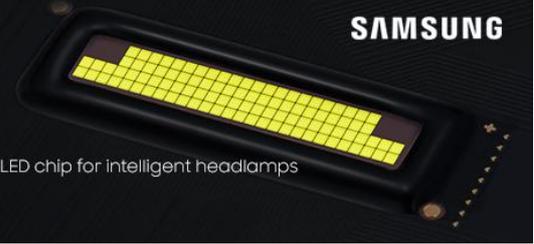


## PixCell LED

Ultimate precision in perfect alignment

100+ individual cells with just 25 µm spacing, perfectly matrixed onto a single LED chip for intelligent headlamps

SAMSUNG



# Editorial

## Micro-Optics: More Than Just Little Lenses

Today I proudly introduce the [DVN Report on micro-optics](#) (that typesetting is at the suggestion of DVN Chief Editor Daniel Stern, and I agree; it looks more interesting and I hope you will like it).

You will find a concise and easy-to-read report, a practical overview about micro-optics for automotive applications. They're used in HUDs (head-up displays); in LED-based interior and exterior lighting; to improve the resolution and image quality of cameras used in reversing-assist systems; in laser sensors for autonomous driving systems; in infotainment displays, and in manufacturing processes to ensure precision and accuracy in the production of car parts. BMW's Light Carpet was the commercialisation which drove the first mass awareness of MLAs (microlens arrays) in the automotive sector, where the technology is rapidly gaining traction—now the first micro-optics headlamps are on the road.

With ongoing advancements, we will surely see more and better applications. An important point to understand is that micro-optics can do more than just act like bigger lenses; their tiny size allows them to exploit the diffractive properties of light—think of a butterfly's wings with microoptical surface structures which selectively reflect and refract light to create brilliant colours, then imagine that principle leveraged to create whole new kinds of 'lightstyles' and visual signatures on automobiles. Exciting!

The progress in lighting technologies never stops. Get informed about the newest trends by visiting the next DVN Workshops in [Tokyo](#) on 6-7 June and in [San Francisco](#) on 29-30 August.

Sincerely yours,

A handwritten signature in black ink that reads "Wolfgang Huhn". The signature is written in a cursive, flowing style.

Wolfgang Huhn  
DVN Senior Advisor

# In Depth Lighting Technology



## DVN Report: All About Automotive Micro-Optics

Today the [DVN Report about micro-optics](#) goes live. Its principal author: DVN Senior Advisor Dr. Wolfgang Huhn. You'll want to download the full report; here we bring you a précis.

**Microlenses**, thinner and lighter than traditional lenses, fabricated with high precision, can handle a wide range of angles and wavelengths of light.

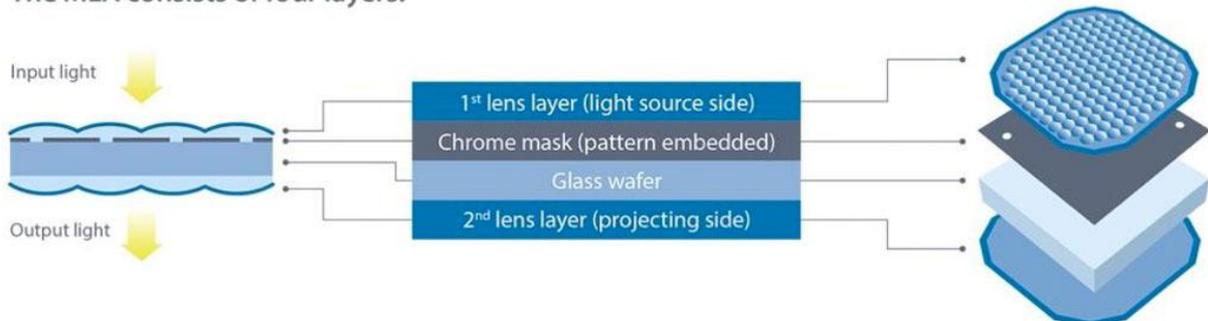
**MLA (microlens arrays)** contains multiple microlenses formed in a one- or two-dimensional array on a supporting substrate.

**Wafer-level optics** is the design and manufacture of micro-optics using techniques first devised for the semiconductor industry, attractive for their effectiveness; affordability, and scalability. With these techniques, anything from a single-element lenslet to a multi-element structure comprising millions of lenses, with precisely-aligned lens wafers bonded together and diced to form multi-element lens stacks.

### Technology

An MLA-based projection assembly comprises an LED light source; collimator, and the MLA itself. The array is a custom-designed module; a typical MLA measures 11.4 × 10.7 × 3.0 mm.

The MLA consists of four layers:



The array is a precisely manufactured set of miniature lenses, or 'lenslets'. As the lens array is fabricated through processes shared with the semiconductor industry, MLA technology benefits from the same cost and quality advantages that silicon chips enjoy. Nanoscale fabrication also means the lenslets can be precisely shaped and positioned so they project a single, sharply-focused image onto a surface—flat, curved, or freeform—at a specified distance and angle relative to the projector.

In automotive, micro-öptics are used in HUDs (head-up displays); in LED-based interior and exterior lighting; to improve the resolution and image quality of reversing cameras; in laser sensors for autonomous driving systems; in infotainment displays, and in manufacturing processes to ensure precision and accuracy in the production of car parts.

## **Prevailing Industry Consensus**

### **Advantages of micro-öptics in automotive applications**

Styling; possibility for black headlamp appearance; homogeneity; enables new functions; compactness (packaging space reduction; miniaturisation, weight reduction)

### **Disadvantages of micro-öptics in automotive applications**

Investment and production cost; special expertise required; tight tolerances and difficult manufacturing processes; individual aperture calculations for each lens in array, relatively low efficiency.

### **Micro-öptics in production**

Light curtains · homogeniser films and optics · colour correction and homogenising optics and lenses · welcome light carpet · projection module condenser lenses · ground projection modules · micro freeform optics · optic approaches for headlamps · microöptical features on primary optics and light guides · signal lights · rear lamps · DRLs · position lamps · headlamps.

### **Main reasons to use micro-öptics**

Styling is the main reason. A lot of new applications like black appearance of headlamps when unlit; contour following light modules; vertical headlamps, and other new original designs stand to be enabled by micro-öptics.

### **Expected growth for micro-öptics applications in cars**

Automaker demand for ground projections will push micro-öptics technology. Overall, over 10 per cent of all automotive lamps have the potential to use a micro-öptical component. The increasing demand for diverse, advanced solutions, as well as the reduction of production costs, is expected to drive the growth of micro-öptics in the automotive industry.

### **Future of micro-öptics in cars overall**

The cost will be reduced by volume and technological progress, as usual in our business. A broadening supplier portfolio over the whole process chain will be the key. Micro-öptics will enable savings in materials, which increases the sustainability of the lamps; that's becoming increasingly important. If micro-öptics become affordable, they will be widely adopted as a routine technology.

## **Applications**

With ongoing advancements, we will surely see more and better applications.

Micro-optics can do more than just act like bigger lenses. Their tiny size allows them to exploit the diffractive properties of light—think of a butterfly's wings with microoptical surface structures which selectively reflect and refract light to create brilliant colours, and then imagine that kind of principle leveraged to create whole new kinds of lightstyles and visual signatures on automobiles.



REVERSE WARNING



AMS OSRAM LIGHT CARPET



REVERSE WARNING, TURN SIGNAL



HELLA FLATLIGHT



GENESIS MICROOPTIC HEADLAMP



LUCID MICROOPTIC HEADLAMP

# Lighting News

## BMW's New Light Channel Next

### LIGHTING NEWS



BMW's newest light channel, a 132-metre-long and 22-metre-wide arrangement called Light Channel Next, is the BMW Group's longest development tool. The facility also includes a workshop where the prototypes are prepared for the light tests.

Different backgrounds are available for the analysis of newly developed lighting technologies and lighting designs.

- The central area is equipped with an asphalt surface that has been artificially aged through a special surface finish. Its reflection properties correspond to those of a road, so that, for example, the colour and homogeneity of static or variable low beam distributions can be evaluated.
- A pavement or a common underground car park floor coating can be used to analyse BMW light carpets, for example.
- An oiled parquet floor, such as usually used for vehicle presentations at trade fairs.
- A test wall 18 m wide and 3 m high which can be lowered if necessary and is used, for example, to measure the colour fringes at the low beam cutoff, or can be used to precisely adjust the headlight inclination.
- The light tunnel is also equipped with a light sail, about 80 m<sup>2</sup>, for detecting unwanted scattered light.
- To evaluate signal lights that are also active during the day, such as turn signals or DRLs, a 10-metre-wide and 5-metre-high daylight wall creates a large, bright background. This can be changed not only in the luminosity, but also in the colour temperature.

In the new light channel, developers primarily focus on the integration of highly adaptive headlamps to ensure safe illumination of the road and surroundings as well as fatigue-free driving at night. But in addition to the safety aspect, lighting for all brands in the BMW Group is also a question of aesthetics. Strikingly-designed DRLs are just as much a part of the lighting equipment of current models, for example as the illuminated BMW kidney grille 'Iconic Glow'.

# Geely's Premium Zeekr EV Brand

## LIGHTING NEWS



Zeekr X compact SUV

Zeekr, the China-based full-electric brand owned by Geely, will start sales in Europe this year. Here's an extract of an interview with Spiros Fotinos, former head of Lexus Europe, now at Zeekr.

"We want to be one of the top three premium pure-EV players by the end of the decade. We will achieve that through product and customer experience. We will take one-stop-shop approach for EV customers, the majority of whom are first-time buyers of electric vehicles.

"We are a brand that was born pure EV. So everything from the perspective of product, service and experience is absolutely focused on that. We don't wear multiple hats. Second, having that Geely mechanism in the background means we know how to produce cars and do it at scale. So our ability to ramp up is different from a lot of the other startup EV brands.



ZEEKR 001



ZEEKR Y COMPACT SUV

"The X and the 001 midsize crossover are just the starting point for us. We have several models in the pipeline. The first deliveries will be in the Netherlands and in Sweden, and then we will be rapidly expanding into the rest of Western Europe through 2026. Both of those models will arrive around the middle of the last quarter this year. Our target for this year is 140,000 units, double what we saw last year".

# LUXIT and PRETTL Announced a Strategic Alliance

LIGHTING NEWS



LUXIT Group and PRETTL Lighting & Interiors announced a Strategic Alliance that will allow both organizations to better serve its global customers. This step toward the future ensures that customers in every region of the world can receive product produced in that region.

**PRETTL Lighting & Interior** has production locations in Poland, Portugal and Mexico; with a development center in the Czech Republic.

Daniel Haag, CEO of PRETTL Lighting and Interiors said, “This is the perfect time to join with another highly regarded lighting supplier to ensure that our customer needs are met. With this partnership, we will be able to support our customer demands in every part of the world without the spend required to open a green field facility. This will help ensure competitiveness and future growth.”

**LUXIT Group** has production locations in the United States, China, Taiwan and Mexico; with a development center in the United States.

Stephane Védie, CEO of LUXIT Group stated, “This Strategic Alliance comes at a time that our customers are requiring product comes from the region in which the vehicle is manufactured. By working together with PRETTL Lighting & Interiors will ensure that our customers are getting the best possible product, at the best cost, in the region that they are manufacturing their vehicles.”

# A lot of Chinese models launched

LIGHTING NEWS



## Great Wall's Haval Thunder Dragon



The new car is priced from 18,500€, cheapest plug-in hybrid SUV under the Haval brand. The model adopts the design of a closed grille and is positioned as a compact SUV. With a borderless shape, the pixel-like grille slowly shrinks from top to bottom. The LED headlights are designed with teary eyes shape.

## Nezha GT



The flat, low-lying shape features an X shape with an X-shaped front "boomerang" light cluster and deflector, concealed door handles and frameless doors on the side. The front lamp realizes fully automatic information display on the basis of the traditional welcome light language,

## GAC Aion Hyper GT



The model adopts a closed grille design, and the headlights have a sharp shape.

## Denza N7



The exterior design of the Denza N7 combines the forms of hunting car, coupe, and SUV, with a closed front face, hidden door handles, end to end taillights, and large-sized wheels.

## BAOJUN Yep small electric SUV



BAOJU Yep adopts urban zebra headlights, "four horizontal and four vertical" layout, equipped with automatic headlights, built-in 184 LED lamp beads. The tailgate is also equipped with track rear taillights on both sides of the tailgate, with a three-lap three-dimensional design and 164 built-in LED lamp beads.

## BYD Seal Championship Edition



The headlights are slender and the daytime running lights are designed independently outside the lights. The end to end taillights echo the headlights, and the arrangement of the internal lamp cavity is similar to water droplets, very recognizable at night.

## IM Motor LS7 Elite



The exterior of this model adopts a new design style, the headlights of the front light cluster are equally divided with the fog lights, and the enclosed grille occupies not much area. The rear part with end to end design.

## NIO ES6



The ES6 continues the one-piece lampshade with a Double Dash two-stage strip design that combines LED matrix headlights and through-side deflectors into one. Matrix light strip composed of 42 LED lamp beads on one side.

## BYD Han DM-i Champion Edition



The front part adopts a large air intake grille and the interior is a dot matrix design, which is very recognizable with the LED headlamps on both sides.

## BYD Han EV Champion Edition model



Adopting the "Dragon Face" design language, the taillights with end to end design with a Chinese knot pattern on both sides.

## Changan DEEPAL S7 electric SUV



Second model of the DEEPAL brand, the DEEPAL S7 continues the family design style and is more in line with the aesthetic preferences of current young consumers. Slender and sharp headlamps and a closed front grille, and end to end LED rear lamp.

## Wuling brand SUV



The new car was named "Wuling Nebula". The new model is positioned as a compact SUV with a five-seater layout. It is reported that the new car will be officially launched in the second half of this year. The front grille and headlights are integrated, and the rear adopts a full width light strip.

# MagWerks Vision are GAMIC Winner

LIGHTING NEWS



The Global Automotive & Mobility Challenge—GAMIC—is an annual competition for early-stage automotive and mobility companies with new technologies. It was created to identify innovative companies from around the world; cultivate new technologies and solutions; and hasten their adoption into the automotive and mobility industries.

This year, GAMIC chose four innovative startups—from an initial field of over 1,500—as winners of the 15th annual competition, sponsored by SAE International and MI Innovation Alliance. Among them: DVN Gold member MagWerks Vision, headed by founder and CEO Michael Pickholz (photo).



MagWerks and the other three winners went through three rounds of winnowing by senior automotive industry executives from automakers and tier-1 suppliers, as well as from the startup investment community. Judging criteria included their business plans; strength of their intellectual property; uniqueness, and potential value of their technologies to the mobility industry.

GAMIC winners receive in-kind commercialisation assistance—including legal; incubation; financial and engineering modelling; investor preparation; cybersecurity support, and targeted executive introductions—and cash to accelerate their business in the automotive and mobility space. They are also introduced to relevant senior decisionmakers in automakers and suppliers.

GAMIC Master of Ceremonies, John McElroy said: “The quality and ingenuity of the products and services presented by the GAMIC finalists are truly world class. Every automaker, supplier and investor should be lining up to get first crack at bringing them to market.”

Pickholz is well known for his relentless pursuit of highly performant, lightweight lighting with innovative technology including better-than-plastic thixomoulded magnesium structural reflectors and silicone optics. He and his MagWerks Vision company aim to become the premier lighting supplier to the mobility and EV industries. Last month we [reported](#) on MagWerks Vision's recent innovations and successes.

# EOI's Q2 revenue is expected to reach a new high

## LIGHTING NEWS



EOI, a lamp LED module manufacturer, is expected that Q2 consolidated revenue will challenge new highs as the shortage of materials improves, new projects are gradually introduced into mass production, and the contribution of Michigan plant in the United States is amplified.

EOI products are mainly sold in the US market, the outlook of the US car market this year is still relatively positive, coupled with the US IRA (Inflation Reduction Act) mainly benefits from local car manufacturers in the United States, are also EOI customers, encouraging EOI Q1 revenue performance off-season is not light, Q2 revenue is expected to continue to rise, and maintain double-digit annual growth performance, legal person expects that EOI Q2 profit will be further improved.

EOI Michigan plant in the United States is expected to have 3 vehicles into mass production this year, including in the second half of the year the large project Ford F150 best-selling car. In addition, the market is also concerned that Tesla Cybertruck will enter the mass production stage at the end of this year, because EOI's main lamp factory customers are also Tesla suppliers, which is expected to inject new momentum into EOI's operation.

# Driver Assistance News

## InnovizTwo for New Light Commercial Vehicle

DRIVER ASSISTANCE NEWS



A major automaker aims to expand their use of the InnovizTwo lidar, by installing it in an existing light commercial vehicle program. With a mid-decade SOP target, the program is on an accelerated track with an agreed framework, pending finalised technical requirements and commercial terms. Potential financial contributions from this program are anticipated to begin this year.

This collaboration includes an important integration with a major computer platform with the potential for additional expansion opportunities. Innoviz cofounder and CEO Omar Keilaf says the expansion "marks a critical milestone in validating our strategy and highlighting the value of our technology. An important part of our long-term business plan has been to show that we can gain a foothold with a large customer and earn the right to become their lidar vendor for multiple vehicles in their lineup. This expected expansion of business with one of our largest customers could achieve that, while also offering a meaningful financial contribution for 2023 and beyond".

*Innoviz are a global leader in lidar technology, working towards a future with safe autonomous vehicles on the world's roads.*

# Ouster Expand Supply Agreements with May Mobility

## DRIVER ASSISTANCE NEWS



May Mobility AV with Ouster lidar sensors

Ouster will provide a greater volume of lidar sensors for May Mobility's autonomous vehicle programs. The supply expansion includes a binding commitment for a combined purchase of over a thousand Ouster OS1 and Alpha Prime VLS-128 sensors through 2024 to meet demand for new AV deployments starting this year.

Ouster have already shipped hundreds of sensors to May Mobility for their commercial programs; May's vehicles have four Ouster OS1 digital lidar sensors for short and mid-range detection and one Alpha Prime sensor for long-range detection, providing surround-view coverage to increase safety and performance.

**Ouster** are a global provider of high-resolution scanning and solid-state digital lidar sensors; Velodyne Lidar sensors, and software solutions for the automotive, industrial, robotics, and smart infrastructure industries. Ouster support over 850 customers in approximately 50 countries.

**May Mobility's** proprietary Multi-Policy Decision Making system is at the core of their mission to help make cities safer, greener and more accessible.

# Two More Awards for Valeo's Lidar Technology

## DRIVER ASSISTANCE NEWS



Valeo's Lidar technology received the SafetyBest Award during the AutoBest Gala last week, and an ICA Summit Automotive Sensor Hardware Solution of the Year award, as well. Valeo are the first tier-1 supplier to receive the SafetyBest Award, which demonstrates the increasing role of suppliers in driving innovation in the automotive industry.

These two awards for the lidar confirm Valeo's technological leadership, coming as they do after the Pace Award in 2018 and the Frost & Sullivan Market Leadership Award in 2022.

Valeo announced this past March orders over the past 18 months worth more than €1bn for their latest-generation Scala<sup>3</sup> lidar. They were the first, and remain the leading company, in the production of automotive lidar sensors and perception software on an industrial scale for L<sup>3</sup> autonomous driving.

Clément Nouvel, Valeo's lidar CTO, says "Valeo's lidar technology is the result of more than 10 years of development and has been in production for more than 5 years. It is already in use on vehicles around the world and contributes to the safety of road users as well as to the development of automated mobility. We are proud to receive these new awards that acknowledge our commitment to deliver the best technologies to our customers and contribute to greener and safer mobility around the world".

Scala<sup>1</sup> and Scala<sup>2</sup> made conditional autonomous driving in traffic jams a reality. Scala<sup>3</sup> dramatically increased the domain of operation of private vehicles thanks to a wider scope of use and higher speed support. Valeo are also positioned as a leader in robotaxi equipment, as Scala<sup>3</sup> enables making robotaxis at scale using a proven, best-in-class technology already in mass production.

# Lidar is '21st Century Seat Belt': Luminar CEO

DRIVER ASSISTANCE NEWS



Austin Russell, the 28-year-old billionaire founder and CEO of Luminar Technologies, has likened lidar to the seat belt in terms of centrality to dramatically reducing traffic deaths and injuries.

Russell acquired an 82-per-cent stake in Forbes Global Media Holdings, parent of the well-known *Forbes* business magazine. The deal values the company at close to USD \$800m. The seller, Hong Kong-based Integrated Whale Media Investments, will retain a minority stake. Russell plans to serve as a visionary for the Forbes brand and won't be involved in day-to-day operations, according to the statement.

# Robosense officially entered the Omniverse ecosystem

DRIVER ASSISTANCE NEWS



RoboSense officially announced that it joined the NVIDIA Omniverse ecosystem to accelerate the development, testing and verification of its lidar technology.

NVIDIA Omniverse is a scalable, multi-GPU real-time development platform based on Pixar's USD and NVIDIA's RTX technologies. On the platform, creators, designers, researchers, and engineers can connect key design tools, assets, and projects, collaborate and iterate in a shared virtual space. In addition, developers and software providers can easily build and sell extensions, applications, connectors, and microservices to extend their capabilities on Omniverse's modular platform.

Robosense has now introduced the second-generation intelligent solid-state lidar model into the DRIVE Sim platform built on NVIDIA Omniverse, which can realize high-fidelity lidar sensor simulation based on physical reality. Users such as car companies or autonomous driving solution providers can directly call the lidar model for development or testing through the platform.

# General News

## Might Musk Rain Money on France?

GENERAL NEWS



French President Emmanuel Macron (L) and Elon Musk

President Emmanuel Macron met with Elon Musk and other business chiefs to urge them to invest in France, and his office said the country is poised to win record foreign investment pledges. Musk, who also had lunch with Finance Minister Bruno Le Maire, said he is confident Tesla will make "significant investments" in France in the future, without giving a timetable. "No announcement today but I am very impressed with President Macron and the French government and how welcoming they are," he told reporters.

Le Maire also pitched to Musk new tax credits for investments in green technology made public last week. Tesla's German plant near Berlin began delivering cars in March 2022, and produces around 5,000 Model Y vehicles a week, with a maximum capacity of 500,000 cars per year.

Macron said France's existing cash incentive of up to €5,000 for buyers of new electric cars will be made conditional on their producers meeting tough low-carbon standards, effectively excluding cars made outside Europe.

# Bentley: Another World

## *Extract from French «Les Echos»*

### GENERAL NEWS



In the Crewe factory, south-east of Liverpool, Bentleys have been manufactured since 1946. At the heart of these red brick buildings, almost everything is made by hand. In the assembly workshop, where more than 700 employees work, there are only two robots.

In 2022, the British manufacturer delivered 15,000 cars, including nearly 6,500 Bentley SUVs. To ensure this record production, Bentley relies on the skills of 4,800 people. By way of comparison, Renault employs 2,000 people to produce nearly 80,000 vehicles a year at its Spanish plant in Palencia.

When positioning yourself on the ultra-luxury car market, many operations cannot be automated. The paint must, for example, be partly applied by hand to ensure perfect color uniformity. Once lacquered, each Bentley is lightly sanded before being polished for twelve hours with sheep's wool.

The possibilities of personalization are like the final addition: without limit. The color and material specialists, most of whom have been with the company for decades, work with unsuspected materials in a car, such as stones or precious metals. Wood is also a regular feature in master cabins. Walnut, cherry, oak, beech, cherry: the dashboard can accommodate many veneers, affixed by experts in white gloves. In addition to the material preparation time, each cabin requires an average of two days of work. The upholstery workshop employs 320 people. Among the hundreds of hours needed to build a Bentley, the part devoted to creating the interiors is quite heavy. Sewn, shaped and finished entirely by hand, the seats, door panels and other leather accessories take up to forty hours to sew.

With what success? Bentley's new clientele, ever younger and wealthy but also very attentive to new technologies, could allow him to take the turn without skid. For conservatives, unknown also remains a source of hope.