temicon
micronano solutions

thinking nano

Functional Surfaces

Films & Panels

Polymer Parts

Metal Parts

“We aim to provide sustainable solutions and innovations to our customers with the help of micro- and nanotechnology.”

Our customers work in such different fields like optics, life science, electronics and many others. Their requirements are as diverse as the final applications. temicon supports its customers by providing sustainable solutions and innovations based on micro- and nanotechnology.

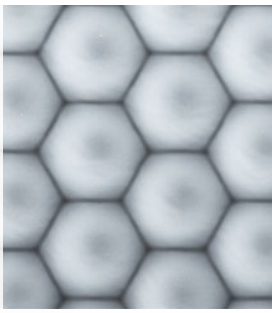
Due to our long experience in the world of micro- and nanostructures we are able to meet the high demands of our customers.

Dr. Oliver Humbach · CEO

It’s all about the details

Functional nanostructures, such as the surface of a moth‘s eye or shark skin, are invisible to the human eye. However, they have an incredibly impressive effect and can be used in various applications.

Micro- and nanotechnologies are playing an increasingly vital role in a wide range of sectors. Structured surfaces or microparts help to enhance the functionality of a technical product or make the development of such a product possible in the first place.

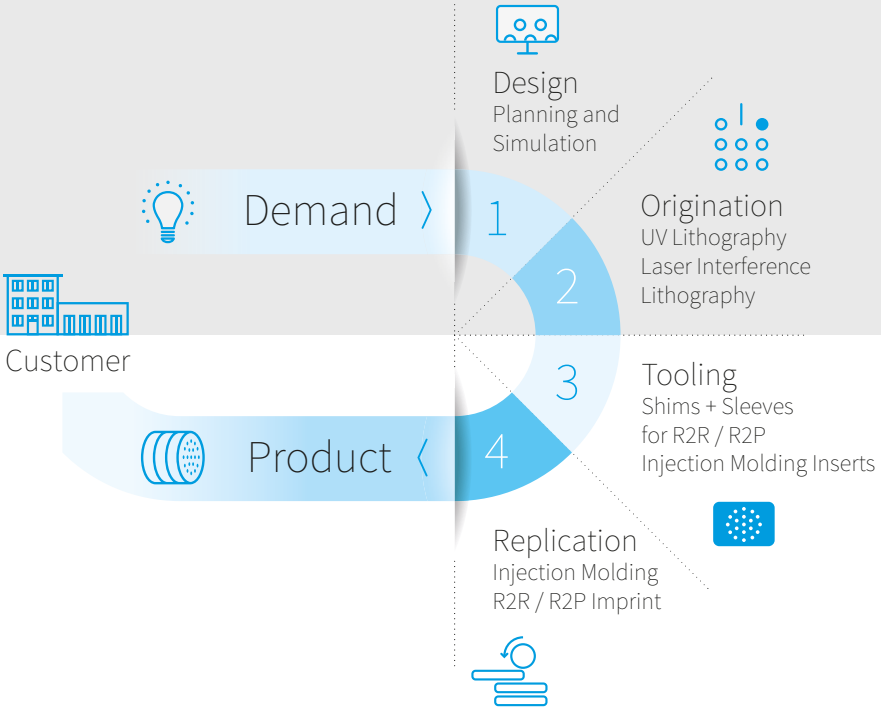


temicon has committed itself to the development and production of „detailed solutions“, with regard to small quantities as well as full production of thousands or even millions of micro- and nanostructured components.

As temicon can cover all stages of the production chain, starting at design and simulation, via tool manufacturing by means of UV- and interference lithography, as well as electroforming, up to full-scale production, we are able to provide a wide range of customized detailed solutions to our customers.

Take advantage of our know-how to ensure the successful realization of your products!

Anything essential is invisible to the eye



Consulting customers, developing products and even bringing them to full production level - we provide all work stages as a one-stop shop.

You are familiar with your market and customers, temicon is the expert in the world of micro- and nanostructure production. We develop and produce e.g. foils and components in large formats, molds, microparts, polymer components or semi-finished products featuring functional micro- and nanostructures.

As a one-stop shop we can provide all stages of the production chain, from the development via prototypes to full production. In order to meet the high requirements of our customers we constantly document, reflect on and enhance our processes to ensure a permanently high quality across all company levels. Our quality management system is in accordance with DIN EN ISO 9001:2008.

TÜVRheinland CERTIFIED

BUSINESS UNITS

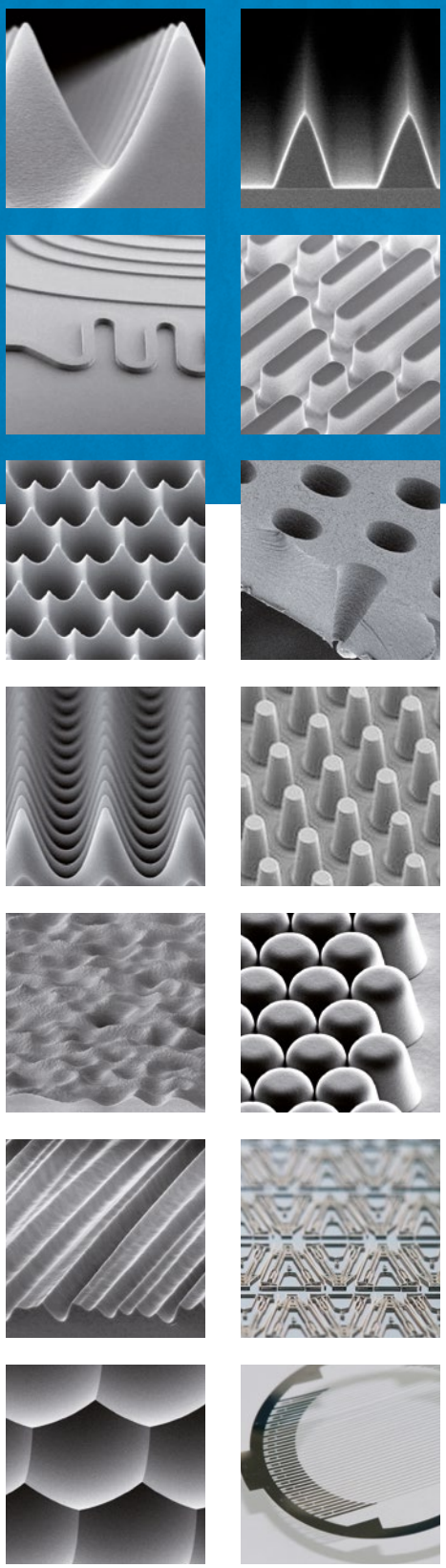
- **Functional Surfaces**
- **Films & Panels**
- **Polymer Parts**
- **Metal Parts**

FIELDS OF APPLICATION

- **Lighting**
- **Displays**
- **Life Science**
- **Photonics & Electronics**
- **Bionics**

EXAMPLES OF OUR

Micro- and nanostructured Surfaces and Metal Parts



- **Optics and Lightmanagement**
- **Hydrophobic and Hydrophilic Structures**
- **Haptic Effects**
- **Microfluidic Structures**
- **Bionic Functionalities**

The structures, which can be used for various applications, are as diverse as the potential fields of application of microtechnology.

Some of these structures have been copied from nature, like e.g. the moth‘s eye or shark skin model which is used to dramatically reduce the reflection in optical systems or minimize friction loss.

With the help of microprecision parts new methods of analysis can be created in medical engineering, so that examinations can be carried out in a faster and more cost-efficient way. Diffusers can be customized according to our customers‘ needs, thus opening doors for new ideas in lighting design. There are many other examples for how micro- and nanostructures enhance properties or even create certain new functions which are essential for developing new fields of application.

Interference colors caused by diffraction of light using nano-technology

FIELD OF APPLICATION
Lighting

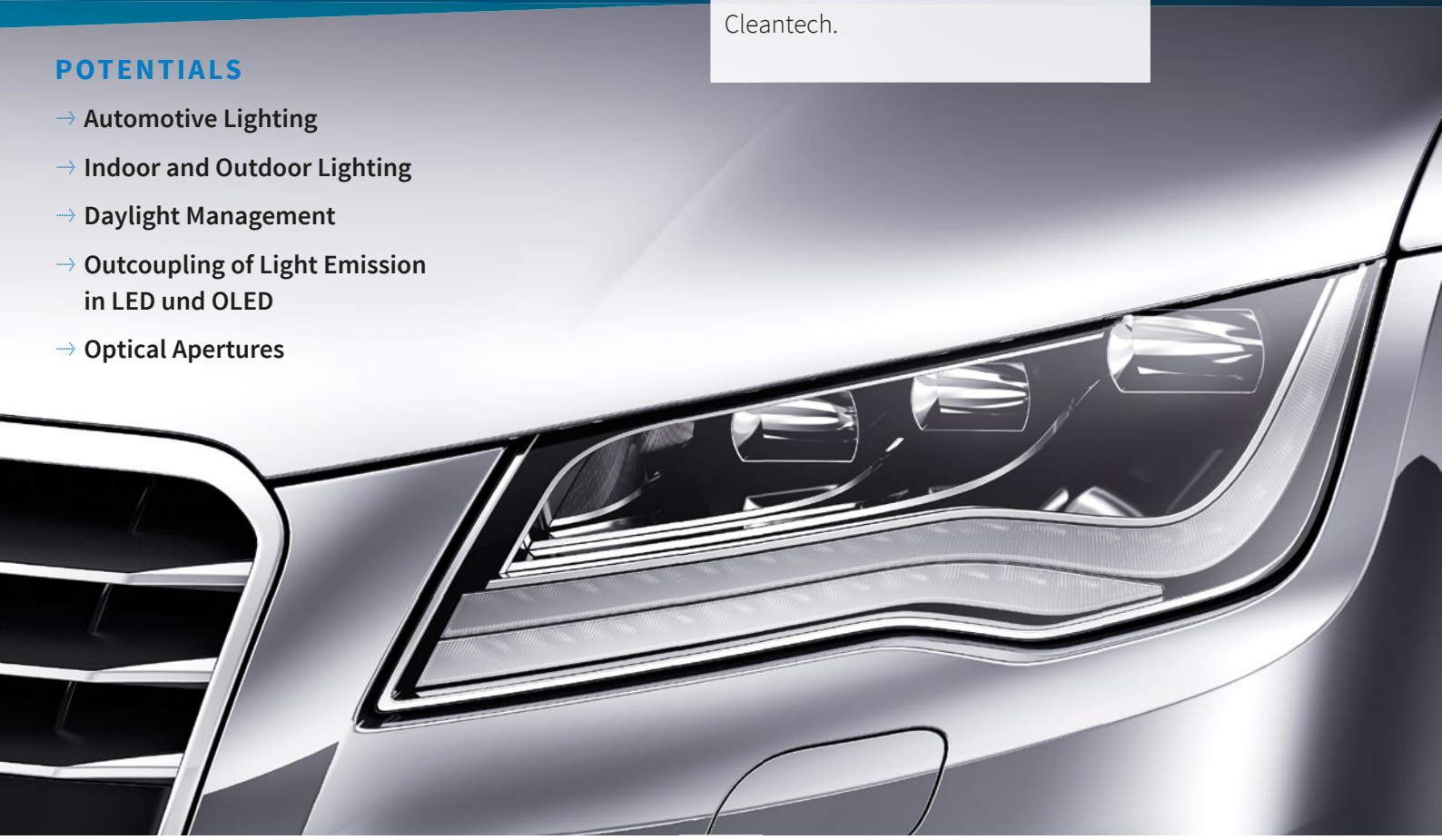
There is a growing trend towards LEDs as the source of light, due to its high energy efficiency, long lifetime, compact size and adjustable light colors. LEDs find their way into a large variety of applications, such as automotive lighting (headlights, taillights, ambient lighting), outdoor and indoor lighting.

Micro- and nanostructured optical components are essential to achieve required light distribution curves from the point light source LED. The micro- and nanostructures contribute to an increased light output efficiency and thus help saving energy and the use of natural resources – Greentech meets Cleantech.

With optically functional surfaces light can be diffused, concentrated and precisely directed.

POTENTIALS

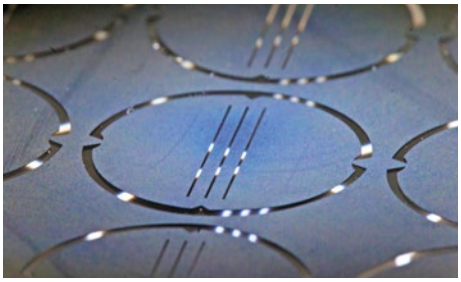
- Automotive Lighting
- Indoor and Outdoor Lighting
- Daylight Management
- Outcoupling of Light Emission in LED und OLED
- Optical Apertures



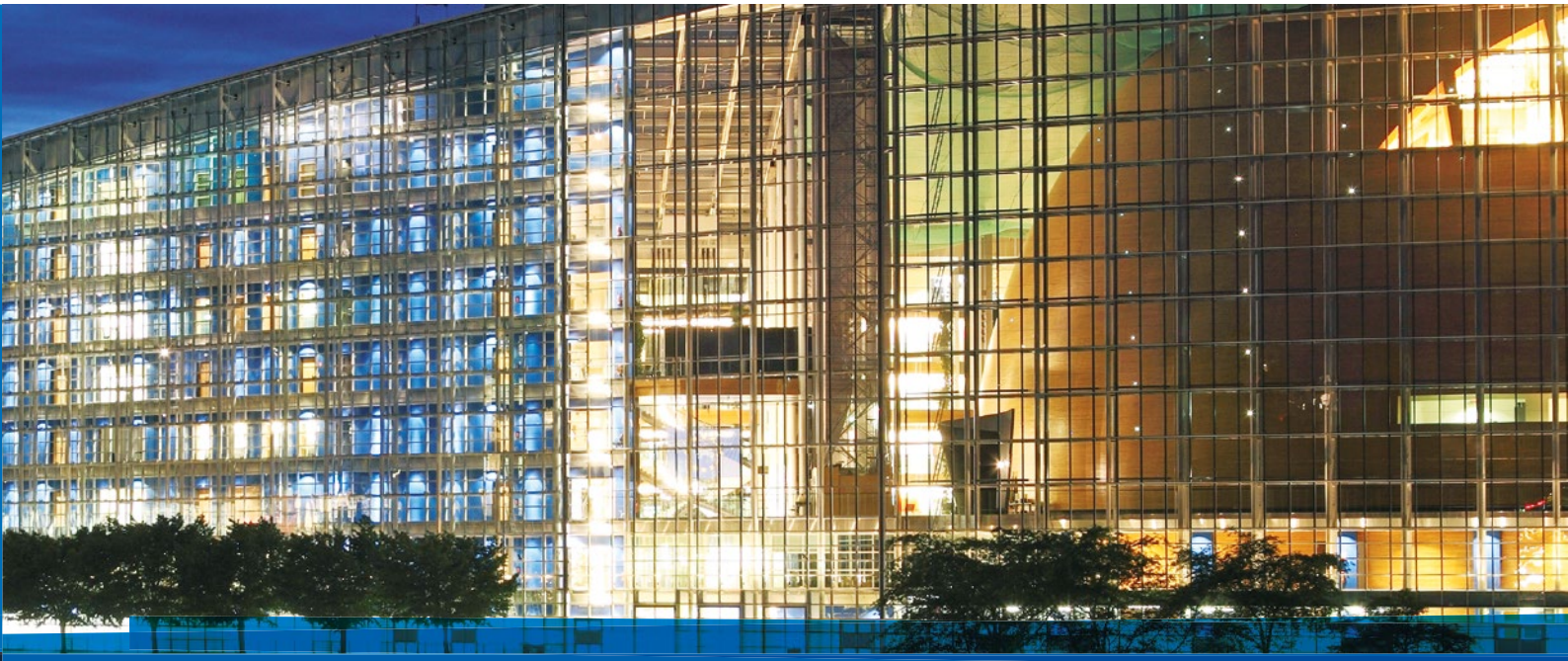
REFERENCES

Nanostructured surfaces such as e.g. diffusors can systematically be used in lighting design.

LED technology and light management systems in automobiles offer new possibilities in ambient lighting.



Optical apertures are used to limit the amount of light or to form a beam individual.



temilux

temilux stands for optical elements, light panels and foils for innovative and large format illumination concepts for rooms and buildings. By combining our microstructured optical elements with LEDs a new range of design options is being created in lighting design and architectural lighting, including fronts, ceilings, walls or objects. The LED-light is entered into the extremely thin temilux optical element from the backside or the edge and is distributed by using microstructured surfaces, such as diffusor, micro lens or light coupling structures.

The structured surface of our temilux optical systems is invisible to the eye but takes full effect in distributing light in a defined and energy-efficient way. With help of our microstructure technology transparent, self-luminous elements can be developed, which can be used in large-surface lights, light installations, front illuminations, partition walls, illuminated ceilings, balustrades or advertising surfaces.

REFERENCES

Large area LED illuminated ceilings

Individual light design for offices and working places

Luminare with LED light guide

Optical reflections e.g. on monitors or displays can be minimized by using nanostructures.

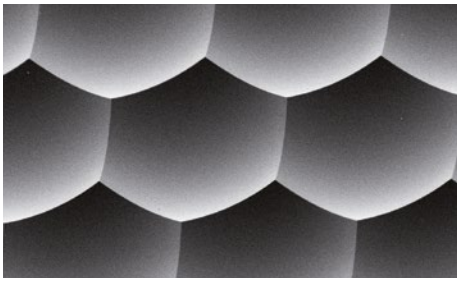
FIELD OF APPLICATION
Displays

The display industry is one of the fastest growing hightech industries. Flat screens are getting bigger. Smartphones and tablet PCs have become modern, electronic devices which use displays not only for information output but also for touch sensitive information input. In display technology high standards are demanded, which results in meeting higher standards with regard to light management used in displays, too. Thin and lightweight construction, low energy consumption, as well as excellent readability even in bright sunlight are demanded.

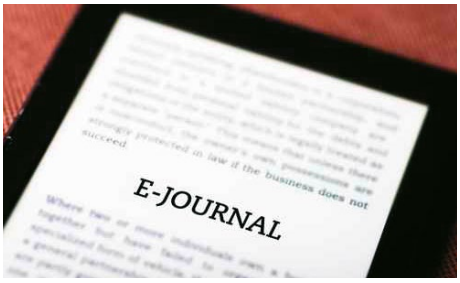
Micro- and nanostructures offer energy efficient and cost-effective solutions for any of these requirements. Optical components with sophisticated light management functionality can be manufactured using injection molding or roll-to-roll processes.

REFERENCES

Gapless Micro Lens Arrays with 100% active area and optical surface quality



Front Light Guide enabling homogeneous illumination and good transparency



Engineered Diffusors are used in head-up displays for improved illumination uniformity

POTENTIALS

- **Back and Front Lightguides**
- **Wire Grid Polarizers**
- **Metal Mesh Surfaces**
- **Anti-Reflection Surfaces**
- **Anti-Fingerprint Surfaces**
- **OLED-Displays**
- **3D Displays**

Micro-hole structures have the function to dose, nebulize, filtrate or separate liquids, particles or powders.

When developing active pharmaceutical ingredients, the so-called Lab-on-a-chip technology of microfluidic structures helps shortening developmental periods and cutting material consumption early on in the drug development process. In addition to this, these chip-systems can make examinations more comfortable for patients as they can be carried out faster or require less sample quantity.

FIELD OF APPLICATION

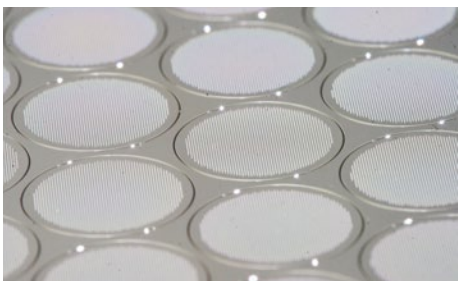
Life Science

Microfluidic elements such as nozzles, channels, mixers or selectively structured surfaces are necessary to handle and define the volume of a liquid right from the very first drop.

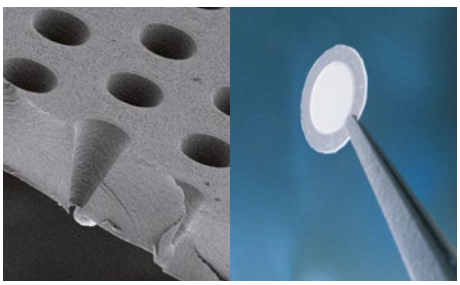
POTENTIALS

- Micro Fluidics
- Micro Titer Plates
- Cell Culture Devices
- Micro Membranes and Microfilters

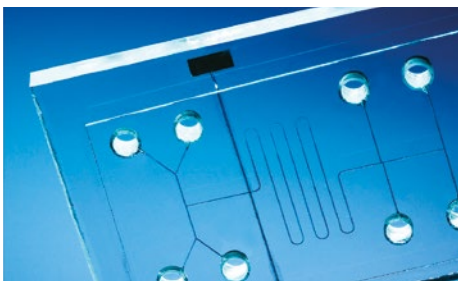
REFERENCES



Nebulizer nozzles with customized perforation pattern



Conical membrane for selective filtration of specific cell types.



Lab-on-a-Chip with micro channels used in analytical applications

Lens of a mobile phone camera

FIELD OF APPLICATION

Photonics & Electronics

Micro- and nanostructures play an important role in the application fields Photonics and Electronics, in particular in the conversion of photons into electrons or vice versa. In solar applications micro- and nanostructures are utilized for trapping, coupling or concentration of sunlight on crystalline, thin film or organic photovoltaic cells.

All kind of optical components like lenses, prisms, retroreflectors, apertures, etc. can be miniaturized to micro dimensions and are used in optical systems, sensors or encoders. Diffractive optical elements (DOE) are key components for the splitting or shaping of laser beams.

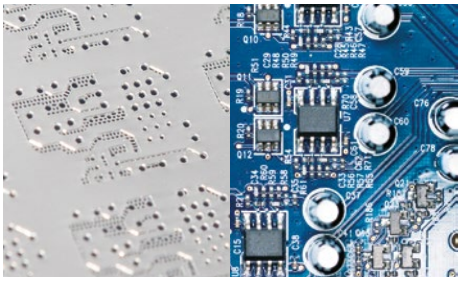
Further fields of application can be found in electronics or printed electronics, e.g. screen printing stencils or shadow masks for PVD processes. Dimensions less than 10 µm in combination with lowest tolerances make micro-structured stencils and masks an ideal choice for printed electronics, solar cells or OLED production.

Microstructure technology makes PV technology more efficient and improves energy yield.

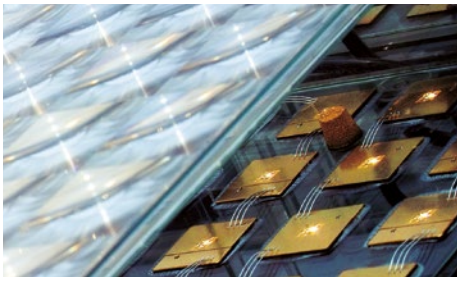
POTENTIALS

- **Solar Applications**
- **Optical Sensors**
- **Optical Encoders**
- **Micro Optical Elements**
- **Diffractive Optical Elements**
- **Printed Electronics**
- **Micro Stencils and Shadow Masks**

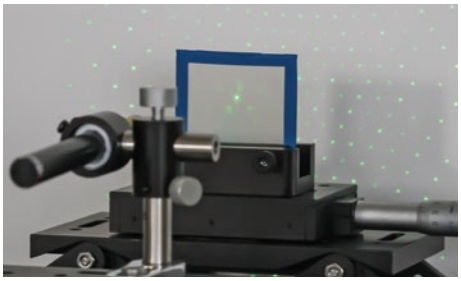
REFERENCES



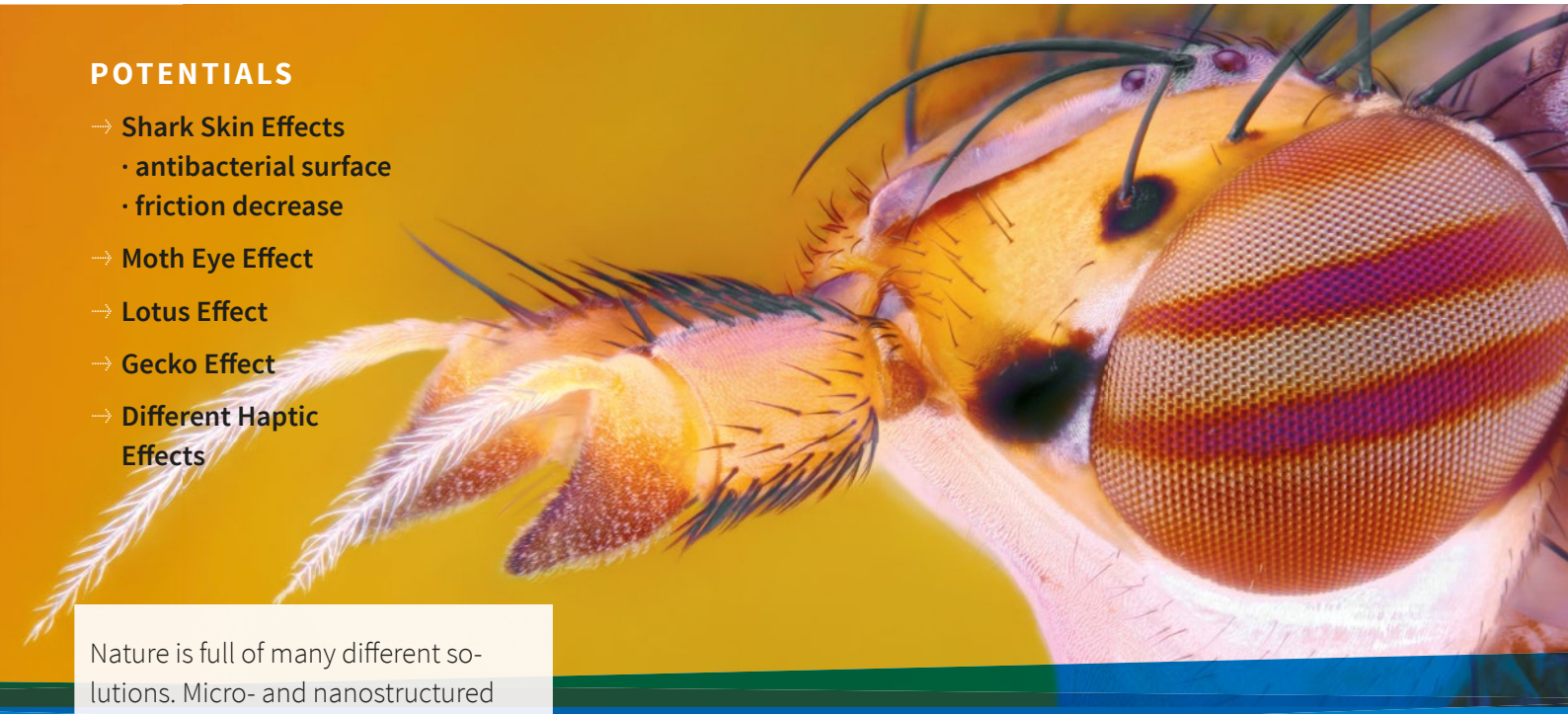
Double-layer screen printing stencil for printed circuit boards



Light concentration through microstructured lenses in CPV modules for generating power



Diffractive Optical Elements (DOE) for laser beam shaping



POTENTIALS

- Shark Skin Effects
  - antibacterial surface
  - friction decrease
- Moth Eye Effect
- Lotus Effect
- Gecko Effect
- Different Haptic Effects

Nature is full of many different solutions. Micro- and nanostructured surfaces can be used to reproduce these functionalities. Customized microstructures can be used to manipulate hydrophobic/hydrophilic surface characteristics (water-repellent or absorbing surfaces, Lotus effect) or oleophobic surface characteristics (oil-repellent surfaces, anti-fingerprint). Appropriate surface patterning can reduce wind resistance of airplanes, cars or wind turbines, imitating the shark skin effect. Frictional resistance of interacting components can be decreased.

The reverse effect of highly adhesive surfaces (Gecko-effect) is also based on micro- and nanostructured surfaces. Based on the shark skin model, micro-bridges which are arranged side by side like fish scales induce anti-bacterial effects, making it more difficult for bacteria to stick, thrive and extend. Antibacterial surfaces are very interesting e.g. for medical facilities, hygienic areas and the food industry.

FIELD OF APPLICATION

Bionics

Bionic structures are copied from nature to optimize technical applications.

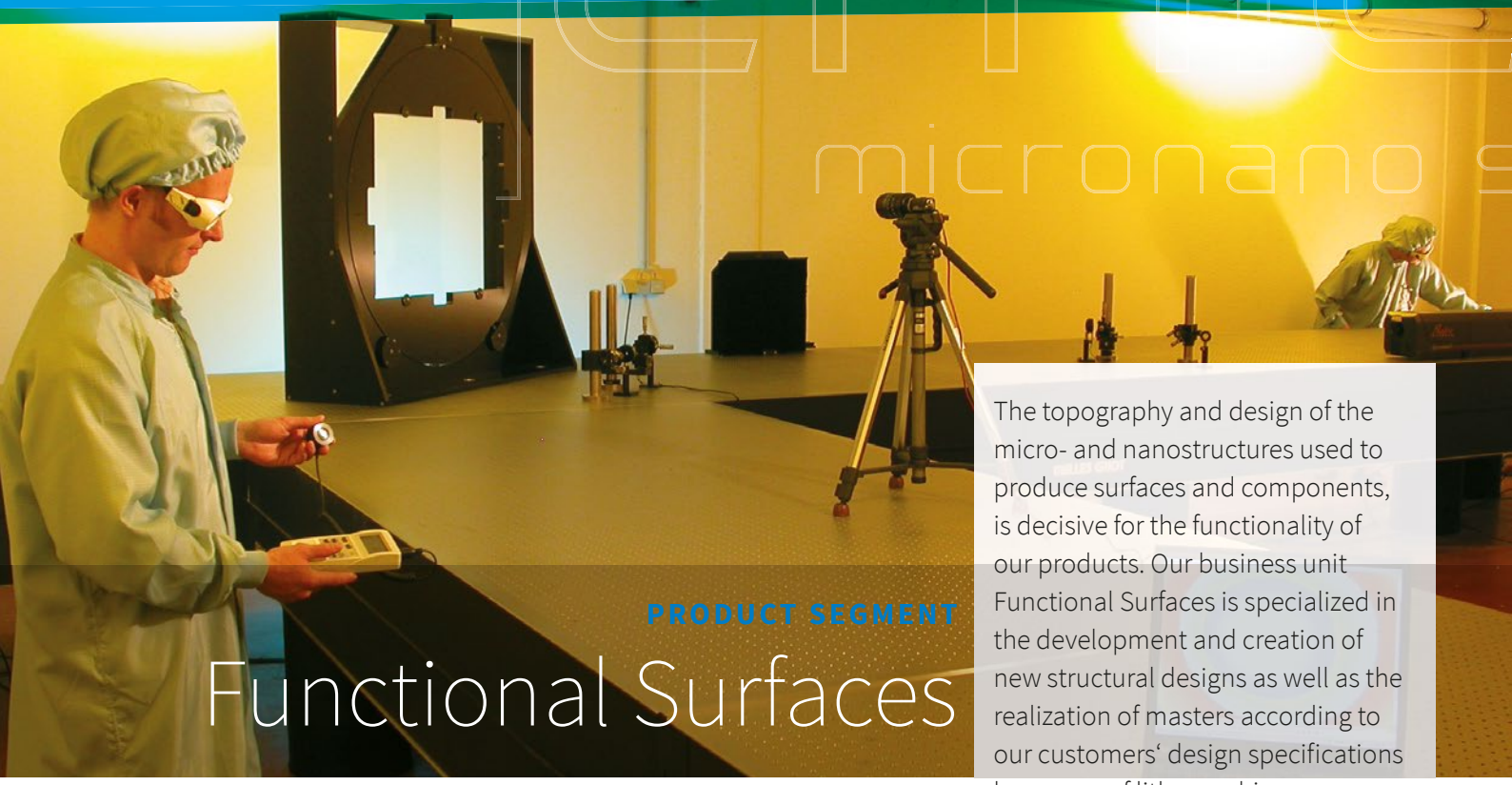
REFERENCES

The antibacterial effect of the Sharklet™ products ensures a high product safety for medical applications.

Self-cleaning surfaces based on the Lotus effect.

Tactile structures help making products perceptible by the senses.

Production



PRODUCT SEGMENT

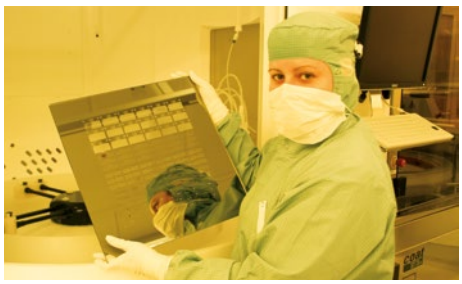
Functional Surfaces

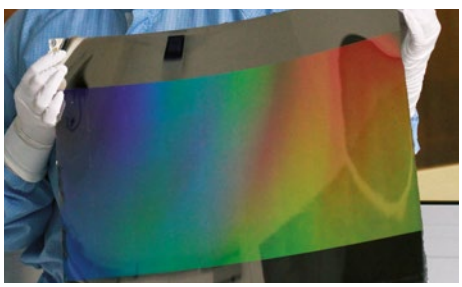
The topography and design of the micro- and nanostructures used to produce surfaces and components, is decisive for the functionality of our products. Our business unit Functional Surfaces is specialized in the development and creation of new structural designs as well as the realization of masters according to our customers‘ design specifications by means of lithographic processes.

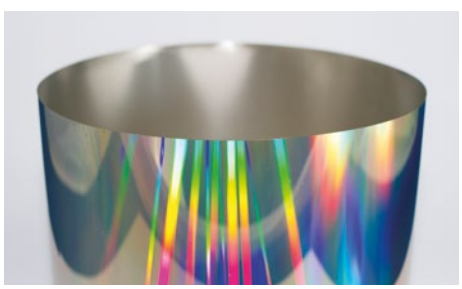
By using UV- and laser interference lithography, temicon is in the unique position to create structures within the range of less than 100 nm up to several 100 µm. Particular attention is paid to seamless functional surfaces of end products up to a size of a square meter.

Large format mastering involves large format electroforming, making perfectly adjusted tools for any kind of replication technology available to our customers. Latest developments in this field paves the way for seamless mastering and electroforming processes on cylindrical surfaces, enabling the continuous production of seamless end products with maximum efficiency.

Design, mastering and tool production of shims and sleeves for volume replication







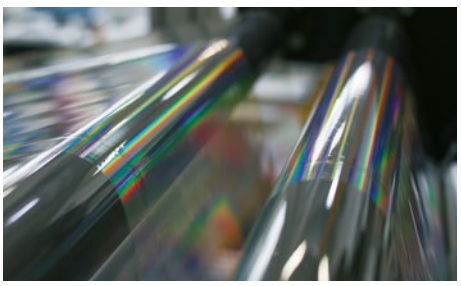
PRODUCT SEGMENT

Films & Panels

Micro- and nanostructured films and panels are produced using our roll-imprint technology, which allows high quality and cost-efficient roll-to-roll and roll-to-plate production of large-area functionalized surfaces. This is done by applying a thin, micro- or nanostructured UV-cured lacquer film on different substrates, such as glass panels, plastic films or sheets leading to films or components with a functional surface.

We have established a technology platform which is one of a kind, by combining our profound knowledge of equipment, process, tool and coating technology. As a one-stop shop and due to our extensive know-how, we can provide customized solutions to our customers, from prototypes via small-scale to large-scale production.

Serial production can be realized using our in-house production facilities, or can be incorporated into the production line of our customers as a turnkey project.



In-house roll-to-roll and roll-to-plate lines for high volume production of films and panels

Production

PRODUCT SEGMENT

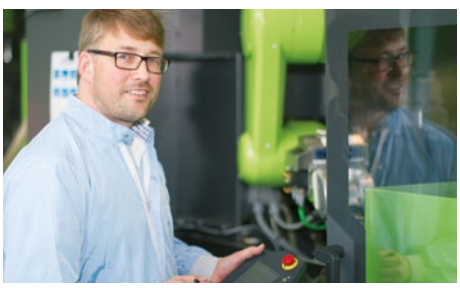
Polymer Parts

You are looking for functional micro- or nanostructured plastic components with a high integration density? Plus, the first piece is expected to be exactly the same as those following, whether we are talking about small-scale or large-scale production? If so, then our business unit Polymer Parts which uses various replication technologies has the knowledge, the employees and technologies needed for joint projects.

Whether you need optical components for LED or laser applications or filters with conical pores or even complex fluidic chips – we are the partner who develops your idea into a feasible product. Our fully-automated injection molding line is designed for 24/7 production and is subject to our QM-system which is geared to guarantee a zero-defect principle.

Finally, our UV-Imprint technology comes into action where other methods reach their limits, thus complementing our innovative technology portfolio and ensuring reliable manufacturing of products with extremely fine structures in large quantities.

Fully automated injection molding lines for 24/7 production of polymer parts



PRODUCT SEGMENT

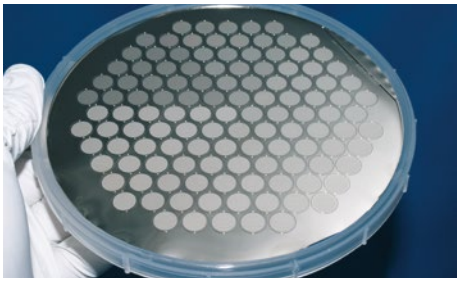
Metal Parts

We use lithography/electroforming technology to produce highly precise metallic microparts at industrial scale. Whenever traditional methods such as metal cutting, embossing, laser cutting or photo etching reach their limits, our innovative technologies come into play.

Typically, a large number of metal components are produced in one batch and separated afterwards, which enables a high quality and cost-efficient volume production. The micro structures have dimensions of several 100 µm down to 100 nm.

Micro membranes and micro sieves are used in a variety of applications, e.g. in environmental engineering, food industry, pharmaceutics, biotechnology, in optical, fluidic, mechanical and electronic systems. Micro-hole structures have the function to filtrate, separate, dose, and nebulise. These small components are often used as the centrepiece of high-tech devices or units.

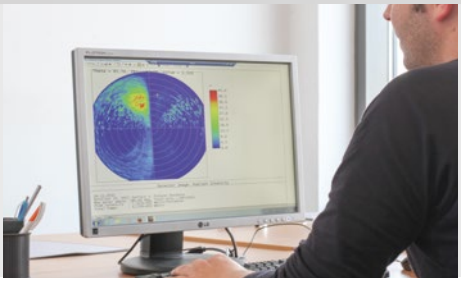
Moreover, microstructured foils can be applied in stencils and shadow masks for screen printing or PVD-processes.



Thousands or millions of metal parts are produced in batch processes on wafer or large format substrates in our lithography and electroforming lines.

Technologies

Design and Simulation



In the design phase of product development, we use up-to-date software tools, a variety of different methods for simulation and visualization of product performance. Our optical modelling team uses raytracing software for optical system design and wave-optical simulation algorithms to calculate optical characteristics of micro- and nanostructured surfaces and optimize their performance. We can create CAD drawings and data sets.

For optical and topographical characterization of products and product surfaces we use high resolution scanning electron and scanning probe microscopes, optical microscopes, photospectrometry for transmissivity and reflectivity measurements, goniophotometers for acquisition of diffusion profiles and ellipsometry. Several testing devices for evaluation of defect rates, water contact angles etc. are available.

UV Lithography

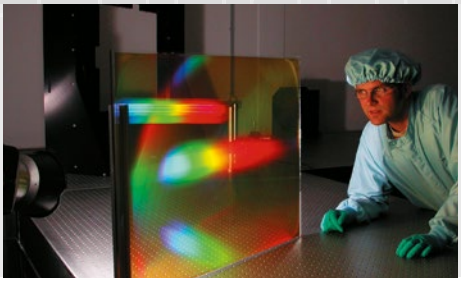
We use UV lithography as a key mastering process for microstructures down to 1 µm feature size. UV-lithogaphy is well known in the semiconductor technology for wafer sizes (4-12 inch).

Over several years temicon has consequently devoloped UV lithography and now has technological USPs in terms of e.g. large formats (square meter), high aspect ratios (above 2,0), precisely adjustable sidewall angles or gapless lens arrays. In this manner, a large variety of microstructures with customized functionalities can be realized.

Two UV lithography lines for
- wafer formats (up to 200 mm)
- large formats (up to 800 x 1200 mm)

are in operation in our 400 sqm cleanroom facility, including resist coating, exposure, wet processing and sputtering.

Interference Lithography



Interference lithography is an unique technology to fabricate highly periodic as well as stochastic surface relief structures in photoresist materials. By modification of process parameters, a large variety of different profile shapes can be generated. One- and two-dimensional structures are realized, whereas the structure geometry could be sinusoidal, parabolic, triangular or even binary. The strength of interference lithography is its upscaling potential to very large, seamless structured areas with a beautiful homogeneity (up to one square meter and even larger). After generating photoresist masters, copying processes by common replication technologies allow the highly cost-effective production of large area film products as well as small structured polymer products.

Electroforming

Electroforming can be used to produce a metallic copy of patterned photoresist masters, thus transforming sensitive micro/nanostructures made of photoresist into a robust metal tool.

For this purpose, a thin metal layer is sputtered on the patterned resist surface. Afterwards, a nickel shim is deposited by electroforming. Typical thicknesses of the shims are in the range of 50 µm up to a few millimeter. The shim is finally laser or wire cut exactly to the required dimensions and if necessary laser welded to a sleeve.

temicon is working on the development of next generation sleeves. These sleeves will be seamless, offering highest efficiency and new fields of application for patterned films.

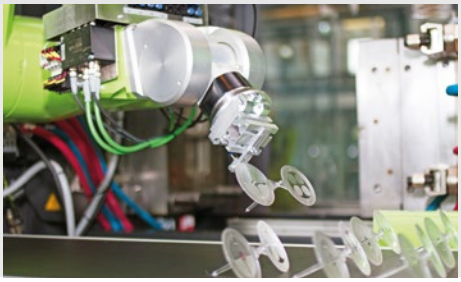
In a similar way, metal parts are electroformed. In this case the galvanic deposition is stopped right before reaching the top of the resist pattern, thus achieving the micro-hole structures in the metal parts.

UV Roll Imprint (R2R/R2P)

UV roll imprint technology is used for the replication of micro- and nanostructures into a thin film on wide web, flexible film and rigid materials. The equipment has been designed and built by temicon, providing us with the requirements to produce functional surfaces in an industrial environment.

A globally unique technology is available, utilizing transparent as well as opaque materials in UV-Embossing. Nearly every flexible and also rigid material, which is available roll-to-roll or in sheets, can be functionalized by micro- and nanostructures, including also metal foils and glass plates. The coating thickness of the applied UV curing lacquer can range from 2-150 µm and have a width of 600mm to form surface structures with sizes from a few nanometer up to 200 µm. UV-Embossing guarantees a 1:1 replication of the structure and therefore highest precision of the optical quality. Using this method the production costs will be essentially lower compared to conventional methods.

Injection Molding



For the production of polymer parts with micro- and nanostructured features in medium to high quantities, we use state-of-the-art injection molding machines and tools. Inserts for the tools are manufactured in-house, using lithography and electroforming steps. Depending on the design of the component, optimized molding processes are established. We can choose from any combination of isothermal or variothermal temperature profiles used for injection molding or injection compression molding. Typical materials processed are transparent thermoplastics like polycarbonate, PMMA or COC/COP, depending on the application.

Other thermoplastic materials can be used as well. Our molding machines are prepared to work in a clean-room-facility and are equipped with fully automated handling robotics. Completed by in-line and off-line analytics we make sure our customers get what they need.

Site Dortmund MST:
UV-Lithography, Nanoimpint and Electroforming

Site Dortmund ZfP:
Injection Molding and Roll Imprint

Site Freiburg:
Laser Interference Lithography

Locations

temicon develops and manufactures micro- and nano-structured products at two sites in Germany: Dortmund and Freiburg. The company was founded in 2005. In Dortmund are the headquarters, cleanroom facilities for UV-lithography and thin film processes as well as 1500 m^2 production area for electroforming, injection molding and roll-to-roll / roll-to-plate production.

The second site is located in Freiburg. holotools GmbH was founded in 2001 as a spin-off of the Fraunhofer Institute for Solar Energy Systems ISE and taken over by temicon GmbH in 2014. Our site in Freiburg is specialized in Laser Interference Lithography e.g. for large format mastering of antireflective structures, so-called motheyes.

Our Partners

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