Automotive
Optical Solutions for the Automotive Industry
Enabling Innovative Optical Solutions
Innovation is part of our tradition

It was at the suggestion of reigning Prince Franz Josef II of Liechtenstein that Dr Max Auwärter – in cooperation with Emil G Bührle – founded the company Balzers in the village of Balzers, in the Principality of Liechtenstein, in 1946. At that time, the technology of vacuum deposition was still in its early stages. With very few exceptions, high vacuum systems were being used only in research laboratories.

Due to the lack of commercially available high vacuum equipment, Balzers had to design and build most of the required vacuum components, equipment and systems necessary for the development of its novel and proprietary thin-film coating processes.

Today, Optics Balzers is a globally recognized leader in customized optical thin-film coatings and components for the photonics industry. The company possesses broad and in-depth know-how in optical thin-film coating processes, complemented by sophisticated patterning, glass bonding and sealing, and further processing capabilities necessary for producing optical thin-film coated components up to optical subassemblies. Highly experienced and skilled development and engineering teams collaborate closely with customers to develop innovative solutions meeting their specific requirements. The combination of these capabilities and skills places Optics Balzers at the forefront of markets in the photonics industry such as Automotive, Biophotonics, Laser, Space & Defence, Lighting & Projection, Industrial Applications, and Sensors & Imaging.

The continuous innovation, quality improvements and additions of expertise and production sites in Liechtenstein, Germany and Malaysia by Optics Balzers, will continue to support customers’ innovative product development efforts with Optics Balzers as a trusted, reliable, and innovative partner.
Automotive Solutions
Our optical components are designed to improve the safety and the comfort of driving by guiding, reflecting, selecting and altering light.

As requirements for road safety, vehicle comfort and level of autonomous driving increase, the demand rises for driver assistance systems based on intelligent high-tech sensor and camera technology.

With precision optics from Optics Balzers innovative systems become a reality. Filters for optical sensors and ultra-thin high performance coatings are key components for the latest generation of near infrared-based active night vision systems, lane departure assistance, adaptive cruise control and head-up displays.

Key components of near infrared-based night vision systems are based on precision technology from Optics Balzers. The active night vision system illuminates the roadway by NIR radiation. A camera, sensitive to near infrared, is placed on the inside of the windscreen and records the roadway scene. The image can be presented by instrument cluster, central display or HUD unit to the driver. This system provides the visibility of driving with high beam and has a large potential for preventing accidents in the dark.
The core competencies of Optics Balzers are the design and manufacture of high precision thin-film optical coatings and integrating them into sophisticated optical components. Optics Balzers' coatings and components are characterized by excellent spectral performance, low defect quality and superior environmental stability. The coatings are produced with state-of-the-art evaporation and sputtering equipment platforms with process and product specific adaptations. The components are both customized to the specific product requirements and optimized for high yield production. Continuous process control like monitoring of the coating process or customer specific component characterization ensures consistent and high quality in volume manufacturing.

**NightVision™ Filters**
With active night vision systems, carmakers are setting new standards in order to prevent drivers from encountering critical situations while traveling during the nighttime. Optics Balzers' NightVision™ Filters offer as yet unsurpassed performance, enabling maximum near-infrared light throughput while reducing the visible light by a factor of 1000 with no visible red leakage. With the help of those VIS light blockers with high NIR transmission the reproduction of objects on the display can be improved significantly.

**NIR-Bandpass Filters SP**
NIR Bandpass Filters SP are used in various optical sensor applications for blocking both ambient visible and longer wavelength infrared light whilst selectively transmitting the signal light of a specified near infrared (NIR) spectral range used for the sensing application. NIR Bandpass Filters SP are key components to achieve very high signal-to-noise ratios in optical sensing or distance measuring applications. This superior signal-to-noise performance can enable either accurate distance measurement with lower signal light power or higher sensitivity and increased precision with standard signal light levels.

**AR-Coatings**
Optics Balzers offers a variety of broadband, anti-reflective coatings to cover a large field of applications: for example Iralin™, a multilayer AR coating designed for maximum efficiency in the visible range. The Iralin™ family can be shifted either into the UV range down to 350 nm or into the near infrared up to 1100 nm.

**Narrow Bandpass Filters for Gesture Recognition Systems**
Gesture recognition and TOF systems like 3D imaging applications require best transmission performance in the range of the illumination wavelength (Laser or LED source) for a wide field of view. Outside the bandpass an extraordinary blocking is required to suppress the ambient illumination for a better contrast. The filters can be provided in various sizes and if required with B-Stage Epoxy or solderable coating frames for optional sealing.
Cold Mirrors
Cold mirrors reflect visible light and allow the transmission of infrared radiation. In general, these mirrors are used at an angle of incidence of 45°, thus reducing the temperature load from a light source by heat-light separation. Plane cold mirrors are an additional component of a high-performance heat management system.

Combiner
A beamsplitter, applied on the front side of the combiner, reflects the image generated by the PGU. The driver can easily read car relevant information on the combiner while being able to see through the combiner at the same time. R:T ratio can be adjusted to the customers need. A broadband AR coating on the substrate’s rear side enhances the overall combiner performance. All coatings are produced with Optics Balzers robust magnetron sputtering technology.

Hardcoatings on Plastics
Plastic substrates often need a hardcoating in order to improve the surface hardness and to enable additional thin film coatings on top. Optics Balzers offers different types of hardcoating solutions depending on the application and the substrate type (e.g. PC, PMMA, COP/COC). The hardcoating solutions developed by Optics Balzers are optimized for dielectric and metallic top coating and meet the harsh environmental requirements of different industries.

Thin-Film Coatings on Plastics
Optics Balzers offers customized coating solutions and components using all major optical plastics. Depending on the requirements, Optics Balzers applies state-of-the-art coating technologies such as IAD evaporation or sputtering to customer supplied substrates and to full turnkey components.

Alflex™ / Silflex™
Alflex™ is a versatile aluminum mirror, providing excellent, stable performance. Depending on the application it is generally insensitive to polarization and angle of incidence over a wide range. All types of Alflex™ are equipped with a protective layer. Silflex™ is a broadband, high-reflectivity metallic mirror offering unprecedented performance and durability. It is virtually insensitive to polarization and angle of incidence, yet maintains more than 98% reflectivity from the visible to the far infrared range.
Patterned Dichroic Filters
Optics Balzers provides patterned color filters for selective spectral filtering on different zones of the cover glass lids. Such dichroic filters may include RGB filters or monochrome UV or IR filters.

Micro-Patterned Interference Filters on Wafer
The spectral response of photodiodes, phototransistors or CMOS sensors can be modified by micro-patterned interference filter coatings. The coatings are applied by photolithographic technology on 2 to 8 inch wafer sizes. Bondpads are kept free. The high positioning accuracy allows several filters to be deposited onto adjacent photodetectors on a die.

Patterned Chrome
Chrome patterns on planar components are widely used in the optical and semiconductor industry. Optics Balzers puts its emphasis on high resolution, low defect patterns – optionally in combination with low defect functional coatings. With CrBlack™ coating, Optics Balzers additionally offers an optical black coating, characterized by high absorption and low reflection in the VIS range.

Polarizing Beamsplitters (PBS)
Beamsplitters – either as cubes or as plates – can be used to separate incoming light into two intensities, polarizations or wavelength ranges. For analytical purposes a portion can be separated from the incident beam or a selected wavelength can be extracted from or coupled into the optical path. The variety extends from simple plates to sophisticated beamsplitter assemblies. Such components are typically customized and can include custom IP.

Low Defect Coatings
High performance digital image sensors require coated lids limited to extremely low defect rates. Optics Balzers offers superior low defect coatings and components produced in the cleanroom production area.
ITO Coatings on Glass and Plastic Substrates

Premium quality, indium tin oxide (ITO) coatings with high transmission and low electrical resistivity are based on dedicated sputtering processes. The ITO layer may be supplemented with dielectric layers for index matching or to obtain anti-reflective properties for the coating. Applications include surface heated cover glasses to prevent condensation, EMI shielding to improve the quality of the sensor or reduction of static charge to avoid attraction of dust.

LED Color Dichroics™ – Dichroic Filters/Mirrors for LED Applications

Optics Balzers LED ColorDichroics™ are used to transmit and/or reflect the light from light emitting diode (LED) sources efficiently. These dichroic filters/mirrors are designed to combine light emitted from LEDs of different colors into one beam. The thin-film coatings of these LED ColorDichroics™ are specifically optimized for random polarized light. Both the high reflection and the high transmission wavelength ranges are specifically adapted to LED spectral emission characteristics.

Filter Coatings

Filter coatings with efficient near infrared (NIR) and optional ultraviolet (UV) blocking tightly shape the sensors’ spectral response and limit the unwanted wavelength range. Details of spectral filter characteristics and wavelength ranges are optimized for customer specific requirements and applications.

TopFlex™ Hydrophobic Coatings

TopFlex™ hydrophobic coatings are chemically resistant to water, oil and grease. This UV to IR transparent top-layer is easy to clean and dirt-repellent. The coating exhibits good adherence to the substrate and other coatings, and is highly resistant to various forms of cleaning processes.

Calflex™ 3000 SP – IR-Blocking Filter

Heat protection filters of type Calflex™ 3000 SP are high performance blocking filters for IR radiation. These filters are produced with the magnetron sputtering technology from Optics Balzers, providing very dense coatings with excellent optical stability both at high temperatures and under harsh environmental conditions. Calflex™ 3000 SP is automotive OEM qualified and meets the ECE white requirements.

ITC Coatings on Glass and Plastic Substrates

Premium quality, indium tin oxide (ITO) coatings with high transmission and low electrical resistivity are based on dedicated sputtering processes. The ITO layer may be supplemented with dielectric layers for index matching or to obtain anti-reflective properties for the coating. Applications include surface heated cover glasses to prevent condensation, EMI shielding to improve the quality of the sensor or reduction of static charge to avoid attraction of dust.
**CoatingPlus™: More Than Just Coating**

Sophisticated optical thin-film components and subsystems require additional process steps beyond coating

**Patterning**

Optics Balzers offers patterning solutions for high quality optical components. Depending on the product and its applications, various patterning techniques such as photolithography, laser ablation or masked coatings are available to meet a broad range of customer requirements for feature sizes and shapes. The lift-off technology allows the deposition of filter arrays onto cover glasses or directly onto photodetector wafers.

**Photolithography**

Photolithography capabilities such as lift-off and etching techniques allow the production of precision patterned coatings and submicron gratings. The photolithography techniques are specifically used in producing masked cover lids for MEMS devices and CCD/CMOS image sensors.

**Masked Coatings**

Precision etched metal masks attached to the substrates provide patterned coatings during the coating process. While the achievable feature sizes and shapes are limited with direct masking, patterning can be applied with almost any coating process and coating material, also with processes that require higher temperatures.

**Marking**

Application-critical thin-film optical components may require unambiguous marking and labeling, either on the substrate surface or on the coating. The pattern can be generated according customers’ specific needs.

**Laser Ablation / Marking**

Laser ablation offers novel opportunities in the patterning of optical filter coatings. By using adapted processes for each specific application, high precision patterns can be produced on the coated components. Laser ablation offers excellent flexibility for customized shapes and patterns together with high speed processing capabilities.
Bonding and Sealing

In various applications, thin-film optical components need to be precision mounted on other components such as sensors or subassemblies. Optics Balzers offers epoxy bonding patterns as well as solder seed layers with a hermetic sealing quality.

B-stage Epoxy
A B-stage epoxy frame on the lid facilitates the assembly process: The epoxy is provided in the dry state and is cured by simple tempering at 100°C – 130°C. The epoxy is applied to the lids in a way which allows for precise patterns and high cosmetic standards. Further adhesive solutions can be developed on customer’s demand.

Gelot™ Solderable Coatings
Light sensitive semiconductor devices require a packaging including a transparent glass lid. Soldering is the assembly technology which provides best hermeticity values of such packaging. Gelot™ solderable coating gives the glass a surface which has good adhesive properties for soldering such as gold or palladium. Gelot™ is applied to the lid as a frame pattern with a clear aperture.

Varnishing

Blackening
High-accuracy dispensing technologies enable continuous or selective blackening of optical parts and complement the low reflection, high absorption coating portfolio from Optics Balzers.

Subassembly
Optics Balzers offers customized optical subassemblies to support its customers’ ever increasing demands. We develop individual solutions for and together with our customers.
Glass Processing

Efficient light management requires ultra precise surfaces. Therefore, Optics Balzers is ever extending the limits of its polishing and glass handling capabilities. Our experience is based on the manufacturing of products where exceptional surface quality is essential. Further, Optics Balzers applies semiconductor cutting technology on coated glass wafers. This is the way to provide cost effective high volume components with small dimensions.

Wafer Dicing and Scribing
The economical production of thin-film coating components often requires substrate wafer based processing. With advanced dicing and scribing capabilities, Optics Balzers manufactures thin-film components to customer specific shapes and sizes with high precision.

Grinding & Polishing
The performance of any optical surface depends to a high degree on the grinding and polishing process. Optics Balzers constantly develops its in-house capabilities for these critical manufacturing steps. Based on our long-standing experience, we are able to identify the most economical solution for your specific application.

Faceting
Faceting helps to avoid the chipping of the workpiece edges in the subsequent manufacturing flow as well as in the final application. Our capabilities include manual as well as fully automated faceting for various workpiece geometries. Standard 45° chamfers as well as other shapes (e.g. C-shape) are available.

Volume Production
The utilization of high-tech singulation equipment paired with sophisticated manufacturing processes allow for a cost-effective mass production of optical parts with small physical dimensions.

Packaging and Handling
Customized packaging and shipping ensures top quality in surface protection and cleanliness during transportation and in subsequent process steps at the customer’s site.

Development Partners
Optics Balzers relies on strong partnerships. Therefore our competence centers in Liechtenstein and Germany count on the close cooperation with scientific institutes, universities, and colleges. Those partnerships allow our teams of engineers to develop innovative solutions, tailored to the individual requirements of our customers.
Applications

The Automotive field is rapidly expanding, driven by development of breakthrough technologies for a broad range of driver assistance applications:

- Lidar
- Head-Up Display
- Night Vision
- ACC
- Lane Departure Warning
- Lane Keeping Assistance
- Traffic Sign Recognition
- Automatic Emergency Braking
- Stop & Go
- Pedestrian Protection
- Collision Avoidance
- Traffic Jam Assistance
- Precrash
- Intelligent Headlight
- Gesture Control
- Welcome Carpets

Windshield Head-Up Display

Combiner Head-Up Display
**Gesture Control**

**Intelligent Headlight**

**Applications**

1. **Driver Assistance Camera**
   - Scene of a truck on the road with a camera and a head-up display indicating an object.
   - Diagram showing the components: light source, sensor, processor, and filter.

2. **Night Vision System**
   - Image of a car driving at night with a head-up display showing an animal.
   - Diagram showing the components: camera, filter, and imaging unit.

3. **Autonomous Driving (Lidar)**
   - Diagram of a car on a highway with lidar sensors indicating objects.
   - Components include: laser source, functional coating, and phosphor element.

4. **Welcome Carpets**
   - Diagram of a car interior with a projector and LED light elements generating a welcome message.
   - Components include: projector, lens, and gobo.
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