of photonic developments. Only by intelligently linking electronics and photonics can both technologies develop their full performance. Digitalization is making information technology a fundamental part of our lives. Information is transported almost entirely in a global optical network. Access is increasingly provided by mobile devices.

The Internet of Things networks industry

In the future, production facilities, machines and devices that surround us in everyday life will also be integrated into the communications network. This will result in completely

new functions and challenges. The growing volumes of information and energy require a drastic reduction in costs and energy requirements. To realize this, integration of information systems far beyond today's level is necessary. Photonic integration alone holds this potential.

GD Optics - always connected to communication

GD Optics has always based its success on the development of pioneering solutions in the telecommunications industry. With the realization of special lenses for the US company AT&T, we laid milestones for the Internet. Today, we accompany the telecommunication industry with a view to the future, by producing customized microoptics in a particularly economical manufacturing method.

Security technology

With security on the pulse of time

In Germany, every five minutes on average a house or apartment is broken into. The number of burglaries in commercial properties is in no way inferior to this. Security is a topic of growing relevance - and the security and the security technology sector is an absolute growth market.

In the Federal Republic alone, annual sales of electronic security technology exceed four billion euros. Moreover, annual growth rates of up to 30 percent are forecast.

Digitization requires intelligent security solutions

In addition to the digitization and networking of security systems, future drivers include remote services and developments such as the Internet of Things, decentralized data processing with edge or local cloud computing, software suites or even smart home applications, which will permanently change the field of security technology. Cyber criminals are quickly adapting to the changing environment, for example with misused tools that allow remote access to systems. They attack institutions and companies with high social value, so-called "big game hunting," but also private individuals.

For a long time now, electronic security technology has not been able to do without photonics and is already being used in a wide variety of areas, from the security industry and defense technology, to transportation, traffic and shipping,

to aerospace and space surveillance. Key applications of optical security technology include: Terahertz technology, automatic person recognition, biometric recognition methods, fingerprint analysis, head-up displays and laser warning systems.

Laser security technology is state of the art

Modern laser processes and optical security systems hold limitless potential for the development of future security technology.

Laser systems play a crucial role when it comes to meeting the increased demands for security with reliable technical tools in the face of global crises and conflicts. They outperform surveillance and thermal imaging cameras many times over.

GD Optics has intensive experience in the development of photonics components in the field of security technology. We not only supply you with customized components, but also with the know-how for effective, productive processes.



Networked security systems

Laser-based security systems can act as a stand-alone system that generates an alarm when it detects irregular activity. They can also be part of a larger security and home or facility automation system that sends messages, can call the owner or technician, and more. Advanced laser sensors can accurately detect the position of moving objects and monitor critical infrastructure.



Outlook and opportunities

Laser sources for standard cutting and welding applications will increasingly be interchangeable. As a result, the laser will increasingly become a purchased part, specified according to power, beam quality and other criteria. Laser manufacturers will only be able to differentiate themselves through special properties such as adaptable beam qualities or flexible power density distributions adapted to the process.

You want to optimize your products? GD Optics supplies the appropriate optical building blocks.

Laser technology

Central technology of the 21st century

From industry to automotive manufacturing to medical technology - laser technology is the definitive technology of the 21st century. Laser technology creates the conditions for climate-friendly and efficient production methods.

Laser technology for collimation of diode lasers

A large proportion of the laser technology used worldwide is "Made in Germany". More than 40 percent of the beam sources produced worldwide and 20 percent of the laser systems in the materials processing sector come from Germany. The export quota is 70 percent. GD Optics is also involved in this. We manufacture lenses for the collimation of diode lasers, in particular the FAC lenses for a wide range of focal lengths.

Innovation driver for many industrial sectors

Laser technology development focuses on increasing efficiency, output power, pulse energy, brilliance and reliability. The aim is to reduce costs and simplify systems, as well as to open up new wavelength ranges required for industrial production. Laser technology has long been a driver of innovation in a wide range of industries and everyday applications. In addition, there are areas of growing relevance. These include areas such as additive manufacturing, which can be used to completely rethink components, and data transmission. Artificial intelligence is currently a hot topic in many industries, including laser technology, especially when it comes to optimizing processes.

Process periphery moves into focus

There is still much untapped potential in laser technology applications. Manufacturers of industrial lasers and laser machines are focusing their developments on increasingly powerful and diverse sources. The aim is also to further optimize processes and thus advance laser technology as a whole. Lasers with high output power are currently very much in vogue. These open up new possibilities in industrial processing, especially in micromaterial processing with pulsed laser light. The performance of CW lasers (continuous wave lasers) is also increasing to open up more areas of application. The industrial market for cutting and welding is dominated by solid-state lasers - that is, fiber lasers and disk lasers, respectively.

But the remaining applications could soon be dominated by another type of laser: ultrashort pulse lasers. In the meantime, they have reached a level that permits their widespread use in industrial materials processing. In addition to the laser sources themselves, the development of the process peripherals is also increasingly becoming the focus of attention. Here, established manufacturers can score points with their knowledge in the development of optics and beam deflection systems as well as machine learning applications. We make possible what may seem impossible today.

LiDAR

3D environment capture technology

Light Detection and Ranging, or LiDAR, is an intelligent sensor technology for detecting the environment and objects. LiDAR sensors generate precise 3D information about the shape and properties of surrounding objects. Object detection and classification is performed by light in the form of a pulsed laser.

The laser beams generate a three-dimensional representation of the environment. LiDAR applications are mainly used in surveying, geography, atmospheric physics and archaeology, as well as in high-tech applications in robotics, smart city applications and autonomous vehicles.

Fast, precise, reliable

LiDAR technology provides a fast, accurate and direct system for 3D mapping while delivering accurate and easily analyzable data. For many challenges, such as scanning between trees, LiDAR proves more reliable than other sensory methods. LiDAR is also increasingly used in mobility applications that require the highest precision and reliability.

LiDAR generates millions of data points in real time, providing high-resolution 3D images. This results in precise mapping, of a dynamically changing environment, enabling rapid object recognition and categorization. For example, in traffic, a car

can be precisely differentiated from a cyclist. Radar devices or ultrasonic sensors alone cannot fulfill this function.

Performance and cost efficiency

LiDAR is capable of detecting and evaluating objects at lightning speed. Its high performance with a range of up to 200 meters and a distance precision of a few centimeters makes it possible.

The introduction of solid-state technology has also brought about a sustained reduction in costs. This is an additional reason why they are being used in more and more applications. Universal application breadth and depth in optical components for modern LiDAR systems is a given at GD Optics in every respect. Cost efficiency and quality are our main focus.

As a developer and supplier of photonic components, we have a great deal of expertise and offer the appropriate



optical solution for every application.

Growing application potential

In terms of its many benefits, LiDAR technology is already critical to many modern applications such as autonomous navigation, HD mapping and people counting. Because it offers greater, more accurate and more reliable performance than other technologies, it is foreseeable when LiDAR will be used in the wider industries.



The world is our market

Global growth in the photonics sector

We enable innovation - everywhere.
 We serve global markets and inspire new technologies.
 technologies. Whether telecommunications,
 medical technology, security technology, sensors,
 or LiDAR - topics that play a decisive role around
 the world, in all play a decisive role.

Thanks to our innovative strength, based on constant re-
 search and further development, we are optimally equipped
 to meet the challenges of dynamically changing markets
 and processes, whether digitization, the "Internet of Things",
 "Big Data" or Industry 4.0. In this context, we have dedicated
 ourselves in particular to microtechnology as an elementary
 key technology. We develop and supply micro-optics
 components at extremely competitive costs.

Not least thanks to innovative tooling, GD Optics offers
 the highest performance in the field of microtechnology.
 By this we mean the in-house development of customized
 molds to manufacture microlenses lenses. Our high-
 precision tools, for example, have recesses of 0.2mm to
 be able to mold the corresponding microlenses. GD Optics
 thus masters a comprehensive technological bandwidth
 to be able to manufacture individual (micro)optics for cus-
 tomers from high-performance industries along the value
 chain of the global lead markets.

It is our declared goal to further expand our outstanding
 competencies in the field of microtechnology in the future.
 This involves not only developing revolutionary new tech-
 nologies, but also making them ready for series production
 and cost-efficient, and thus suitable for the mass market.

Our solutions for your success

GD Optics is your partner for groundbreak-
 ing applications and exploitation of growth
 potential. Would you like individual advice?
 Don't hesitate to contact us - our experts will
 be happy to assist you and will get in touch
 with you immediately.

