DVN Munich Workshop Report

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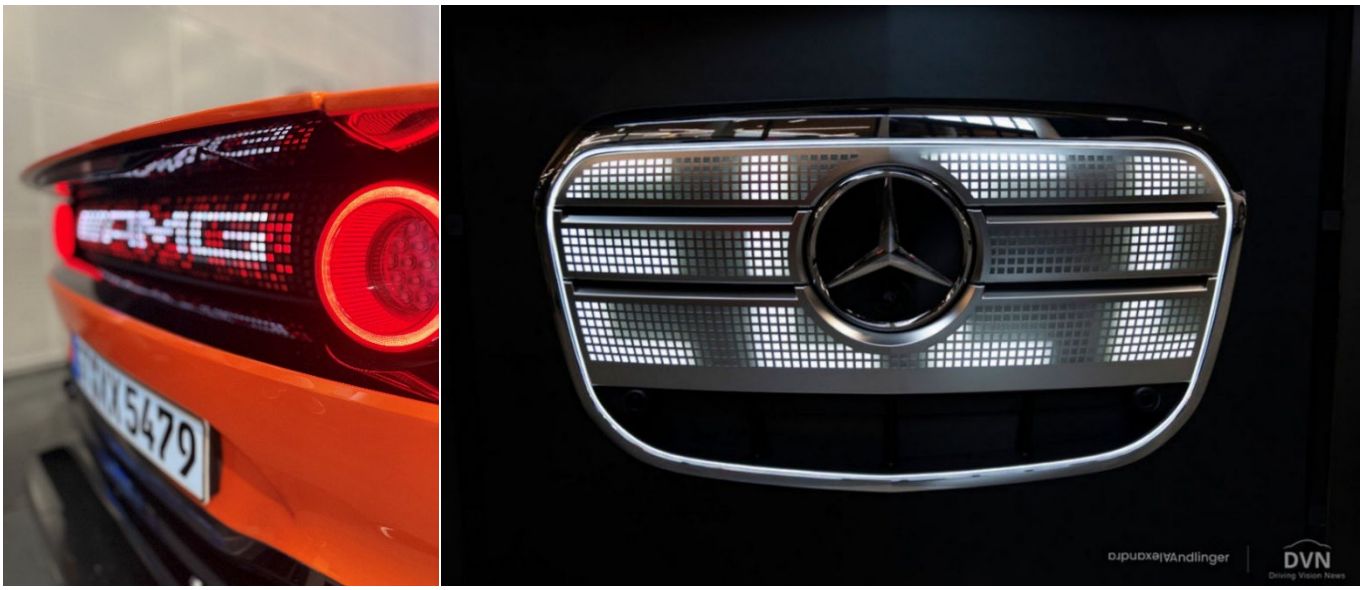
TABLE OF CONTENTS

EXECUTIVE SUMMARY & KEYNOTES SPEECHES



Last February 2026, we host our annual event in Europe, in Munich, the automotive capital city in Europe.

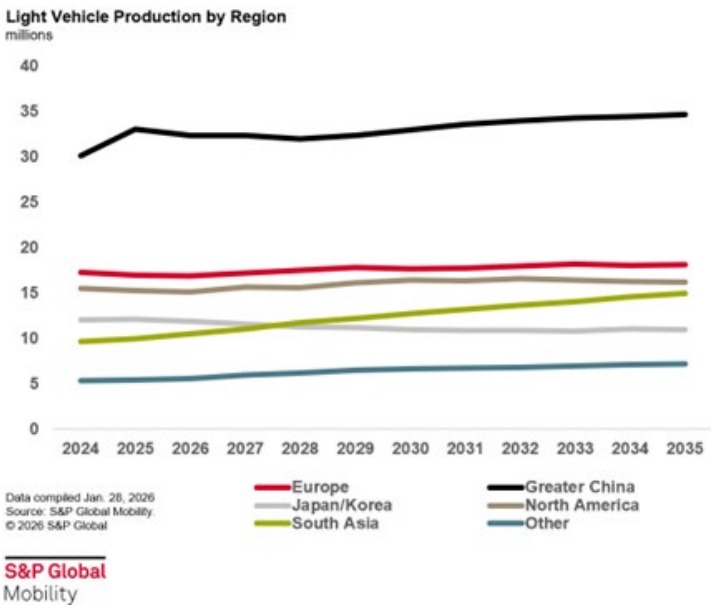
Although the company travel restrictions, the intense competition we are all facing in our daily activity, we see the need for connection and networking. Innovation is still driving our business with a lot of new technologies from light sources, semiconductors, Software, raw material companies. We need to follow the trend, to be award about what is coming. And then, where to go? DVN seems to be one of the places. That's why 620+ automotive lighting experts joined this event. Just for that we would like to thank you for your trust in our platform.

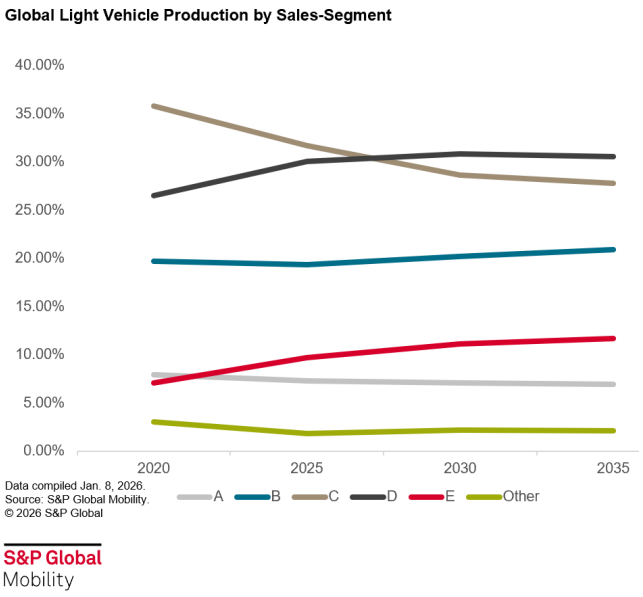
The conference agenda was focused on what's next?

For this purpose, we organized a design contest with design school to have their fresh view about what may come in 2035. We organized also a dedicated session about optical design, EE strategy, simulkations tools that may incorporate AI and a deep dive session about illuminating grills, incorporating films, ink and a lot of new technologies.

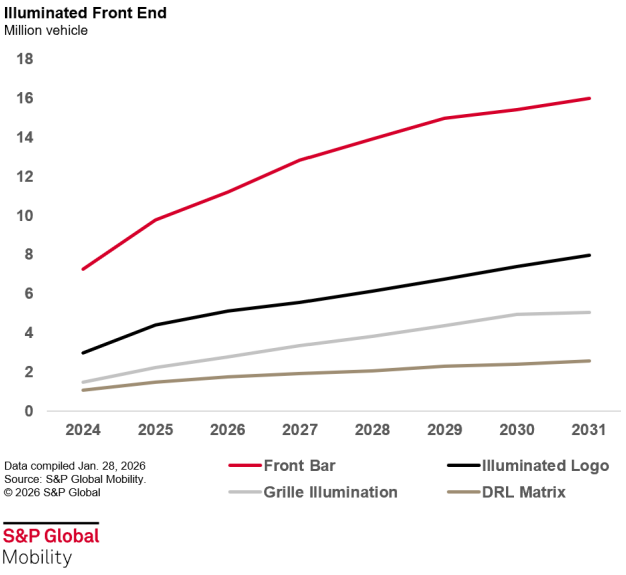
It's not easy to watch in a crystal ball, but we have some datas. S&P shared during a keynote some interesting figures about the automotive market and more especially the lighting markets.

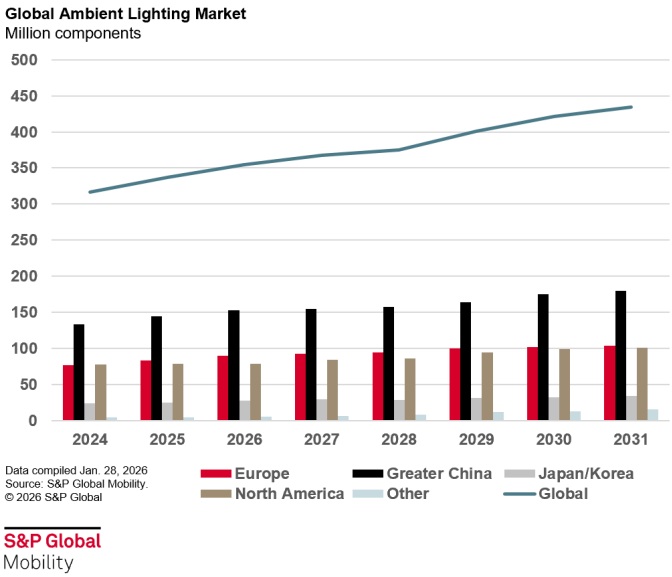
- Automotive market is flat in number, but increases in value (D & E segments are increasing)



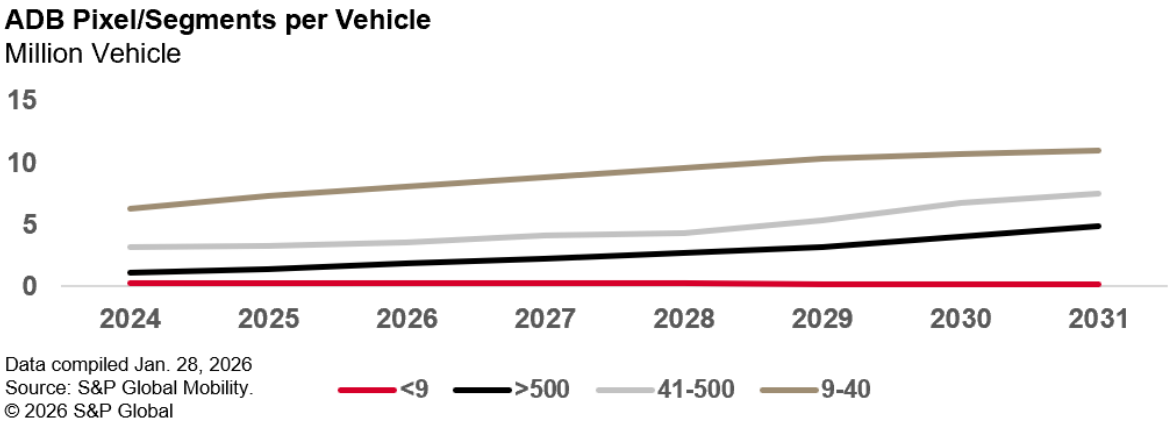


- Illuminating grill, logo interior lighting, what we may call ‘christmas tree and bling bling lighting’ is booming with more and more units and value per car





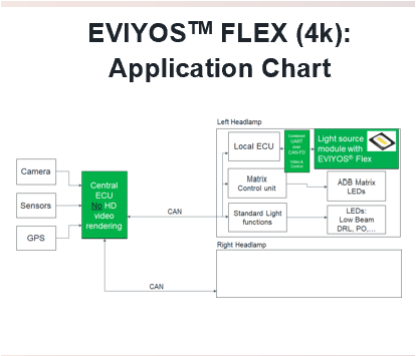
- ADB is continuing to grow with more and more vehicles equiped with ADB, and then with HD, that means Safety is still something important for final customer



Jorg Strauss, ams OSRAM EVP, focused his Keynote speech on 3 mains topics; Innovation, Cost an Resilience that was for him the main 3 topics for our industry

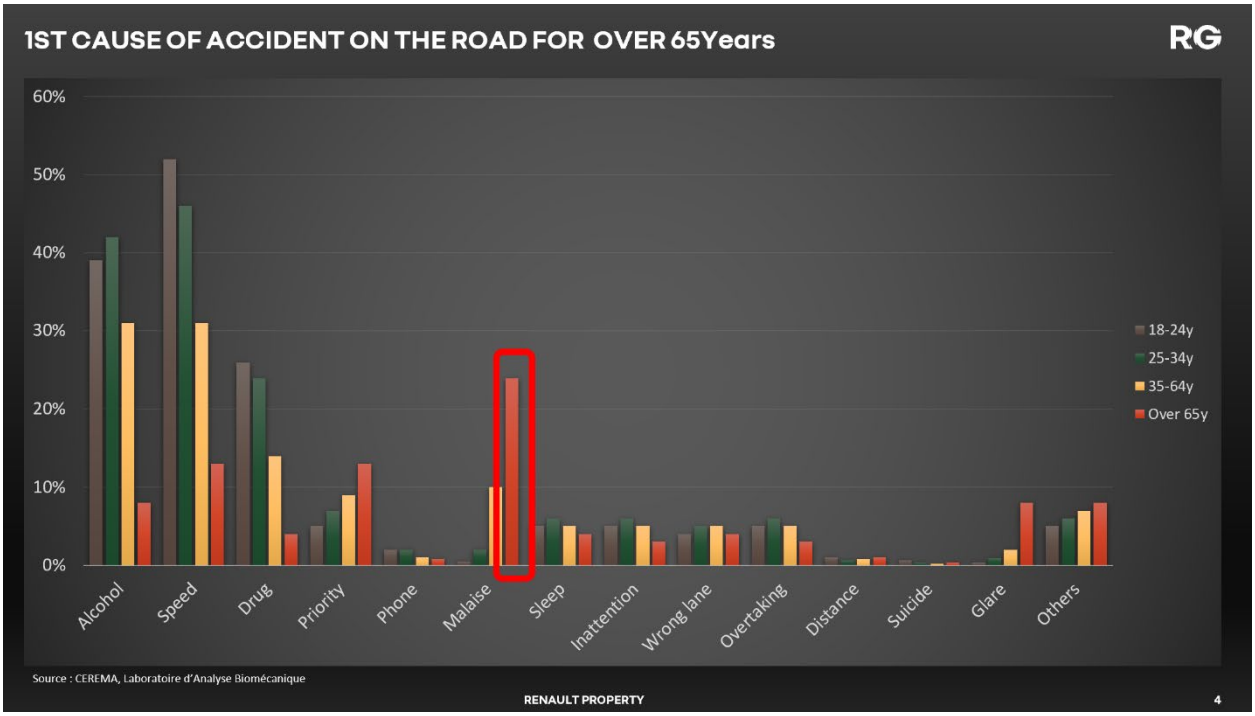
- Innovation, like MicroLED or MiniLED technology

- Cost like Eviyos Flex 4K, that allows OEM to remove LVDS connection and connect microLED technology with CAN FD (quite easy with SDV architecture)

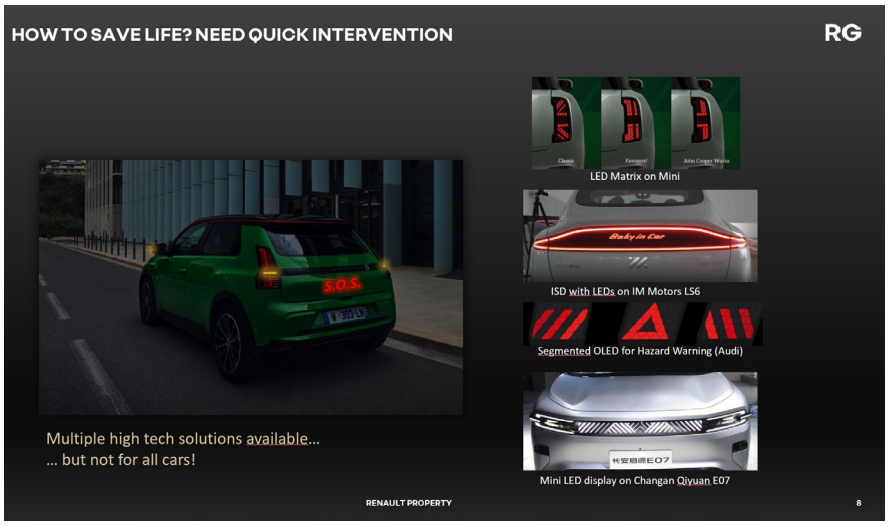


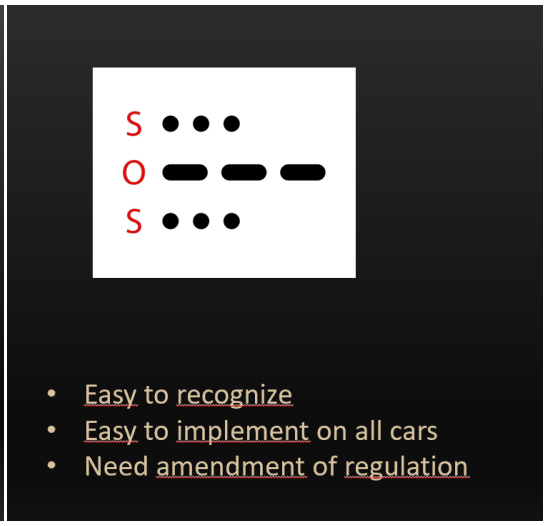
- Resilience, like IP respect and global footprint to be able to propose local for local

The last keynotes from Renault (Francois Bedu) were focusing on how can lighting save life as a visible alert to warn other road users. 25% of accidents are due to disease and could be prevented with an exterior alert



However, visible alert is not allowed today (and same for e-call) and maybe a modification of lighting regulation should, be done to open new lighting usage to prevent accident, as proposed by Renault.





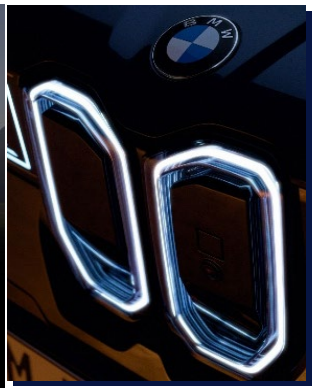
This would open a lot of new possibilities, innovation and design ideas

PANEL SESSION SUMMARY WITH MERCEDES BENZ, AUDI & BMW LIGHTING LEADERS ABOUT AUTOMOTIVE LIGHTING CHALLENGES

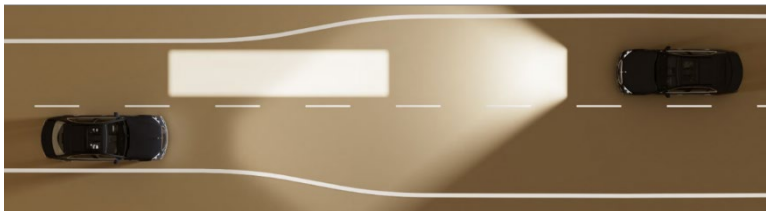
We gathered on stage lighting leaders from Mercedes, Audi and BMW to exchange with the automotive lighting community about the challenge our industry is currently facing.

Discussion started with OEM highlights

BMW mainly focused with “Neue Klasse” (last year DVN award for best concept car lighting) by integrating smartly sensing and lighting and realizing classical BMW design (e.g Kidney style).



Mercedes Benz marked their highlight with “Lit Grill Concept” (demonstrated during exhibition, receiving award for “best new technology”) and also introducing to the market their next “digital light generation” with MicroLED technology.



Audi mentioned new Q3 with Micro-LED plus OLED available now for all vehicles at least as an option and closed all functional topics developed over the last years in reality now.

First question was focused on **lamp size and performance**, a usual discussion between R&D and Design team, never easy to arbitrate.

Audi is handling with early involvement of design options by specifying module sizes (e.g beam angle defined beforehand). No compromise on performance. Targets are well defined and agreed. BMW is quite similar with early agreement with design on target values including size. Mercedes is defining lens area (size). If necessary, compensation via aperture (light cone) may be realized to find the best compromise. Also, Mercedes mentioned that signal lighting of GLC and S-class were also a challenge for design and functionality (3D Star).

Second question focused on ADB, and especially ADB US – why not first?

Mercedes clearly stated that added value as function is main reference. Functions are also dependant on platforms and which architecture is under consideration. Audi claimed that initially SAE and NHTSA had a specification, but then NHTSA came with its own proposal. So adaptations were necessary regarding oncoming traffic (glare values low/high beam), including camera software modification (detection). That took time.

What about SDV (software defined vehicle). Is SDV generate any change of process and organization?

Audi mentioned JV with Rivian (VW – RVT). New generation is under development with HW and SW, and also Audi will be incorporated with next vehicle. Audi is preparing R&D capacities, with already more than 50% workforce in function development (including SW)

Mercedes is focusing on its “own operating system” (OS). Then SW can be realized by its own or outsourced. certification still a bit more HW and SW identification under work (unclear still)..

What about China (Speed and Platforms): how to answer?

BMW identifies change management being necessary but also mentioned this is time consuming. China is more stringent in staying with fixed design until SOP. BMW still manages design iterations if necessary. Audi has been first by trying a unique “Chinese platform” with Safety, Chassis and Design initialized in China (with target price 50% of normal price). Speed is possible but acceptance of China standard and R&D to be proven. (Audi E5 Sportback with SAIC).

Mercedes is claiming short life cycles with partially low sustainability. Mercedes is still focused on reliable safety concept, and does not develop only entertainment lighting feature like “fixed DLP module”

What do they think about Exterior Displays – progress and regulation ?

Mercedes has already worked on specification for components in an advanced mode. Potential Use Cases are still under discussion (probably conflicts with Design). Audi pretty much agreed with discussion during “deep dive session” the day before DVN Munich event. We need a set of standardized Symbols to be learned and widely accepted. This should be realized before” autonomous driving” become reality. In 2027 Audi will demonstrate more options either mandatory or optional, but correlation with “autonomous driving” is obvious. BMW still under discussion which direction to focus.

What about Sustainability – How do you focus here?

BMW realized a deep headlight research study with Hella (> 70% of components able to be recycled). Nevertheless, design compromise is necessary, and Light is only 1 % of total vehicle (so what?). More focus is needed on energy efficiency.

Mercedes has lighting activities bundled with program “Tomorrow XX” (possibility to exchange components for aftermarket or lamp reuse). Audi is also a bit sceptical on lighting design requirement (“homogenous light”) that are destroying energy (low optical efficiency). Activities derived on 48V Bord Net that may be more efficient for lamps (no need to have voltage buck/boost that may be replaced by only a buck that is more efficient (and cheaper).

How to improve ADB performance. Closed Loop ADB – How do go forward ?

Audi focused on simplification of production but future direction clearly on autonomous Headlight. (e.g Headlamp including sensors that include the right aiming). Predevelopment is ongoing , SW bottlenecks is still the pain. Mercedes has very high interest in SW – and System development. Predevelopment is also ongoing, not yet fully ready but with a strong focus.

As a conclusion, what would be the 3 key messages for suppliers?

BMW focused on Trust, Reliability and Know How. As a Summary, the Quality of Work. Stronger Home Base of suppliers in Germany is desirable. Mercedes is strongly confirming that pressure is getting stronger, complex change management is sometimes absorbing and purchasing decision are not getting easier.

Audi summarized with “fair partnership” integrating competence, quality and willingness to co-develop.

SESSION 1 PART 1 – LIGHTING, COMMUNICATION & DESIGN – THE NEW 3 PILLARS FOR OUR COMMUNITY

Mercedes-Benz – Anton Nelson, Dominik Reule, Üsame Akkoca

“The Mercedes Tech-Program Concept AMG GT XX”

The presentation was given by all three authors, who work in the predevelopment of front and rear lighting systems and the exterior innovations department. The introductory video showcased the AMG XX concept's high performance, demonstrating that the long-run test resulted in traveling "around the world in under 8 days," covering 40075 kilometers.

The AMG XX's headlight system was designed for high-speed runs on the racetrack. It contains two wide and four ultra-range high-beam modules, which give the driver the utmost confidence at very high speeds at night on the track. A static bi-LED module produces a low beam, which is irrelevant for racing purposes, as well as a wide high beam. Additionally, there is a set of perimeter lamps for styling and the usual DRL/PO/TI functions.

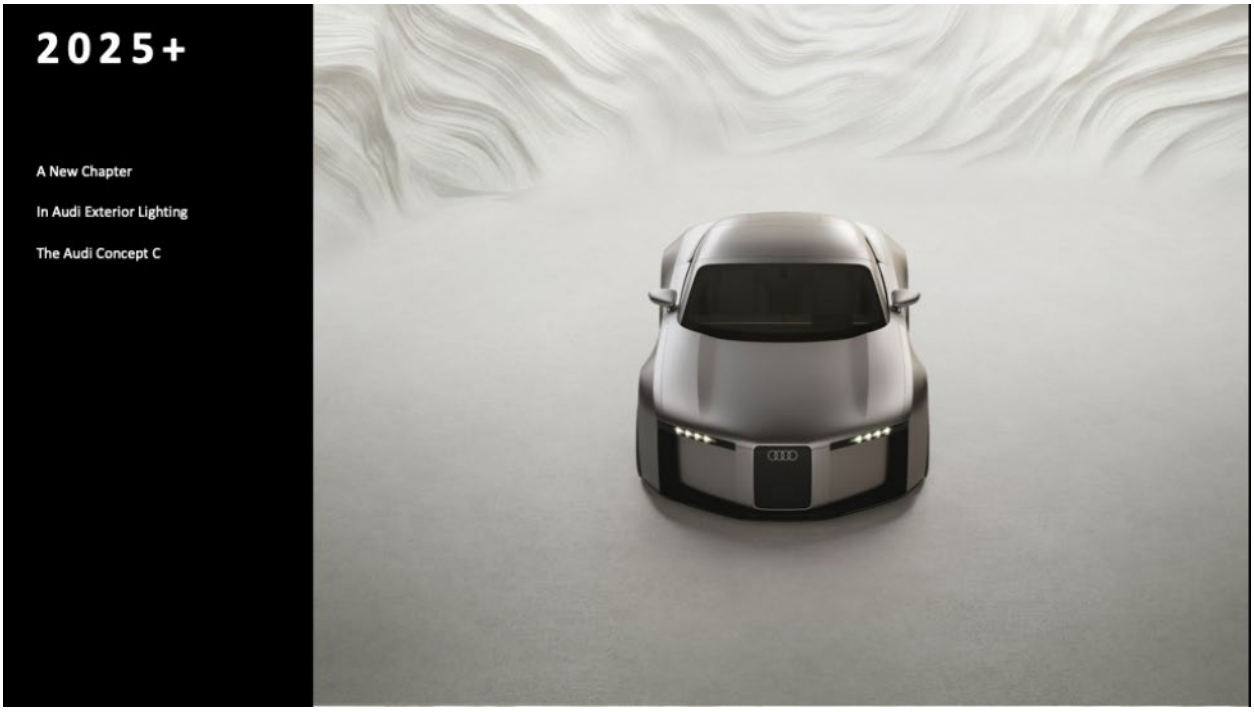
The rear lamp system contains all relevant ECE functions, including a CHMSL and rear reflectors. A special feature of the rear end is the innovative MBUX fluid light panel, which enables active communication with the environment. It contains over 700 individually controllable RGB LEDs with a 3D pixel look and spatial depth effect. The content of the display varies, including styling elements, such as the animated AMG logo, as well as general information, such as charging status, driving mode, and safety information.

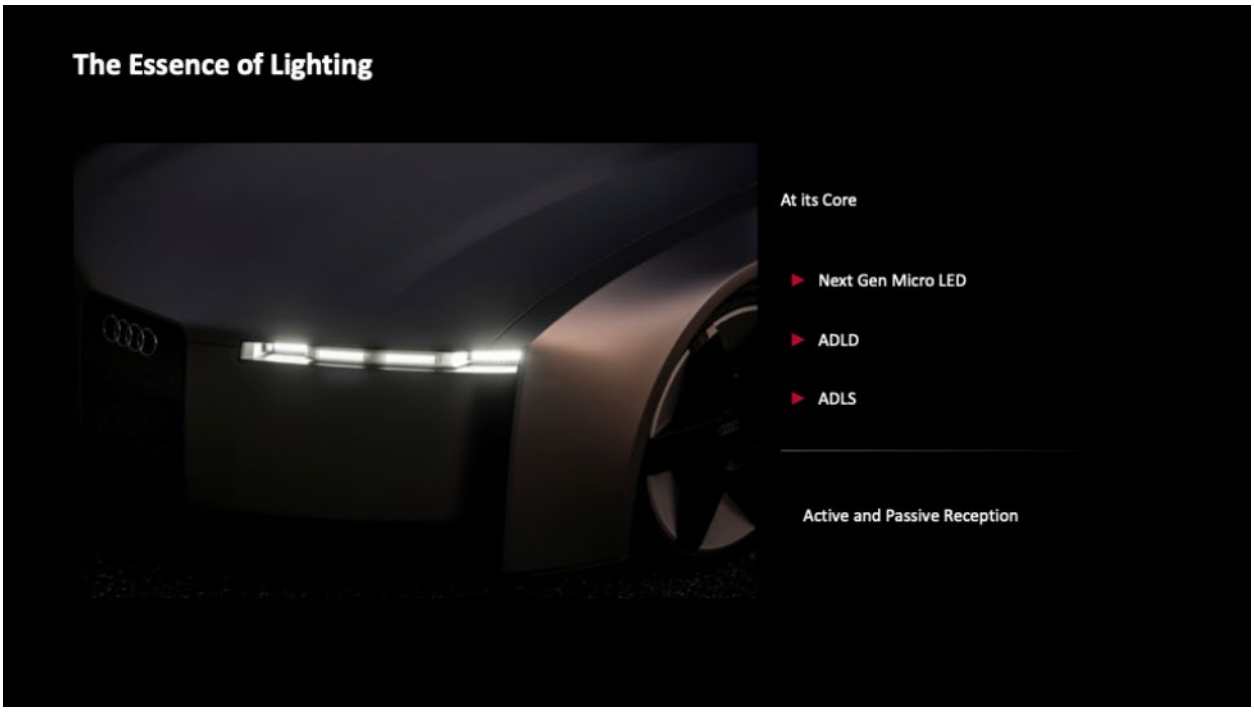
Audi – Michael Kruppa

“Essence of Lighting – Technical precision and radical simplicity”

Michael’s presentation provides a comprehensive overview of how a radically new, clear, and simple car design challenges the lighting system design. Consequent system thinking ("think the whole lamp") is necessary, including thermal, optical, and efficiency parameters, to meet the miniaturization approach without losing performance. Adaptive digital light distributions demand digital light sources, which realize the technological potential for styling with simplicity and clarity.

For example, the DRL was shown using integrated, individually addressable elements with an OLED-like appearance from every viewing angle. The main light functions use next-gen modules, which are maximally reduced in size with a perfect night-and-day appearance. They focus on digital content, efficiency, and resolution. In summary, Audi uses clarity, emotional appeal, and technical excellence to create the essence of lighting.





BMW – Thorsten Krajc

“**BMW’s neue Klasse – Implementation of a new exterior light design”**

Thorsten gave an overview over BMW iX3 lighting system which is no longer about visibility only, but becoming an interface, a sensor carrier and a brand identity icon. The side-to-side lit front contains the classical BMW 4 eyes and the lit kidney. This is the area of orchestration with surface illumination, but also a perfect location for the seamless integration of a radar sensor and a front camera with cleaning nozzle.

BMW created a coherent signature through a physical connection between the kidney grille and the lighting elements. This approach significantly reduced system complexity. The front end became a modern stage adaptable to a wide range of use cases. Close collaboration between experts in different fields was mandatory, as was a close connection to suppliers. The key learning was: Engineering excellence is enabled by disciplined, end-to-end execution.

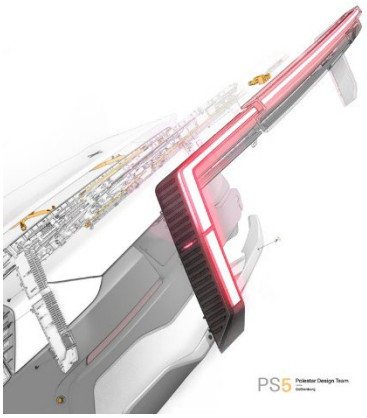
Polestar – Christophe Ferreira Da Silva

“Polestar 5 lamp details”

Christophe gave us a presentation from the designer’s perspective. How to realize a vision? He showed this from the styling idea down to the details with several videos from first design sketches to technical sections of the real product. The Polestar vision is pure, progressive and performance. A vision of what Polestar stands for and what makes the brand relevant.

With Polestar’s state-of-the-art production facility in Chengdu, China, where the Polestar 5 is produced, Polestar guides the industry towards a more sustainable future. Polestar Performance Architecture underpinning the Polestar 5 is a brand new, bespoke, hot-cured bonded aluminium platform that forms the basis of the Polestar Performance Architecture (PPA). Using high-strength aluminium extrusions, pressings, and castings, the structure is light-weight and rigid, and affords the Polestar 5 with torsional rigidity higher than that of a two-seat sports- or supercar. Polestar 5 consists of 13% recycled aluminium and 83% aluminium from smelters utilising renewable electricity, substantially lowering its CO2e footprint compared to standard sourcing.

The rear lamp was designed to protrude from the rear of the bodywork like a blade, creating a sharp edge. This made a conventional optical system infeasible. The solution was LG's Nexlide technology for the position and stop lamps. This technology uses blue mini LEDs embedded in phosphor resin, allowing for a very small package size.



The Polestar 5 front light system, developed with ZKW, uses lightguides for the dual blade light signature. The main light functions were realized with modules using a 12-segment matrix beam.

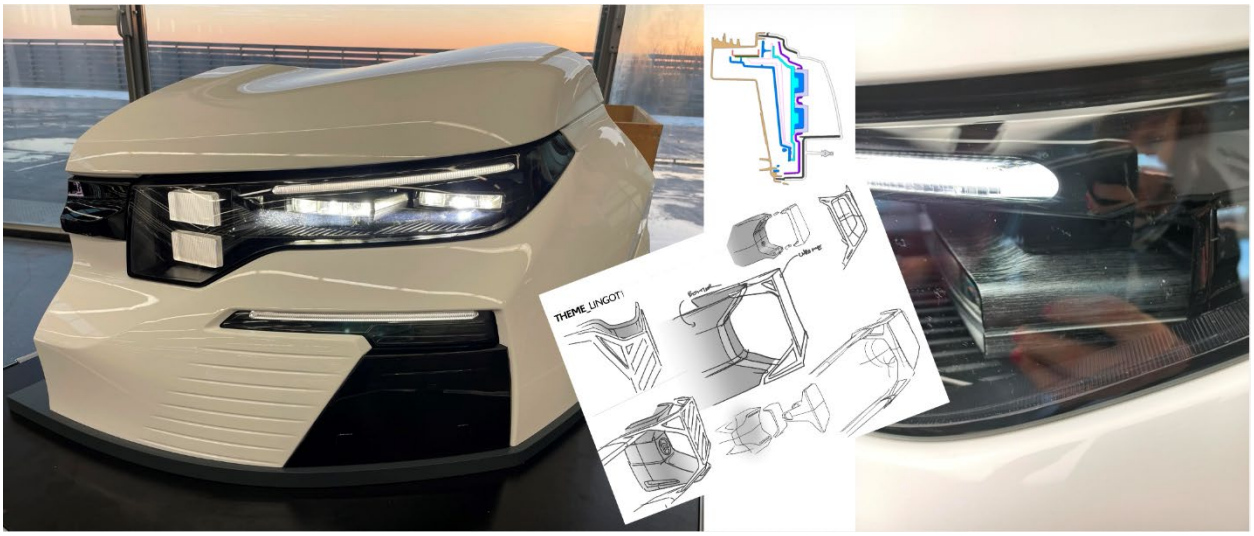
Stellantis – Richard Brevet

“Citroen C5 and Elo lighting design”

With the help of four black-and-white graphics, Richard explained the iconic Citroën lighting since 1948. Then, he delved into the design of the lighting for the new C5 Aircross. He drew inspiration from high-end consumer electronics.

The C5 Aircross's rear lighting elements have additional aerodynamic functionality. Airflow influenced the design significantly.

The headlights contain a matrix beam, and the rear lights are spectacularly streamlined, as is the entire rear end of the vehicle. This attention to aerodynamics yielded tangible results by limiting the impact of the body shape. With a drag coefficient of 0.75, the C5 Aircross SCX is a clear improvement over the previous generation (compared to 0.84 for the previous C5 Aircross). This benefits customers by providing an additional electric range of over 30 km on the motorway compared with the previous generation.



The Elo concept adopts the lighting signatures of the new C5 Aircross, with detached wing-like lights but not only at the rear, but also at the front, creating visual continuity between the two ends of the vehicle. The front and rear lighting signatures are designed to echo the aesthetics introduced on the C5 Aircross, while being adapted to the Elo's cubic and functional silhouette.

The very vertical front end integrates two double optics reminiscent of the ice cube headlights of the new C5 Aircross, (nicknamed "the ingot") as well as two thin vertical LED strips that extend from the bumper, like the Light Wings rear lights first introduced by the SUV.

OPmobility – Michael Rosenauer

“Transforming Automotive Lighting Design with Advanced Decoration and Sustainable Manufacturing”

Michael introduced the OPmobility portfolio, which includes lighting, bumpers, and tailgates, as well as complete front- and rear-end systems. He said the drivers of innovation for lighting are sustainability, styling, performance, integration, decoration, and the software-defined vehicle. He showed an example of this: the revised European Regulation for Sustainability and Circularity. Regarding decoration, there are three key areas: raw materials (quality and source), paint replacement (e.g., PUr overmolding), and light integration into exterior body parts.

The path to circular, sustainable materials requires an understanding of and definition for quality levels, maximum use of recycled materials, and proof of production readiness.

From a styling perspective, the "hidden until lit" functionality is extremely interesting. Today, a seamless look is possible with smoked materials or, better yet, microperforated technology. Microperforated technology also offers clear segmentation, body color, and optical efficiency of more than 10%.

SL Corporation – Hyeongdo Kim

“Color MLA Headlights”

Headlights that use micro-lens array (MLA) technology are rare; colored ones are even rarer. SL Corporation presented a new technology called color MLA, which allows customers to choose from a wide range of colors for their headlamps.

MLA headlights are used in Genesis models GV60, GV70, GV80, G80, and G90 for their distinctive double horizontal stripe signature, which sets them apart from other brands. In the future, this signature can be updated with a clearly visible colored aspect that doesn't influence the color of the light itself.

Tactotek – Dominique Heilborn

“Seamless Skin – A Designers Dream”

At the beginning of his speech, Dominique said, "Today’s designers envision smooth, intelligent, seamless surfaces that promise clarity, simplicity, and control." Until now, we have added more technology, more features, and more layers, but we have also experienced more fragmentation. To manage complexity, we separated it into layers. Each problem was solved and optimized locally.

"But people experience the whole, not the parts," Dominique said. "What if we design the skin itself?" he asked. The skin is where structure, light, and interaction meet. The solution is to transition from fragmented solutions to a coherent design approach. When the skin is designed as a whole, the space becomes calm again, and the design stops fighting itself.

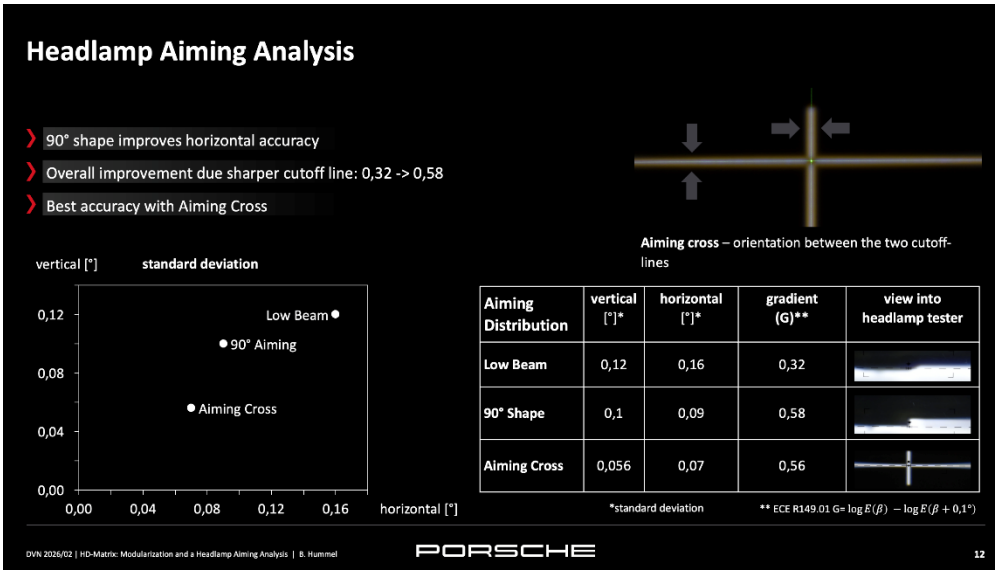
Porsche – Benjamin Hummel

“Porsche HD Matrix: The hidden Role of Modularization and Headlamp Aiming Analysis”

At the beginning of his presentation, Benjamin reviewed the Porsche HD Matrix concept that he had presented at the DVN Workshop in 2023. It is a double Micro LED system that remains unmatched to this day. It was first introduced to the market in the Cayenne, followed by the Panamera, the 911, the Taycan, and the Cayenne Electric. All of these cars feature the brand's signature four-point styling, both day and night. Benjamin differentiated between brand identity and product identity, stating that brand identity is more important.

The HD system offered by Porsche provides driver assistance functions such as lane and construction zone lighting, as well as several greeting animations. To improve traffic safety, Porsche has cut out the opposite lane in the light distribution projection for Autobahn driving, to avoid dazzling truck drivers whose headlamps are hidden to the camera by the middle lane separation barrier.

Alongside his description of the powerful Porsche double HD serial system, Benjamin demonstrated how different projection graphics influence the precision of headlamp aiming. He presented the results of their test study involving 13 participants and explained how they were obtained. Experts can expect these results to be valid for future auto-aiming, too. The best results were achieved using an aiming cross, as shown below.



Microrellejus – Raul Garcia

“Production Tool Engravings vs. Direct PMMA Processing with Femtosecond Laser: A Comparative Study on Homogeneity and Efficiency”

Raul demonstrated the advantages of femtosecond laser engraving for tools compared to the direct PMMA injection molding process. The results are measurable and, more importantly, of a higher visual quality.

The femtosecond laser process starts with optical simulation by an optical team. Next, a milled PMMA prototype is engraved with the femtosecond laser. The same shape as the final part should be achieved. The next step is to engrave steel inserts using the femtosecond laser and inject them into a 70x70 mm tool, followed by a tolerance analysis. Confocal microscope analysis is essential to check the results of the engraving, as is photometry for correlation analysis to compare the simulation with the measurements.

SESSION 1 PART 2 – LIGHTING, COMMUNICATION & DESIGN - THE NEW 3 PILLARS OUR COMMUNITY

Sabic – Dr. David Elvers & Erhard Bruss

Trends and Opportunities in materials for Automotive Lighting – Focus Light & Chrome

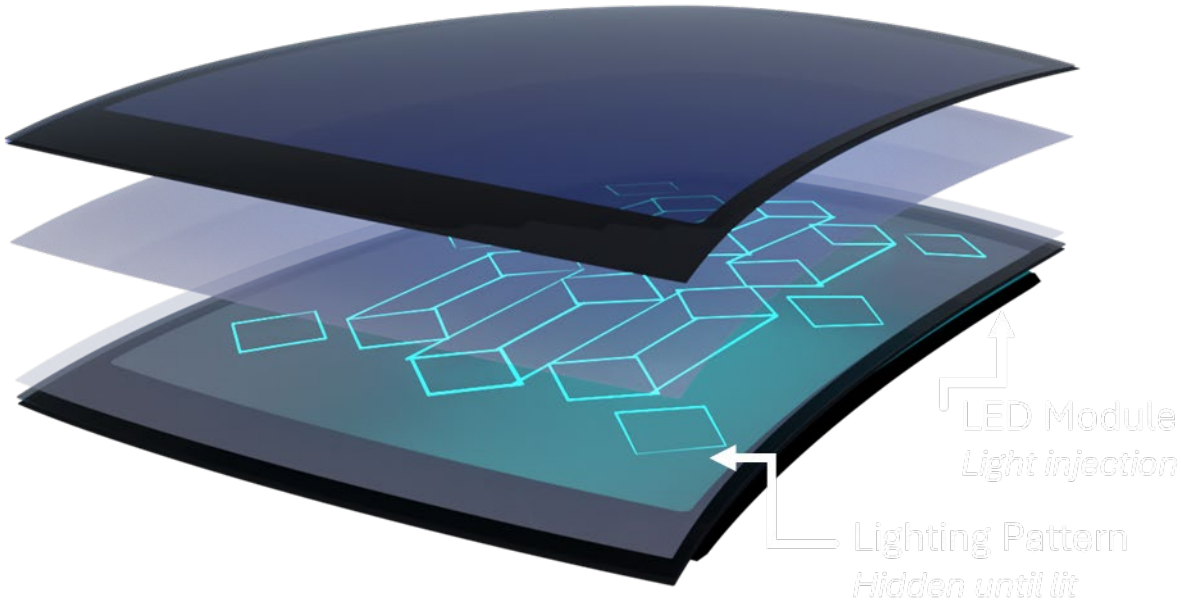
SABIC's Engineering Thermoplastics and Specialties business highlighted advanced light and chrome solutions that support smart lighting applications while delivering essential performance such as impact resistance and light diffusion. The presentation highlighted two different material trends: 1st materials for integrated panels with light diffusion as well as 2nd materials enabling chrome plated parts combined with decorative lighting.

For integrated panels, a first-to-market application was spotlighted, featuring a fully integrated front-end design with embedded lighting functions. The part includes white diffused light bar components in LEXAN™ LUX (PC) resin that reinforce a distinctive and cohesive lighting signature. SABIC also showcased the IQ Light in-mold decorative concept developed with Leonhard Kurz. This headlamp lens concept combines SABIC thermoplastics – transparent LEXAN (PC) resin and black CYCOLOY™ (PC/ABS) resin – with Kurz's decorative finishing technologies. An in-mold PUR coating from Rühl protects the decoration across the entire lens, illustrating how thermoplastics and decorative processes can be combined to achieve both functional performance and high-end aesthetics. Additionally, SABIC shared studies from the Elmann Technology Center, highlighting novel surface structuring approaches for PUR coatings and PC panels. These innovations demonstrate unique styling effects and the potential for micro-optic integration, expanding design freedom for next-generation automotive lighting applications.

For the combination of chrome and light, the presentation showed three different design options: 1) film-based technologies, 2) integrating a separate lightguide into the front, 3) integrate the light diffusor into the grill. SABIC showed how to implement the third option. Combining weatherable PC Copolymer ELCRES™ SLX1271D resin with an ABS resin (or compound) and selectively chrome plate the ABS resin, offers the option for a seamless integration of light into the chrome plated grill. The first application at BMW (G70 grill, SPE award in 2022) demonstrated the benefits of the integration and is now translated to new models showcased during DVN Munich Conference in 2026.

Saint Gobain Sekurit – Gabien Geniaux

Light in Glazing: New Horizons for Automotive Lighting



This presentation focused on Light in Glazing.After short introduction of the company emphasizing global leadership in automotive glazing systems with innovative and sustainable innovations,they started with activities at windshields with transparent glass. As Light enters vision is expanding including side window with cabin luminosity and sunroof. Summarizing the mission of glass is to open lighting features. As sunroof is switchable to adapt to different light entries,active functions and electronics are seamlessly integrated into glazing systems. Also invisibility is given once not in use to maintain transparency. Next challenge for active glazing is becoming a light source . The So-called Sekurity Amplisky Lumin is able to demonstrate several use cases like relaxation,racing,music&Lights and many others. Here light is injected inside the glass guided through optical system guides. Once light hits the transparent design pattern it becomes visible to passengers. It consists of two pane laminated glazing with variable color (RGB),intensity and animation. Full system includes Light Module and ECU and combines flexibility to switch and thermal coatings. First applications are developing for enhanced lighting experience in the cabin (eg illuminated roof glazing) on demand. Market is growing fast with 10+ Models end of 2026. Next generation will open use cases shifting from interior to exterior (eg Vehicle to X interaction). The Sekurit Imagine Lab is an experiental platform dedicated to automatic designers opening glass and glazing as a new enabler for unique designs.

ZKW - Gerald Boehm

Display Solutions and Challenges

The presentation highlights the increasing relevance of advanced display technologies in modern automotive design. Displays serve multiple purposes including communication, information, safety warnings, comfort, and styling. Beyond traditional lighting, they enable new digital functions such as animation on demand, personalization, and brand differentiation.

Different applications require distinct performance levels. Signaling functions such as daytime running lights, direction indicators, and position lights require extremely high luminance values of up to 50,000 cd/m² and strong contrast to ensure visibility in all lighting conditions. Information displays must remain readable in daylight while avoiding glare at night, whereas entertainment displays focus on balanced luminance and high contrast. Additionally, depending on the requirements, the pixel-grid should not be visible when the device is switched off. Likewise, no colors – specifically yellow if white display – should be invisible on the display - ideally, just black.

ZKW's displayZ technology portfolio addresses these requirements for signaling and high resolution with innovative solutions. The displayZ LD concept offers a compact design with a three-dimensional depth effect and individually controllable bi-color LEDs, enabling dynamic light signatures for signaling functions.

For higher resolution and flexibility, displayZ HD LED and miniLED solutions provide small pixel pitches, high brightness, customizable layouts, curved display concepts, and a dark appearance when switched off. Overall, these technologies combine functionality, safety, and aesthetics, supporting the future of digital and personalized vehicles.

In the future, other technologies currently being developed for consumer electronics could further advance automotive displays. An additional challenge will be the ever-increasing pressure on costs.

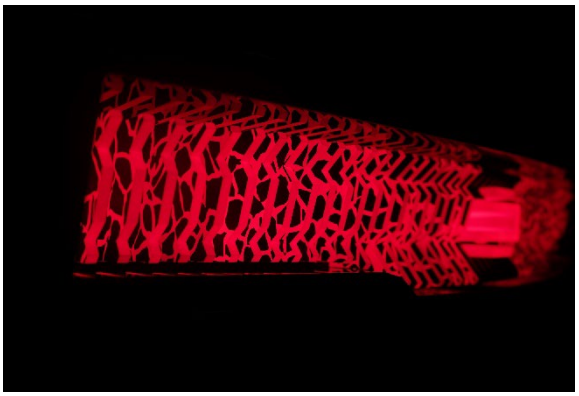
Salil Kulkarni – Tata Motors

From Tata Motors LED Lighting Evolution to the new Sierra's Lighting Journey

This presentation is describing the journey of LED Lighting at Tata Motors and later focusing on modern and classical transformation for the legendary Sierra Model by applying new lighting concepts with optical science. Usually the story started with different use cases at Rear Lights ,either pixelated or tube-similar stripes developing unique brand concepts. The beginning was characterized by improved illumination with energy efficient LED Lighting before rather focusing on identity. Long stripes of homogenous light distribution marked the early moves by adapting to the curved front shapes of vehicles. Many iterations on Safari,Curvv,Altraz and Punch duocumented this journey to Sierra. Different design iterations like aerodynamic front chassis and heightened rear parts paving the way for a "Jeep Design" in a classical direction. And the main question was "what makes a legend" ? Normally legends are capturing the imagination of a generation to be influential,recognizable and memorable. Also Legends are able to transform themselves through time without losing their classical image. Tata's Sierra was India's first ever indigenously designed SUV in 1991,achieving legendary status . All efforts focused on reimagining the legend without disturbing the original impression. Diverse needs and tastes and a multigenerational society has to be incorporated. (Gen X-Z) Out of many design iterations ,the India Team was able to understand customer needs better and the emotion behind the revival of an icon. The unified vision as a result of starting with an EV Concept in Jan. 2023 resulted in a production start at November 2025. Design has been treated as being honest and timeless to make the product understandable. No matter the era it looks relevant and modern with striking graphics to give a strong presence. The Sierra has been recognized with the RED DOT AWARD and received 70.0 bookings within 24 hours.

Jannes Buthmann – EDAG

Natural 3D Appearance,unbounded: EDAG's Remote Phosphor Approach for Lamp Design



EDAG Lighting and Display Systems is demonstrating here 3D Appearance by Remote Phosphors Approach for Lamp Design. Starting with the role as Lighting Partner for Innovation Development. Typically in this project EDAG was contributing styling,electronics and software,validation of phosphor coating and development lead to realize a mock-up. Hochschule Magdeburg was involved by correlating the optical simulation for light conversion,design of pre-development concepts and visualizing the mock-up in unreal engine. Nichia also participated with technical input of physical data for phosphor,guidance for process handling and delivery of raw phosphor material. First the project conducted remote phosphor Rearlamp Benchmarks with MB EQS (sculptured 3D repetition), Alfa Romeo Bertone (organic unpredictable complexity) and Saab PhoneiX (flat display-inspired design). Strong design potentials in Tail Lights explored integrate geometries,volumetric layering and expressive structure.

Visual metaphors could serve as inspiration beyond the object. (eg Kryptonite Crystals,infinite mirrors etc). Other natural objects as Magma with energy under tension or bioluminescent algae with light reacting to movements introduced other elements. Very expressive has been light emerging from the core to symbolize inner force. Moments of motion captured in light and fluid documented even more ideas. Out of all delivered iterations,design concept 1 was formulated as transition from intangible gesture to physical structure. Design Concept 2 clearly showed the effect of Light Emerging from the Core. The Mock-Up Styling then demonstrated the Fire Blade Graphic Styling Refinement. Now all the Light/Phospor interaction was going through multiple correlation tests. (eg Simulation in Light Tools). Several coating try-outs were conducted to illustrate the effects. Finally the Design Vision "Imagine molten lava frozen into a controllable light signature" was formulated. After that the build-up of a physical mock-up was realized and evaluated regarding optical status (by Gonio and LMK measurement). So the Phosphor Concept has been validated on complete rearlamp level. All necessary environmental tests were performed and proved OK Status. Testing in accordance with DIN EN 60068-2-30 proved no observation of phosphor changes or lit on/lit off appearance after test sequence. Finally Remote Phosphor will unlock new levels of 3D Depth and Design Freedom in Rear Lamps.

Felix Freytag – Marelli

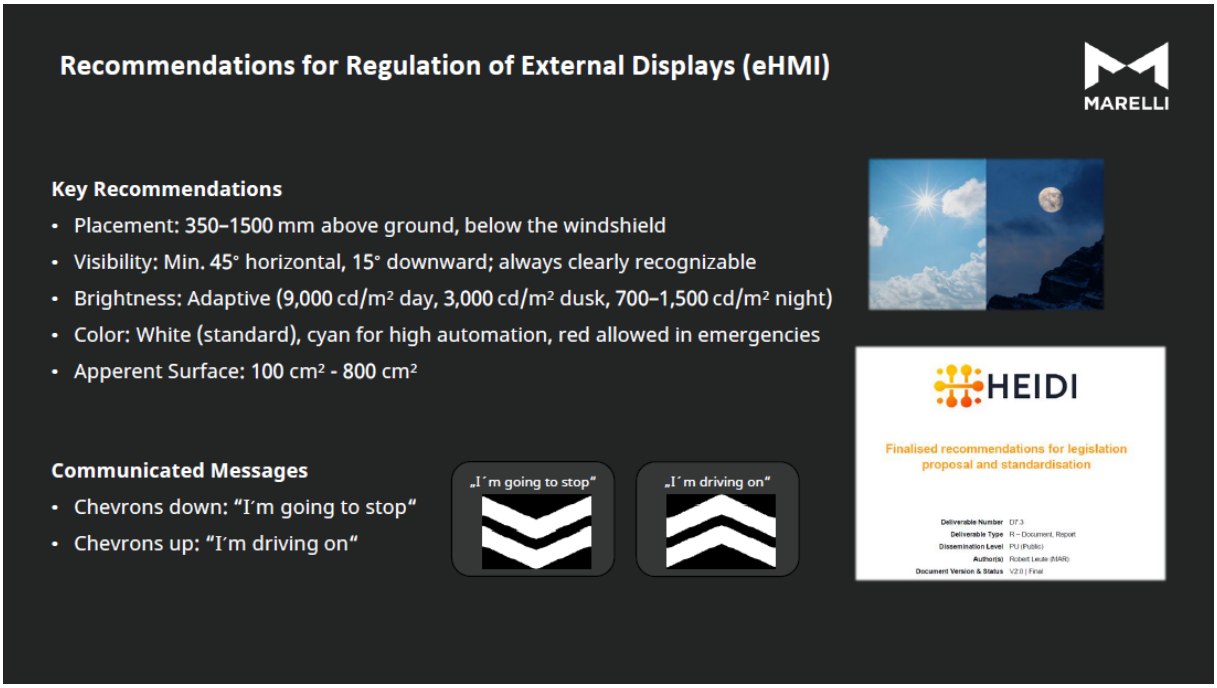
Summary of Presentation: External Displays and Ground Projections for Future Vehicle-to-Everything Communication

In today's traffic environment, vehicles communicate primarily through conventional light functions and informal human cues such as eye contact or gestures. As mobility transitions toward higher levels of automation, these human-driven interactions will disappear, creating the need for new, safe, and intuitive communication channels. The presentation explored how external displays and ground projections can support this shift by enabling clear vehicle-to-everything (V2X) signaling.

Ground projection (GP) is already used in comfort applications but is now evolving into a safety-relevant technology. Upcoming updates to ECE regulations will, for the first time, allow signaling ground projections—extending functions like reversing lights or turn indicators directly onto the road surface, making them more visible to pedestrians and cyclists.

The second part of the talk highlighted findings from the EU-funded HEIDI project, in which vehicles were equipped with external displays showing simple intent-based messages such as "I am going to stop." In controlled crossing scenarios with full motion tracking, these displays led pedestrians to cross earlier and more confidently, reducing typical interaction time from around 10 to 8 seconds. Traffic simulations showed smoother flow, fewer complete stops, and improved following distances, demonstrating both efficiency and safety benefits.

Finally, recommendations for future regulation emphasized standardized placement, visibility, color, and minimum display size—starting around 100 cm²—along with restricting messages to vehicle intentions. Regulation action needs to start now to ensure safe and intuitive communication as automated vehicles become widespread.



Mike VanBelle – Ford USA

Update from Ford

Ford presented a short update on Ford Company illustrated with pictures and movies. Starting with historical milestones ,they reminded everybody on their long heritage with the founder Henry Ford. He created the first famous people's car with Model T. Their mindset has not changed by still evaluating "universal vehicles" now even transferred to the latest EV Platform. Still having main focus on USA by having 24 plants in America. Also committed to invest > 8 Bn USD in UAW-represented facilities by mid-2028. 100 % of the famous F-series trucks are still assembled in America. So Ford is and will be the No.1 Auto Manufacturer in USA going forward. Ford opened in Fall 2025 a new world headquarter and product development center in Dearborn,Michigan. They are living actively with a culture of Engineering Excellence with global experts in Exterior Lighting and Electronics. Full commitment is given to support SAE,GTB and many others to comply with industry standards for ADB and other lighting topics.

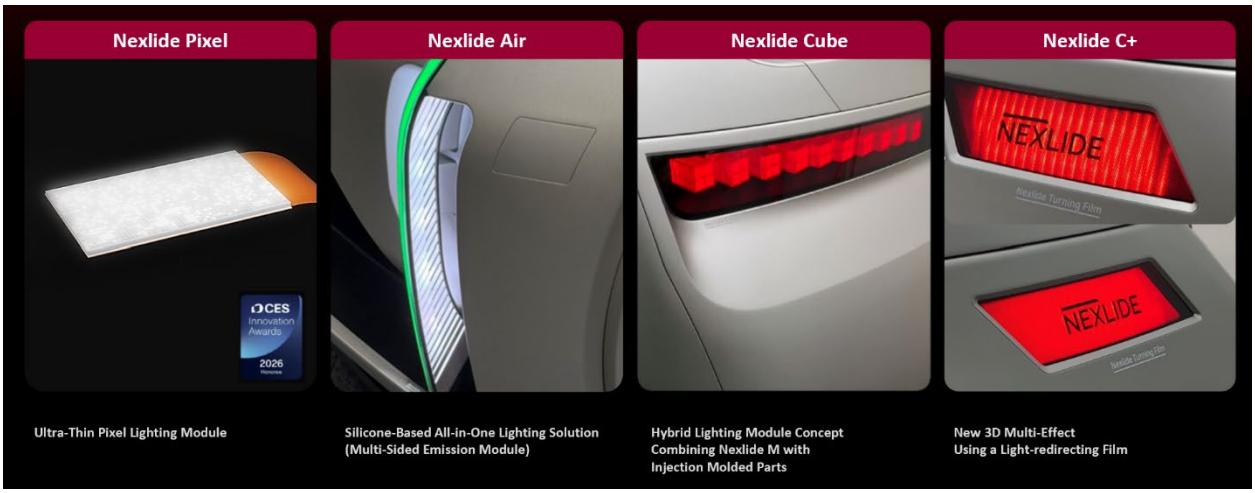
Mind – Jin Hui

“How High-Performance Technology and Reliable Solution Empower Chinese User and OEM Challenges ?”

Mind gave a presentation about automotive industry transformation and the emerging challenges to enable solutions trough advanced technology. Main reason for disruptions are driven by many aspects out of new energy (eg environment),but also human&bio-inspired changes (eg Aging). Combined with fast development of AI and Digitalization (also SDV),the automotive industry is at the turning point. Also Rise of Chinese EV Players significantly shaped the transformation by having minimal legacy in ICE Systems to allow faster pivot to electric and software-defined vehicles.Brands like BYD proved agility,low legacy costs and integrated electronics to gain global momentum. Speed, Investment,integrated supply chains were strong reasons to accelerate global expansion. One other example underlines this transformation as intelligent assisted driving is rapidly evolving into a lifestyle embraced by users. (eg fast adoption of active safety). Out of these challenges MIND formulated “intelligent lighting in advanced autonomous driving” as essential role for their company. ADB penetration rate in all regions (esp. China) is developing with > 10% p.a. over next five years. Also pixelation to realize highest bresolution and strong contrast is rapidly evolving. EV Era of today asks for high freedom design flexibility of the Lighting System,where natural conflicts are discussed at the OEM. (eg cost vs exquisite perception) Lighting is becoming more and more an information hub with generic HMI,Software as a service,real-time performance and higher resolutions. As regulation is complex and sometime critical (eg new visual signals)and conflicts of human vs machine could not be avoided,safety risks in adaptive systems are challenging. Mind is also committed with Sustainability along full product lifecycle . Newest generation of intelligent projection headlamp is the Navigator for several functions and scenarios. (eg intersection navigation). Advanced Technologies have been developed with Micro LED Module being most efficient to fulfil most criteria. Mind also developed 3D RCL Display with different scenarios for signal,vehicle status and entertainment. Mind also active with 3D Optical Fiber RCL to paint pictures with light. So Mind is well prepared to tackle the challenges with smart and dynamic soutions in automotive industry.

LG Innotek – Svenja Sohrbeck

Lighting the Future : Nexlide Pixel in a Compact Design & Nexlide Air with a Simplified Structure



Lighting the future of automotive at LG Innotek is driven by curiosity and continuous innovation.

The Nexlide journey is built on two core platform technologies: Nexlide A and Nexlide M.

Nexlide A is a UV-cured, resin-based platform with a slim profile of under 3 mm, achieving excellent homogeneity through an optimized air gap and optic film.

Nexlide M, a heat-cured silicone-based platform with a height of 10 mm, integrates dual silicone layers to ensure uniform lighting without an additional inner lense.

Over time, both platforms have evolved to cover nearly all exterior lighting functions, including DRL, indicator, tail and stop lamps, as well as logo, grille, and bumper lighting.

A major milestone was Nexlide Pixel, enabling individual pixel control for V2X communication. To meet demands of further miniaturization, LG Innotek developed the Ultra-thin Pixel Lighting Module. With a thickness of just 3 mm — around 70% thinner than conventional solutions — and a reduced pixel size of 2×2 mm, it delivers higher resolution while increasing light efficiency by 30%. Its layered structure, consisting of a PCB, reflective pixel bezel, and diffusive silicone layer, ensures uniform light distribution and minimizes hot spots despite the ultra-thin design.

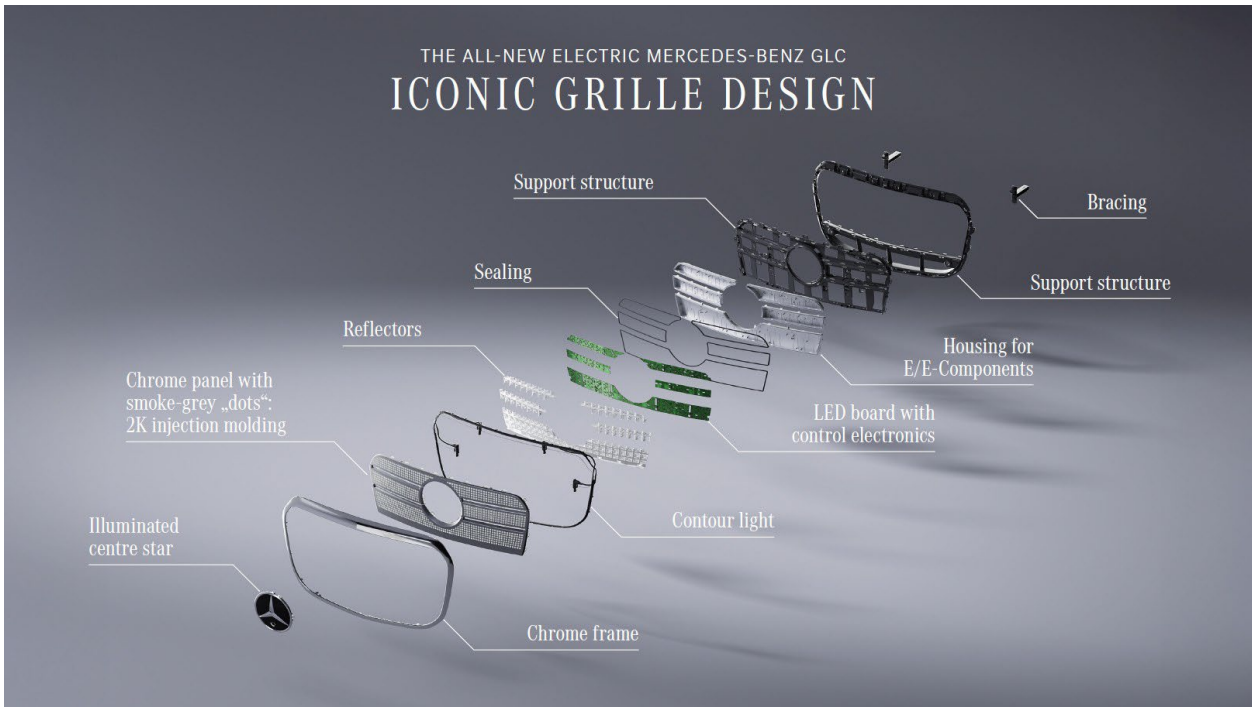
The second innovation, Nexlide Air, redefines lamp architecture by eliminating bulky housings. Using only an outer lens, a Nexlide M module, and a flexible back cover, it reduces thickness by 50% and weight by 40%, enabling 3D or flush integration for illuminated grilles, bumpers, and logos.

SESSION 2 – DEEP DIVE INTO FILM TECHNOLOGY – PRODUCT & PROCESS

Mercedes Benz – Marc Hainke

“The all-new electric Mercedes-Benz GLC Iconic Grille”

The new lit grill of GLC is composed of 942 dots (with 140 leds). Chrome panel is done with smoke-grey2K injection molding (ABS – PC). Chrome is fixed on ADB while PC is inert to chrome bath and will not get any reaction. That make the grill transparent for light. (which is a totally different process versus PDV usually used for lighting application)

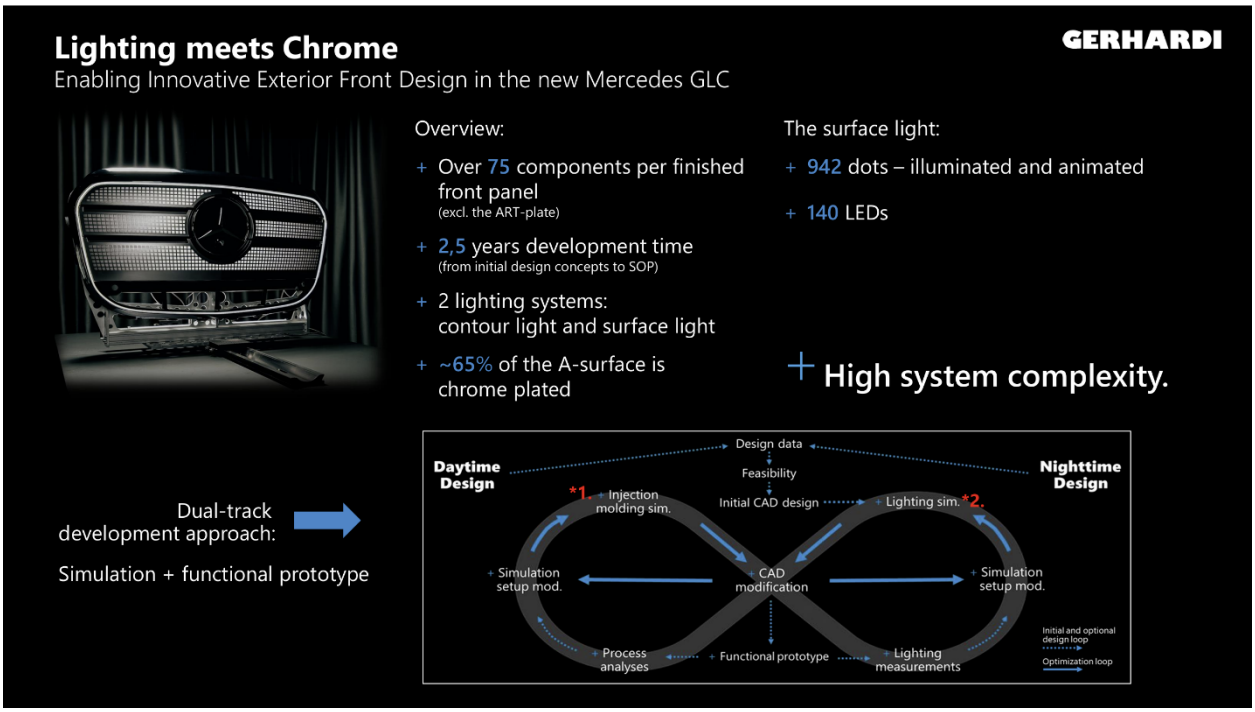


For contour light, Mercedes is using a glass fiber with standard LED sockets.

For the lit pixelated grill, flat verticals PCBs are placed between a white housing, a reflector and the chrome outerlens

Gerhardi – Nicole Michael, Product and Process Development

“Lighting meets chrome: Enabling Innovative Exterior Front Design in the new Mercedes GLC”



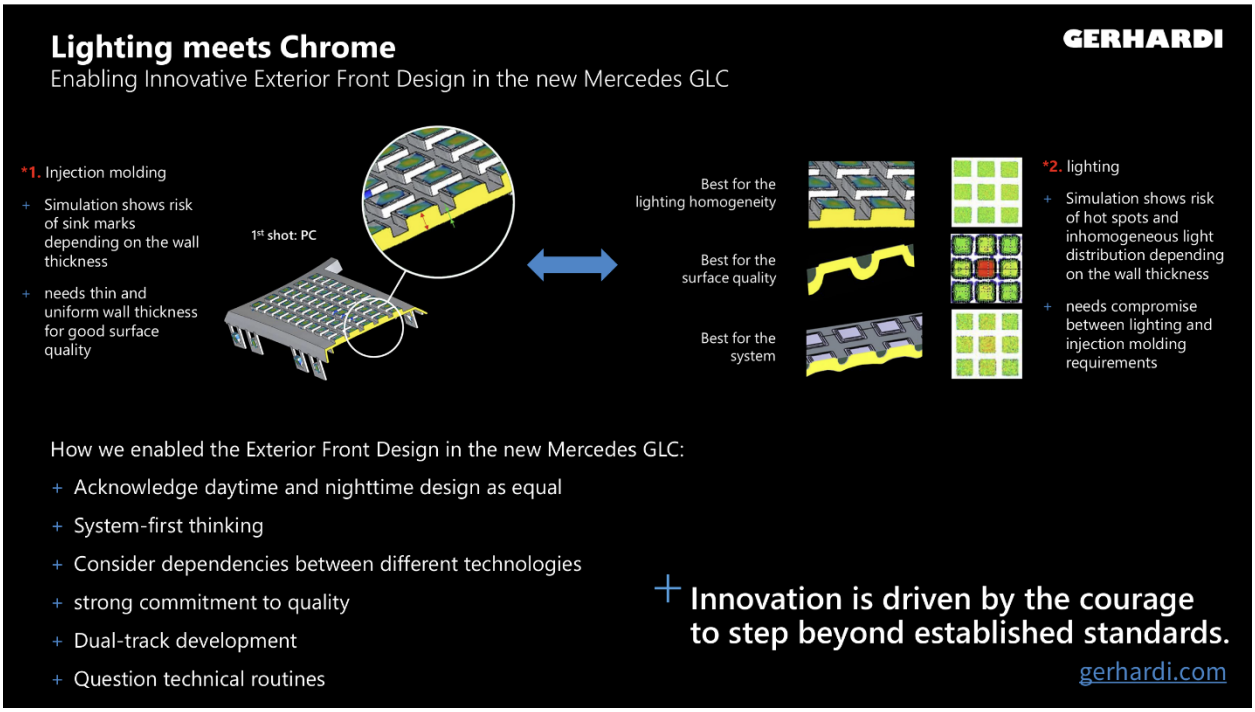
The front panel of the new Mercedes GLC marks a visionary step in exterior design. For the first time, an exclusive chrome surface is combined with a sophisticated illumination concept to reinterpret the iconic grid design of earlier models.

This innovation is enabled by improved UV-stability of polycarbonates. The module consists of over 75 components, integrates two lighting systems, and features chrome plating on around 65% of the A-surface.

Numerous interfaces and interdependencies across components, materials, and technologies create high system complexity. The interaction of injection molding and lighting in the chrome covers is a key example, as both disciplines jointly shape the characteristic grid appearance. The premium visual impact results from the interplay of high surface quality and homogeneous lighting.

The chrome finish is the first visible element and requires a sensitive 12-step coating process, whose quality strongly depends on the underlying injection-molded part.

Therefore, optimization of the substrate and the lighting system progressed simultaneously. Using a dual-track approach, the two-shot molding process and the lighting setup were simulated, while functional prototypes were produced to generate realistic material data for the simulation.

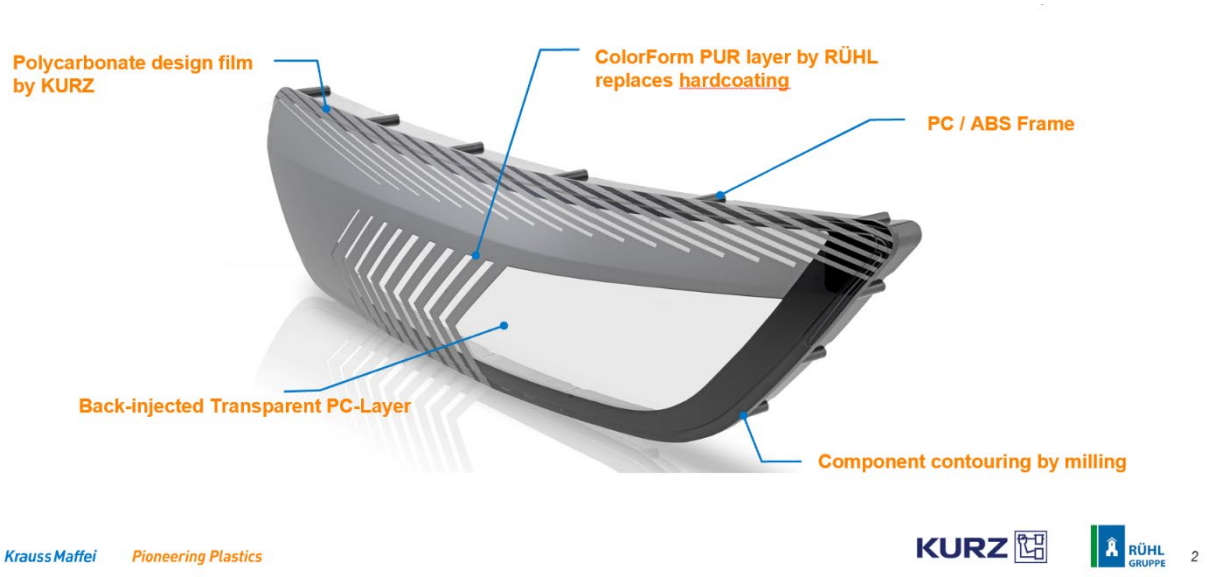


A central challenge lay in balancing thin, homogeneous wall thicknesses needed for surface quality with thicker walls preferred for increased light scattering. After several optimization loops, a compromise was achieved that meets all surface and lighting requirements while maintaining acceptable molding conditions.

The resulting GLC front module shows how engineered surfaces and light functions can be integrated into a robust, manufacturable system with premium visual impact.

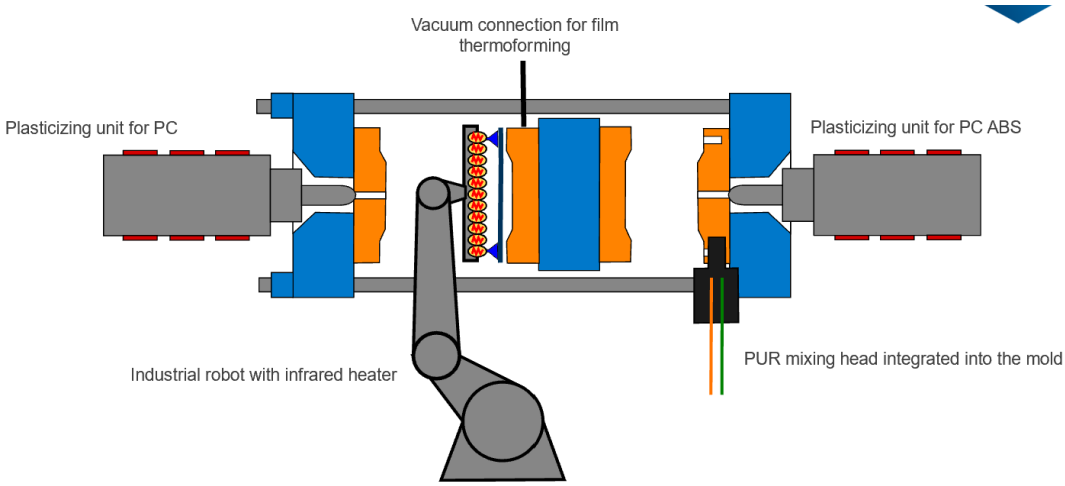
KraussMaffei – Andreas Bierbaumer

“From Hard Coating to In-Mold PUR: A New Approach for Automotive Lighting with ColorForm ®”



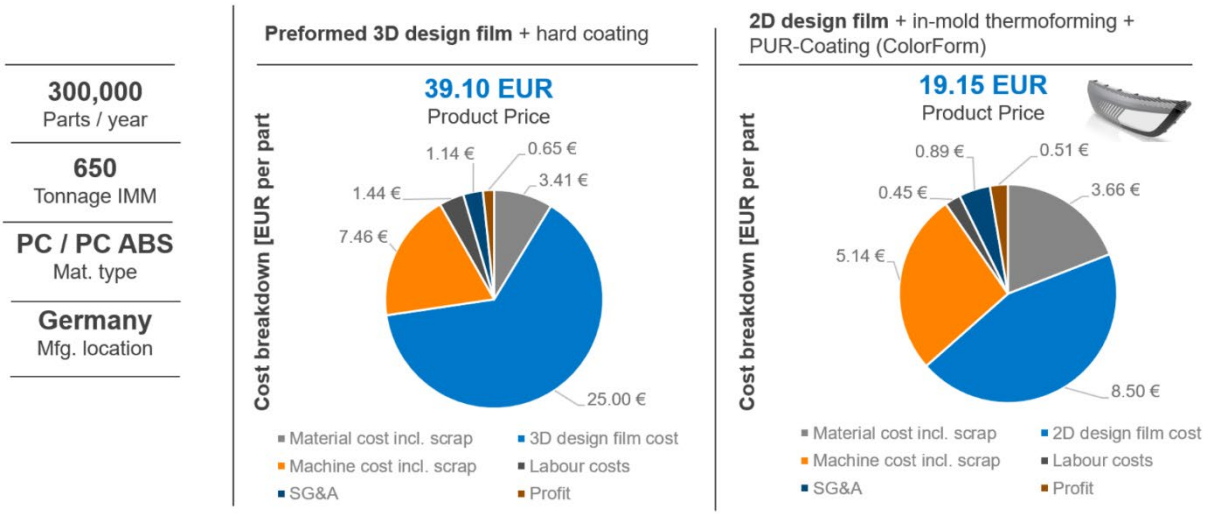
As automotive design shifts toward intelligent and illuminated exterior modules, traditional manufacturing faces increasing challenges regarding efficiency and complexity. Conventional hard-coating processes are typically energy-intensive and require multiple offline handling stages, leading to higher logistics costs and a larger CO2 footprint.

The FrontIQ Light demonstrator introduces a highly integrated alternative to these traditional methods. Developed by KraussMaffei and LEONHARD KURZ in collaboration with Rühl Puromer GmbH, Covestro, and SABIC, this concept replaces secondary hard coating with an inline ColorForm polyurethane (PUR) process. By consolidating 2K injection molding, tool-integrated foil deep-drawing (IMD VARIOFORM), and direct PUR coating into a single automated cell, a "one-shot" ready-to-install component is achieved.



A key technical enabler is the tool-integrated foil forming, which utilizes an automated heating gripper for precise 3D shaping directly within the mold. The subsequent application of the PUR layer provides high UV stability and self-healing properties, delivering a premium Class A finish.

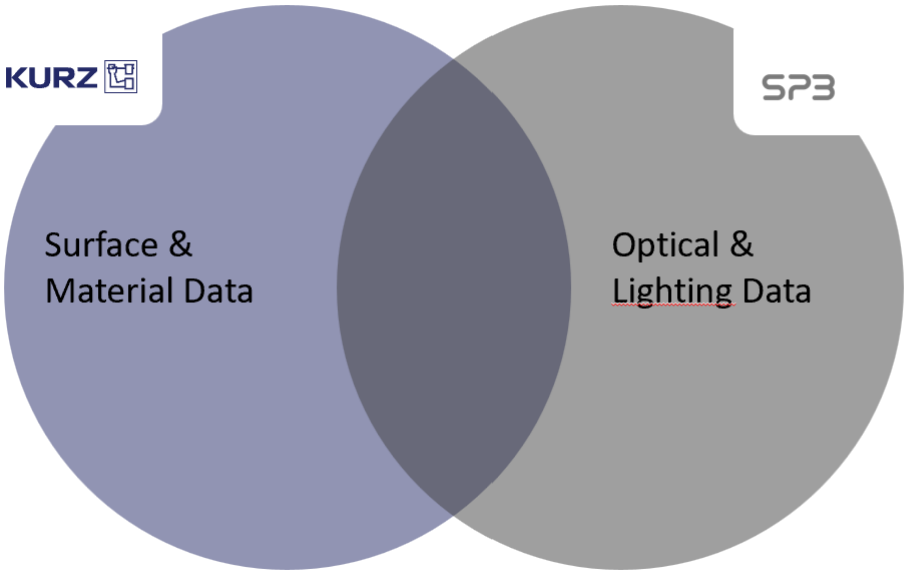
This transition from fragmented production to an integrated approach yields significant industrial benefits: up to a 50% reduction in total cost per part and a 30% reduction in energy consumption.



ColorForm is not only more sustainable due to minimized logistics but is also fully scalable for both front-end and rear-end automotive applications. It marks a definitive shift toward a more efficient, cost-superior, and integrated future for automotive lighting manufacturing.

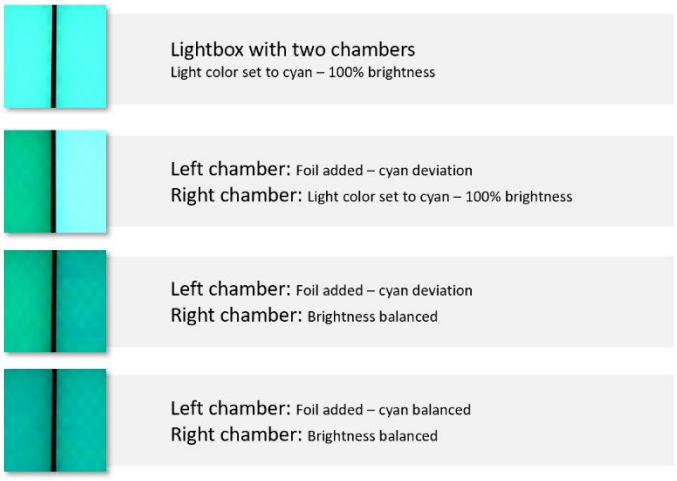
Leonhard Kurz & SP3 – Sven Oberndoefer

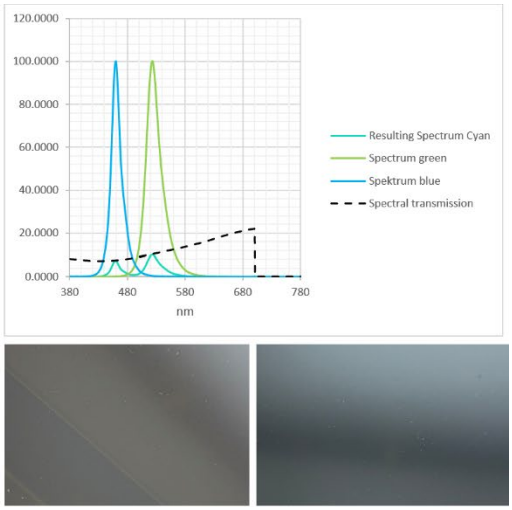
“Virtual validation of design driven multi-layer lighting”



Presentation focused on color shift due to foil addition. With SP3 optimized virtual tool, color deviation can be simulated and avoid may physical loops with film modifications. First sample is already close to target, this is reducing iterations

This is valid for all foil application like interior (PHUD, smart surface or lit grills)

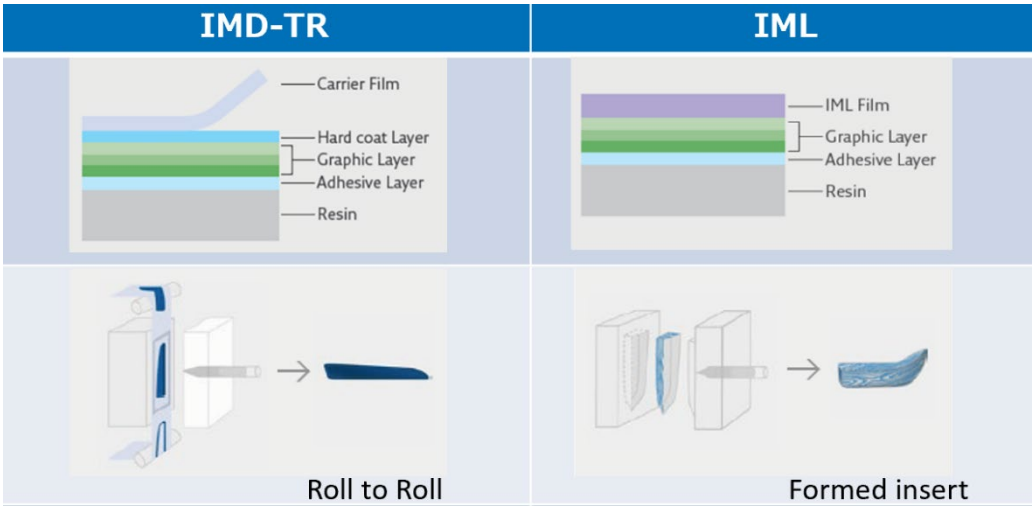




Nissha – Tino Theer

“Film technology illuminating the next step in automotive exterior lighting”

Nissha is a worldwide supplier for film-based technologies to enable decoration and functionality of plastic parts. they can provide IMD (In-Mold-Decoration) and FIM (Film-Inser-Molding) solutions globally. With 30 years’ experience in the automotive interior, they’re expanding their portfolio since several years to the exterior.



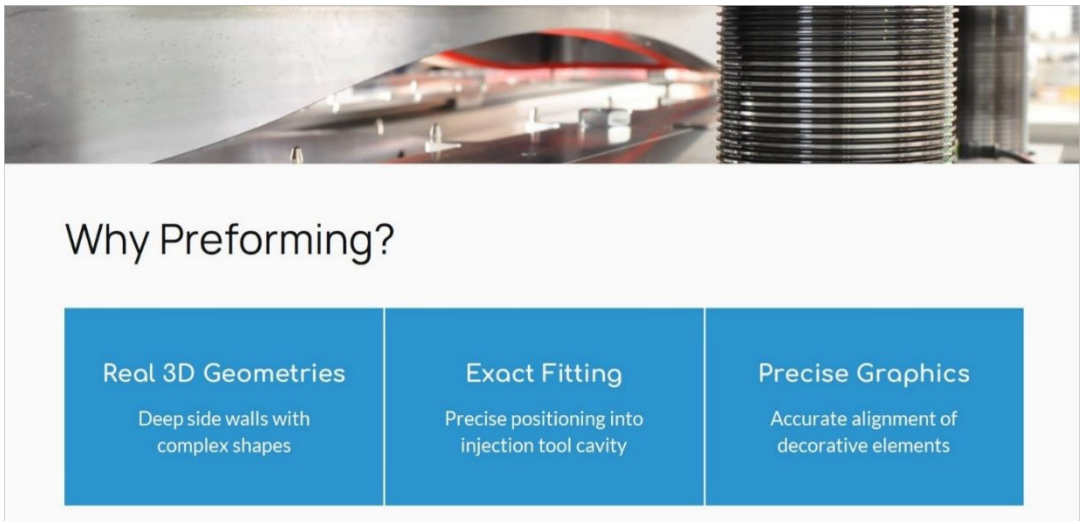
Their films can feature attractive designs, lighting functions and heating wires for de-icing systems. Due to that they can integrate multiple functionalities in a thin plastic film which can be overmold with various resins or overflooded with PUR. Their inks can support the guiding, decoupling and scattering of the light. Balancing high transmission rates with the customer target design is the key of our technologies. Typical applications are front grilles / panels, head- and rear lamps as well as inner lenses.

As a Tier 2 supplier they can offer additional engineering support like forming/graphic simulation and optical characterization oftheir films and inks. With their own CMF-Team they can create designs as needed for customers. A major challenge is the matching of their technologies with spray painted car body colors. They can offer a range of suitable colors for that including through-light effects with low color-shift. Their material range covers mostly PC, PMMA and PP films and resins.

As part of BMW's ‘Neue Klasse’ program Nissha is contributing to the next generation of vehicles by developing and manufacturing decorative and functional components. (with 1st film inside headlamp)

Niebling – Udo Weustenhagen

“Preforming for Film Insert Molding (FIM): Fundamentals and Industrial Boundaries”



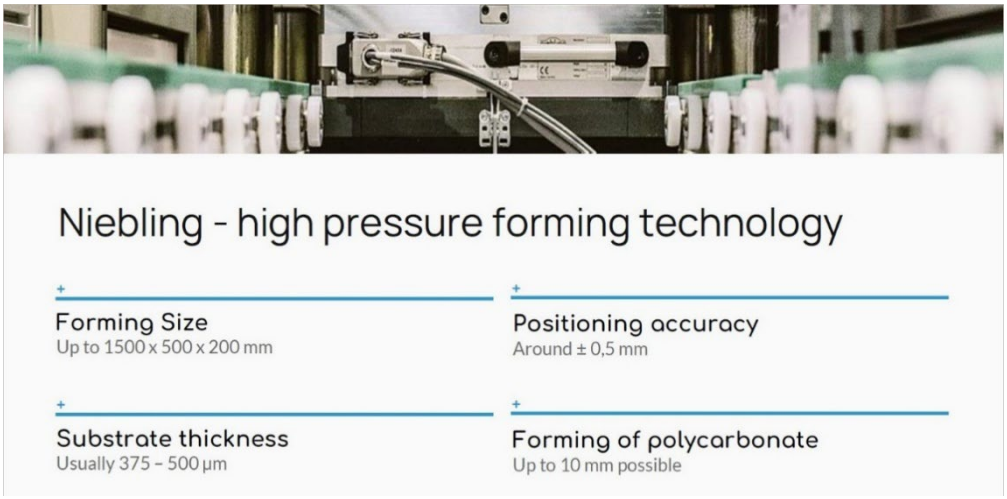
Film Insert Molding (FIM) has become a key technology for automotive lighting applications. Films are no longer used solely for decoration but increasingly act as functional carriers for design, branding, and integrated features such as heating, radar, or sensors. This shift significantly increases the industrial complexity of FIM projects.

While the design potential of FIM is widely recognized, many projects encounter challenges during industrialization. A decisive factor is whether the film is under control before injection molding. Injection molding does not correct geometry or positioning. For this reason, preforming is not optional but a key enabler for stable and repeatable FIM processes.

High-pressure forming (HPF) enables real three-dimensional geometries, precise positioning of film inserts within the injection mold, and accurate alignment of decorative and functional elements. This leads to higher reproducibility and process stability. Typical industrial parameters include forming sizes up to 1500 × 500 × 200 mm, positioning accuracy around ± 0.5 mm, and substrate thicknesses commonly between 375 and 500 microns.

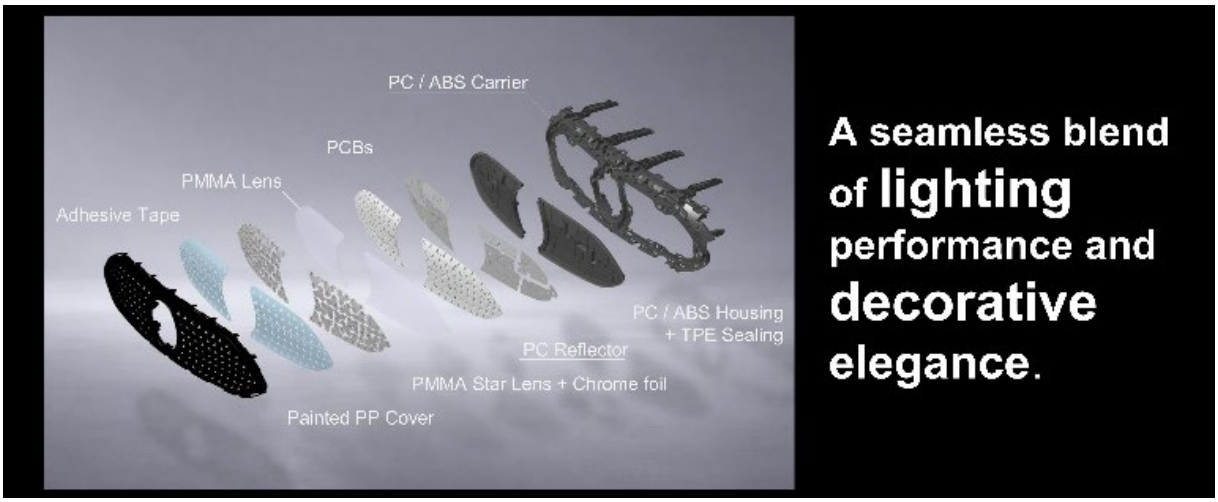
However, FIM is defined by industrial boundaries rather than by individual technologies. Limitations are often driven by limitations of screen-printing equipment, handling of large-format films, trimming concepts, and the complexity of injection tools. Increasing part size does not automatically create value; in many cases, realistic dimensions combined with higher functional integration are the more robust solution.

Successful FIM projects require early design guidelines, series-proven materials and inks, and a realistic time-to-market approach to ensure stable series production.



Magna – Bünyamin Uzun

“Chrome-Film Meets Light: Challenges and Solutions in the Illuminated Frontpanel”



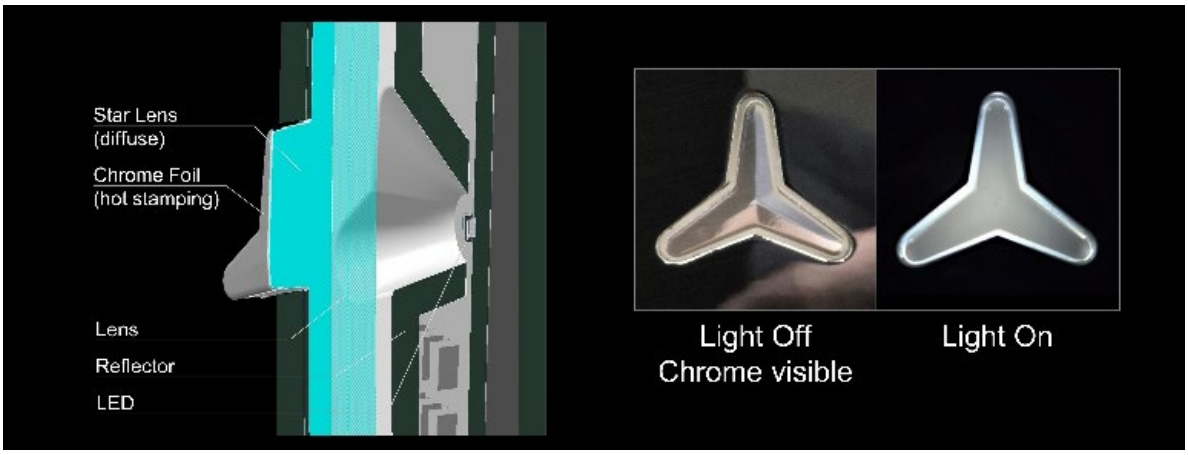
Illuminated exterior elements have become a key design feature of modern vehicle front ends, enabling clear brand recognition in both daytime and nighttime conditions. A demanding approach combines a premium chrome appearance in the off-state with a homogeneous light signature in the on-state. Implementing this dual-function concept places high demands on optical system design.

The presented front panel concept integrates a light-transmitting chrome foil into a multilayer optical system of LEDs, reflectors, lenses, and diffusive structures. While the chrome foil delivers the desired decorative appearance in the off-state, its optical properties significantly influence lighting performance in the on-state. Spectral filtering reduces transmission—especially in the blue-green range—leading to luminance losses and chromaticity shifts that may approach or exceed defined target areas.

Deviations between simulation and measurement were driven by a change in chrome-foil characteristics between the initial characterization used for simulation and subsequent measurements on first-tool-off components. Based on this updated material behavior, the LED binning was adjusted to compensate for the spectral impact of the foil.

Evaluations on optimized components confirmed compliance with the target chromaticity range while improving the overall appearance of the light signature. These results show that chrome foils can enable both premium aesthetics

and reliable lighting performance. This requires stable design boundaries, precise material characterization, and close collaboration across OEMs, Tier-1, and Tier-2 partners.

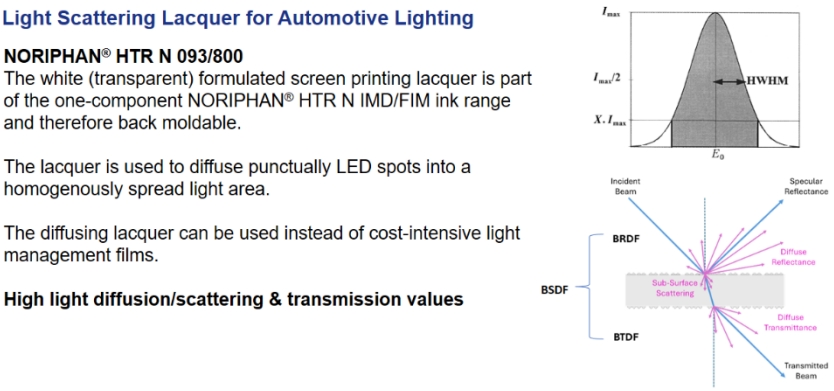


Proell – Hans-Peter Erfurt

“IMD/FIM Technology – Film Insert Moulding, a consistent and persistent method for decorating products “

Proell is a German manufacturer of screen and pad printing inks as well as specialized ink systems, adhesion promoters and protective lacquers for IMD/FIM technology.

Hans-Peter presented special inks and lacquers for automotive front modules and lighting applications. The new light scattering lacquer NORIPHAN HTR N 093/800 was the highlight!



The white (transparent) formulated screen printing lacquer is part of the one-component NORIPHAN® HTR N IMD/FIM ink range and therefore back moldable. The lacquer is used to diffuse punctually LED spots into a homogenously spread light area. The diffusing lacquer can be used instead of cost-intensive light management films. The lacquer shows high light diffusion/scattering & transmission values!

Advantages of IMD/FIM parts:

- Second surface ink layer combinations, with optimized climate & hydrolyses resistance and improved interlayer cohesion
- Day and night design, dead front effects, ambient lighting
- Light diffusing (scattering) lacquers with high transmission
- IR & radar transmitting black color shades
- Non-conductive black and silver color shades for functional panels and displays

PRE-SESSION – OPTICAL DESIGN DEEP DIVE

Huaju – Jia Zhenquing

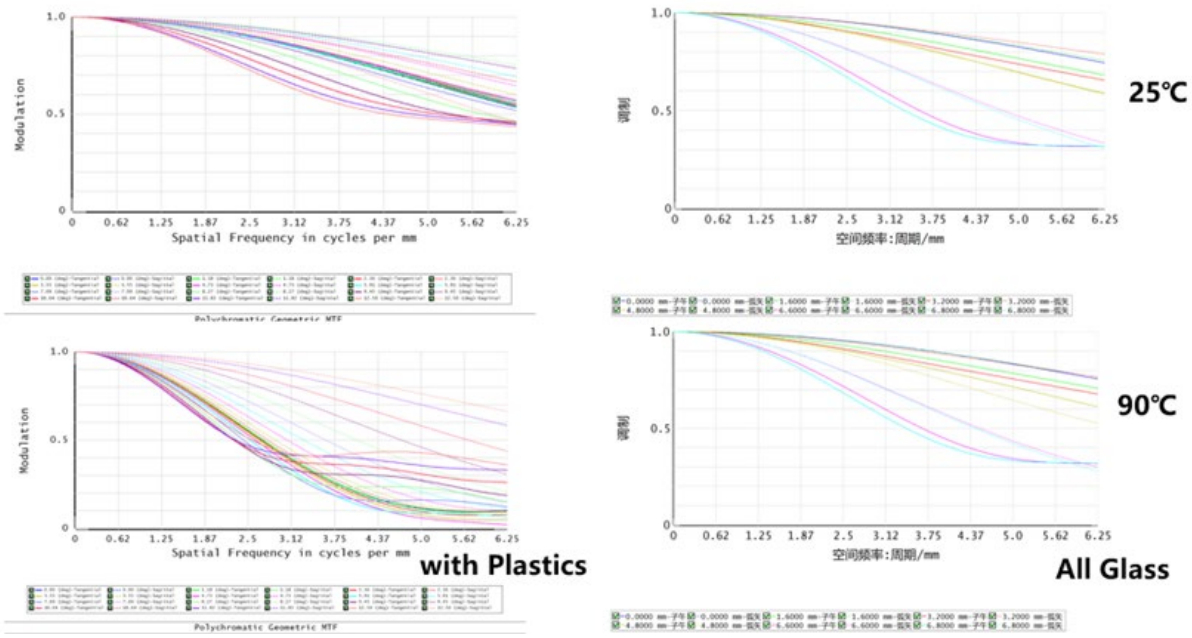
“Beyond Spherical Limits: How Aspherical Glass Lenses Elevate Automotive Lighting Performance & Design”

Huaju presented a comparative study between different types of lens systems for optical design of a Micro LED projector and a DLP projector, with analysis of relations with key parameters: cost effectiveness, efficiency, size, temperature resistance and sharpness.

The presentation then focused on the design of lenses for HB/LB projection systems, with advantages of aspherical lenses made in glass compared with the ones made in plastic: the influence of aspheric accuracy on projection effect is also investigated and it plays a key role in the precision of the projected pattern without side deformation and colour fringes. The conclusion is that glass aspherical lenses permit to achieve superior performances in definition and thermal stability for matrix beam applications.

Comparison Dimension	Glass Aspherical Lens	Plastic Aspherical Lens
Optical Performance	High	Medium (significant thermally)
Light Efficiency	High	Medium-High (prone to attenuation)
Thermal Stability	Excellent	Poor (deformation and yellowing effect)
Service Life	Long	Short (3-5 years, prone to aging)
Cost for lens	High	Medium-High（dimension，thickness）
Cost for Tooling	Very low	High
Environmental Physical recycling rate	95% >90% optical-grade reuse	10% zero optical-grade recycling

Advantages of Glass Aspherical Lenses in HB/LB

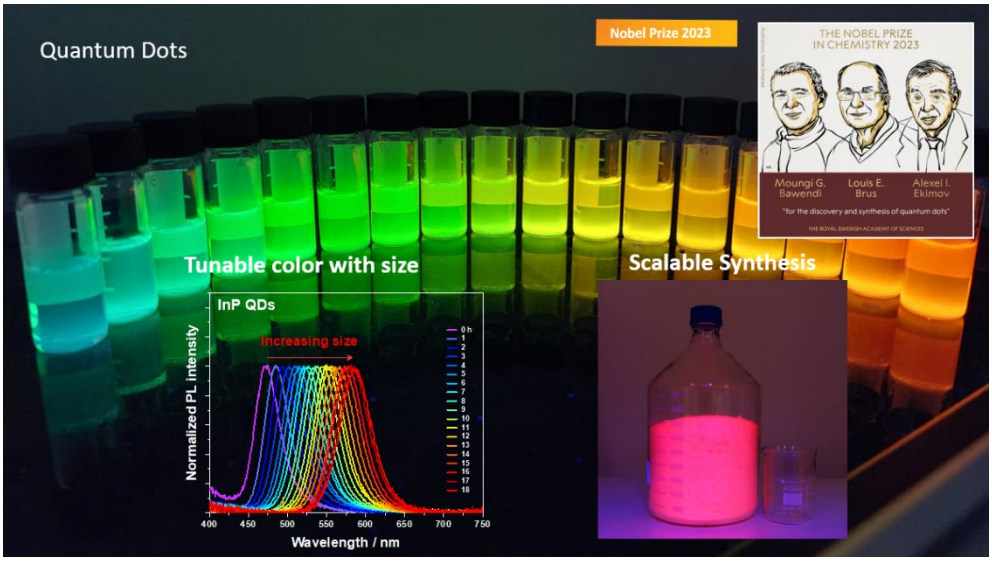


Aspheric lenses in Optical design : plastic vs. glass

Fraunhofer IAP – Manuel Gensler

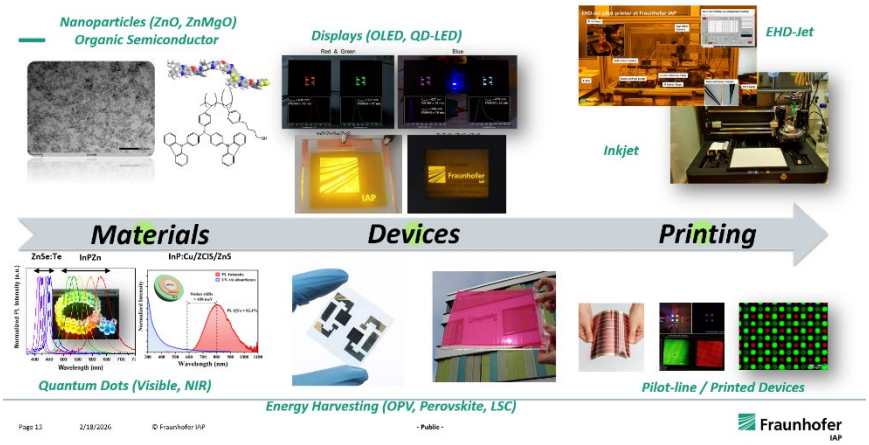
“Engineering Customized Light: Quantum Dots Beyond Information Displays”

Fraunhofer IAP presented the recent progresses of the Institute on the development of Quantum-Dots for color conversion with a list of methods of application from the embedding in polymers to the printable ink formulation (UV-curable). Among advantages over phosphors we can consider the very flexible processability due to ligand exchange, the tunability of color to match any needed one for emission and for branding, the very narrow FWHM that means purity of color and high effiency, high stability due to inorganic nature and cost efficiency when up-scaling synthesis will be achieved. First application to improve color of LCD and OLED displays has been realilized demonstrating the purity of color achieved. Quantum-Dots and a promising new high-performance technology for MicroLEDs.and a project for they assembly has been launched involving other 3 Fraunhoper Institutes: Fraunhofer ILT for Laser Lift-Off and Transfer, Fraunhofer IZM for Joining Technology, Fraunhofer IPMS for CMOS backplane Technology. A semi-automated pilot line at Fraunhofer IAP has also been presented to demonstrate a first step to move the QDs applications from the laboratory scale to a pilot scale and able to operate on substates up to 150 mm x 150 mm.



The purity of color provided by Quantum-Dots

The presentations concluded with the general developing process of the Institute for an industrially feasible display module with QDs: first of all, materials should be prepared for device application, and then printing technology should be accompanied for compact display module.



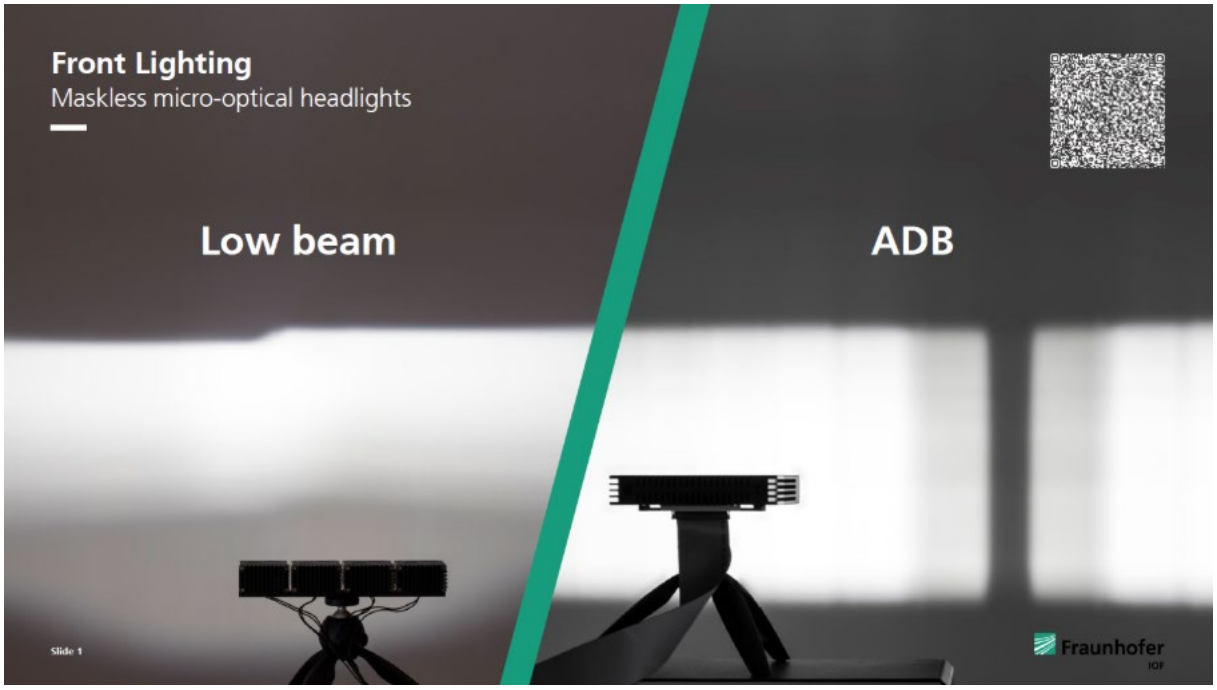
General development process for a display module wih Quantum-Dots

Fraunhofer IOF – Dmitrii Stefanidi

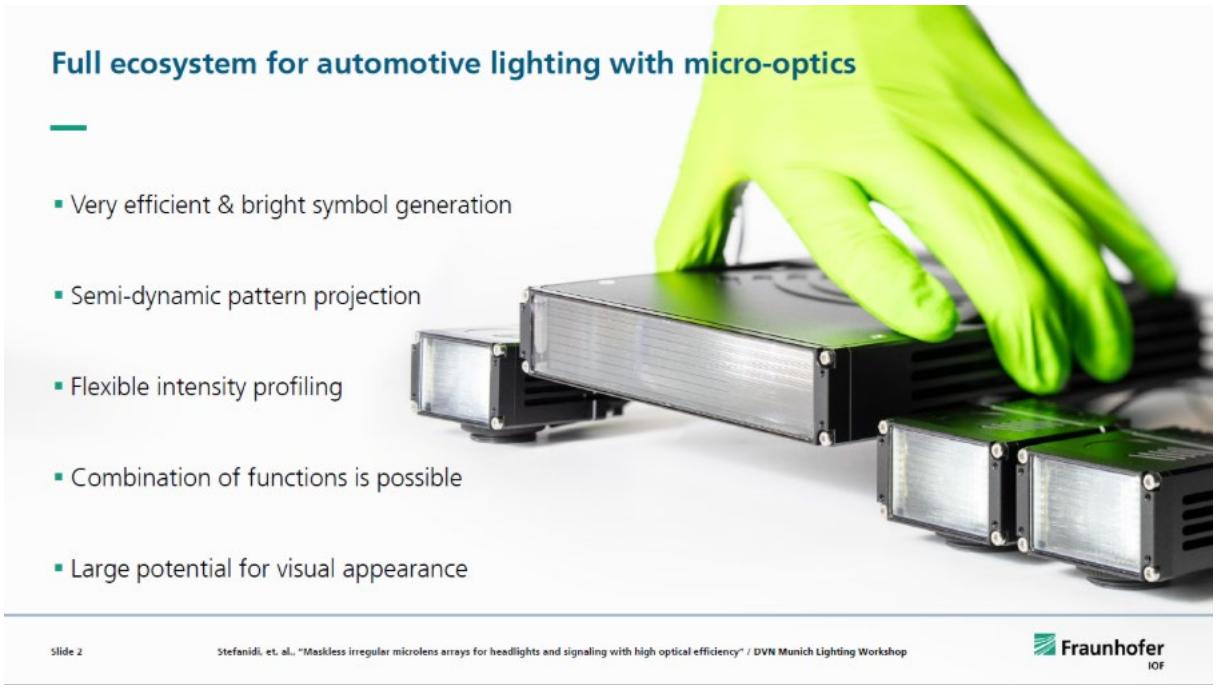
“Maskless irregular microlens arrays for headlights and signaling with high optical efficiency”

Fraunhofer IOF presented its recent development of maskless, irregular, double-sided microlens arrays (MLAs) for automotive illumination and symbol-projection systems with high efficiency. The presented demonstrators and use cases show strong potential for this technology to achieve the desired headlight performance within a very compact lighting-module form factor. It also enables the combination of different lighting functions in a single module.

For symbol ground projection, maskless MLAs provide very high pattern brightness, making daytime visibility feasible.



Front Lighting: Maskless micro-optical headlights



Full ecosystem for automotive lighting with micro-optics

Docter Optics – Markus Winkler

“Cost competitive lens solutions for Pixel Light Headlamps”

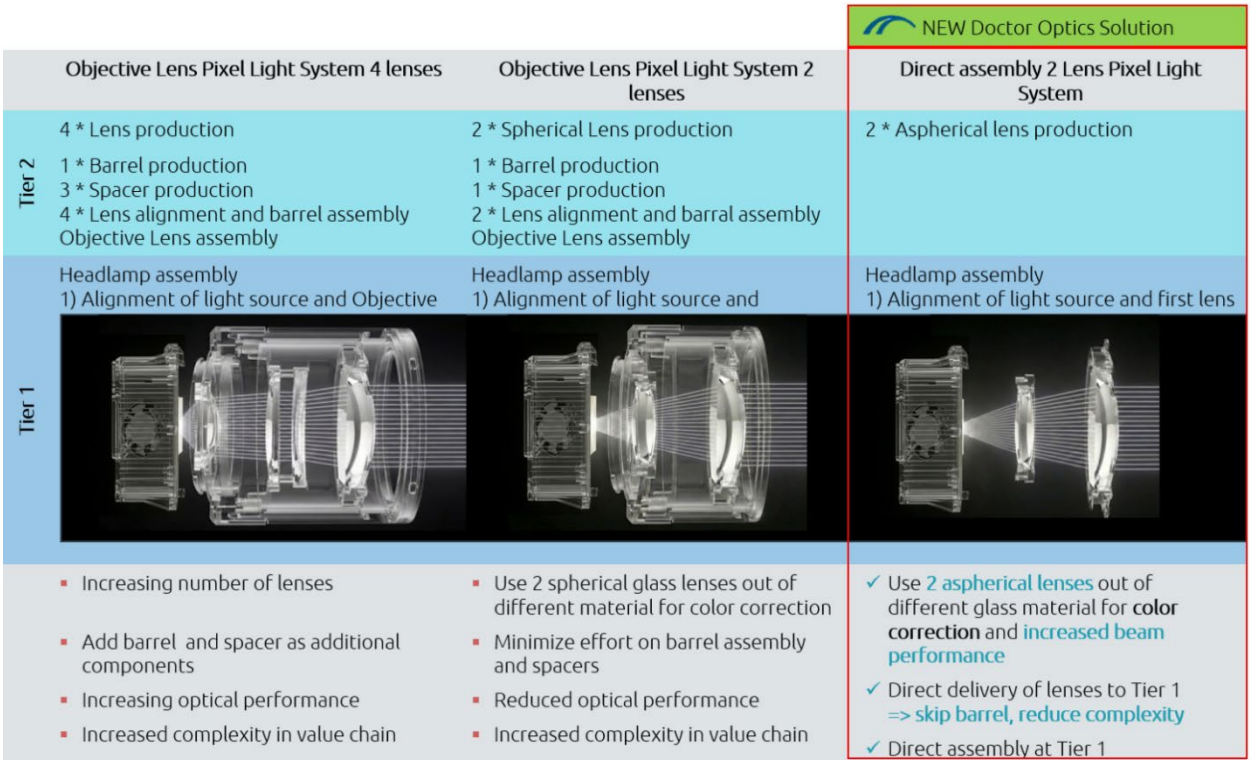
As the demand for high-performance yet cost-efficient systems continue to rise, the development of scalable lens solutions for pixel light headlamps has become a strategic priority.

Pixel-based projection technologies enable adaptive, high-resolution lighting but also pose new challenges — reducing system complexity, minimizing weight and installation depth, and managing component diversity — all without compromising optical quality.

In his presentation, CTO Markus Winkler shared valuable insights into how a cost-effective LED pixel light system for automotive front lighting can be realized using aspherical glass lenses. He presented several reference designs demonstrating performance across extra-wide, wide, and spot field-of-view configurations.

Leveraging its in-house optical development expertise, Docter Optics is actively exploring new approaches to optimize lens architectures that combine high optical performance with cost-efficient scalability.

In addition to pixel light systems for front lighting, Docter Optics also showcased its new DOCLaP application — a multichannel dynamic laser projection system for automotive exterior and interior applications, offering 24-bit true color and 60 fps at VGA resolution, with support for up to eight projection heads.



Value chain – design cost breakdown: Tier 1 / Tier 2

ams OSRAM – Florian Wittmann

“Novel intelligent LEDs for Highly Scalable Dynamic Exterior Lighting”

The automotive industry is experiencing a growing trend towards advanced lighting solutions, including horizontal taillights and grille lighting spanning large areas, complemented by dynamic lighting effects.

These lighting designs not only enhance vehicle aesthetics but also offer customization and personalization options, while improving visibility and safety.

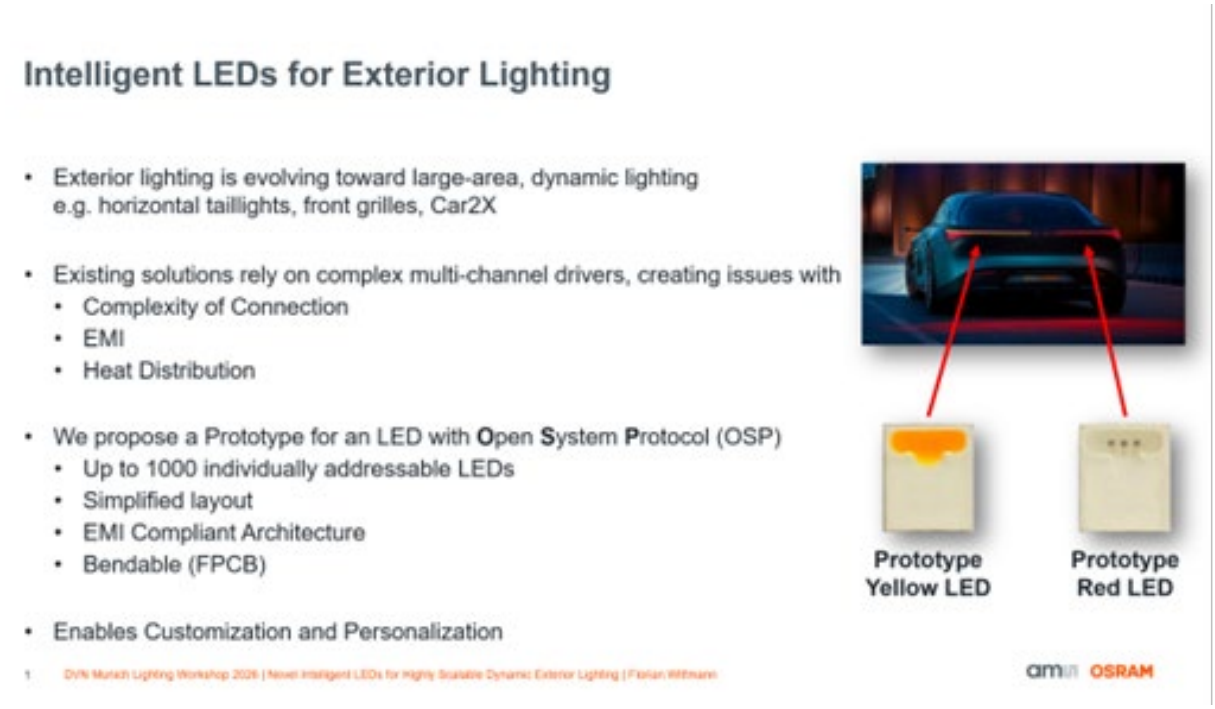
However, achieving dynamic and individually controllable lighting effects with current solutions faces significant challenges.

Traditional methods require complex and costly implementations, including extensive wiring, multi-layer PCBs, and additional drivers, which increase both the space requirements and the potential for electromagnetic interference (EMI) issues.

To overcome these challenges, we propose a novel approach utilizing individually addressable red and yellow prototype LEDs with the Open System Protocol (OSP) developed by ams OSRAM.

The OSP protocol is an open, license-free standard that enables dynamic lighting applications through a daisy-chain architecture. By leveraging the OSP, it is possible to individually control up to 1,000 devices in a single chain with minimal space requirements, simple PCB Technology, and low cost, making it an ideal solution for large scale exterior lighting in modern vehicles. Because the OSP protocol uses differential signaling, EMI compliance is significantly improved, and reliable boardtoboard communication becomes straightforward.

While the OSP is typically used for intelligent RGB LEDs, it is adapted to drive red and yellow LEDs for exterior lighting, especially Rear Combination Lamps.

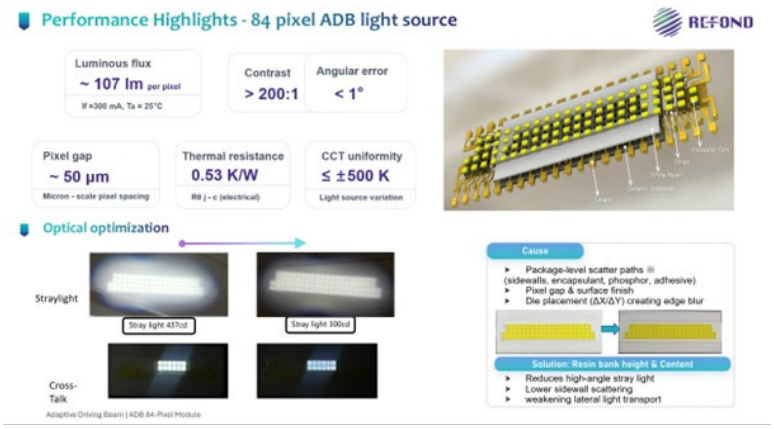


Proposal for intelligent LEDs with Open System Protocol (OSP)

Refond – Felix Zhang

“Optimization of ADB Light Engine”

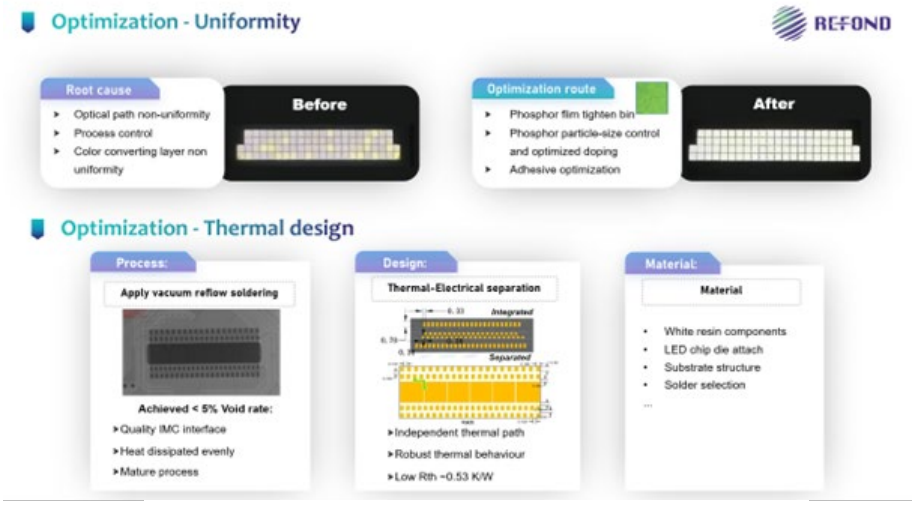
Refond presented package-level optimization of an 84-pixel Adaptive Driving Beam (ADB) light engine, treating pixel-level beam shaping as a packaging-dominated problem. Optical optimization addressed inter-pixel crosstalk and stray light in arrays with ~50 µm pixel gaps. Resin-bank geometry and material were engineered to form optical barriers with high reflectivity, suppressing lateral photon transport through sidewalls, encapsulant, and phosphor interfaces; measured stray-light intensity decreased from 437 cd to 300 cd (~30%), reducing high-angle scatter, improving mask edge acuity and enabling >200:1 contrast with <1° angular positioning error.



84 pixel ADB highlights and optical optimization

Color-uniformity optimization reduced pixel-to-pixel CCT dispersion by controlling conversion-layer statistics: tighter phosphor-film incoming binning, constrained phosphor particle-size distribution and doping ratio, and stabilized adhesive rheology/thickness for repeatable film attachment. The result was CCT uniformity within ±500 K across all pixels.

Thermal/process optimization focused on lowering junction temperature gradients at high power density. Vacuum reflow soldering achieved <5% die-attach voiding to improve intermetallic continuity and thermal contact uniformity. A thermal–electrical separated architecture decoupled current routing from the primary heat-spreading path, and with ceramic substrates the light source delivering Rjc~el ≈ 0.53 K/W and ~107 lm/pixel at 300 mA (Ta=25°C). Collectively, these levers mitigate efficiency droop and chromaticity drift, and improve margins for automotive reliability stress validation (e.g., HTOL and temperature cycling) under sustained high-current duty cycles.



Optimization of uniformity and thermal design

DELO – Christoph Appel

“Adhesive-enabled optics alignment for complex automotive lighting geometries”

Modern automotive lighting systems incorporating Matrix-LED and Digital Light Processing (DLP) technologies demand unprecedented optical precision, with alignment tolerances of ±5 - 50 µm. Traditional assembly methods—mechanical fixation and laser welding—fall short of these requirements while imposing significant design and cost constraints.

This presentation demonstrates how advanced light-curing adhesives enable active alignment solutions that revolutionize precision optical assembly in complex headlight geometries. Unlike rigid mechanical systems, these adhesives provide inherent stress compensation through viscoelastic properties, effectively absorbing thermal cycling and vibration-induced stresses throughout the component lifecycle. Active alignment processes achieve positional tolerances of less than 10µm, surpassing conventional assembly capabilities.

Key advantages include unlimited material compatibility, eliminating mono-material restrictions of welding processes and enabling optimal component selection based on functional requirements. This technology supports complex three-dimensional geometries impossible with mechanical fasteners, empowering optical designers to prioritize performance over manufacturing constraints.

UV-curing adhesives offer substantial process benefits: high-throughput processing, reduced cycle times, and significant CO_2 emission reductions compared to energy-intensive welding. The controlled curing mechanism ensures consistent joint properties while maintaining positional accuracy during polymerization.

DELO provides tailored customer solutions for these demanding applications, offering comprehensive material portfolios specifically engineered for automotive optics integration. Through collaboration with OEMs and Tier-1 suppliers, customized adhesive formulations ensure seamless integration into existing production lines while meeting stringent automotive qualification standards. Transform optical assembly from a manufacturing constraint into your competitive advantage, delivering precision, adaptability, and sustainability for future automotive lighting innovations.

Adhesives, Dispensing & UV-Curing

SESSION 3 – SIMULATIONS & AI: HOW TO ACCELERATE AND CHANGE OUR WAY OF WORKING

Renault – Benoit Deschamps

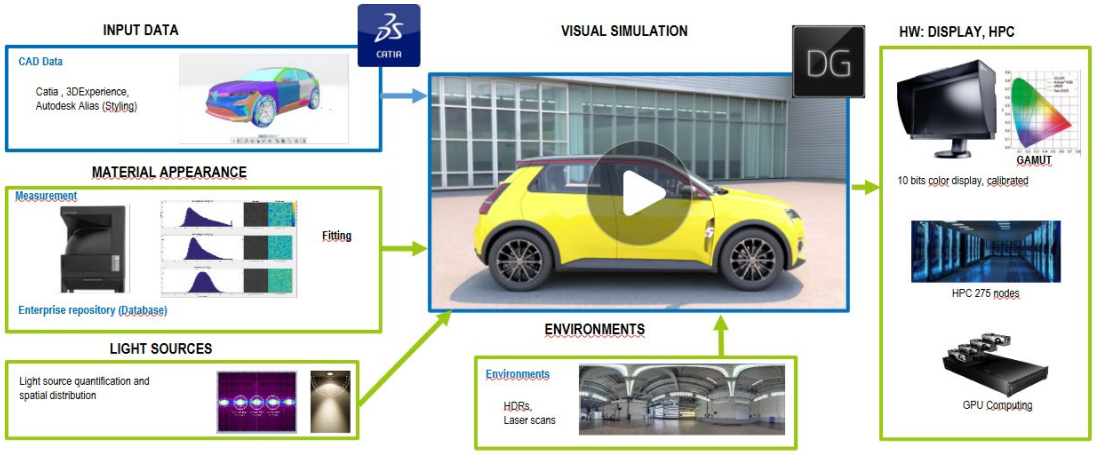
“Automotive Lighting Challenges: From Collaborative Design to Predictive Simulation”

The automotive industry is facing unprecedented pressure to develop vehicles faster while ensuring higher levels of quality, safety and customer experience. Shortened development cycles, increasing product complexity and the rapid expansion of advanced lighting technologies require new methods capable of delivering both speed and accuracy.

In this context, Renault Group focuses on accelerating vehicle design through advanced numerical simulation, high fidelity visualization and cross functional digital tools.

We present an end-to-end approach that combines physically based rendering, objective lighting analysis, and collaborative digital workflows. These methods enable early validation of styling and engineering intent, reducing dependencies on physical prototypes and minimizing costly late design iterations.

The primary challenges for simulation software providers are twofold: facilitating collaborative design among various departments within the automotive company and their suppliers, and reducing simulation computation times without compromising accuracy through GPU approaches or AI-based denoising.



Furthermore, welcome sequences and advanced driver assistance systems based on matrix beams present additional challenges due to the numerous possible combinations and the design phases required to validate the entire sequence.

Homogeneity analysis from luminance views

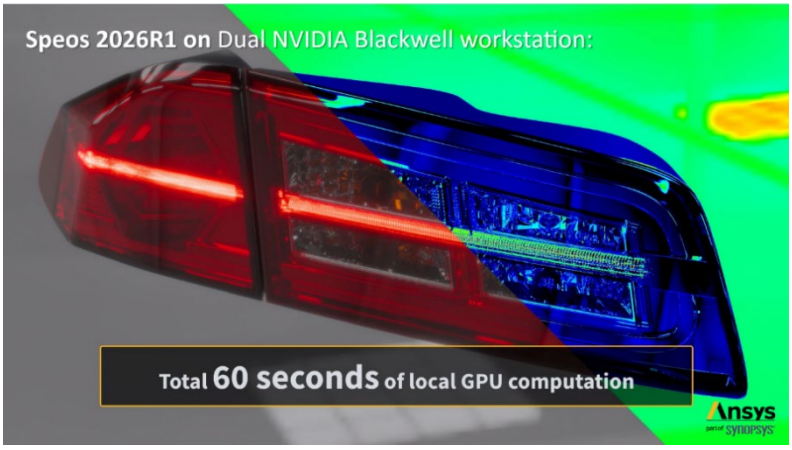
Leak of light zoning and intensity from illuminance views

Contribution analysis by lighting system using raw visualization

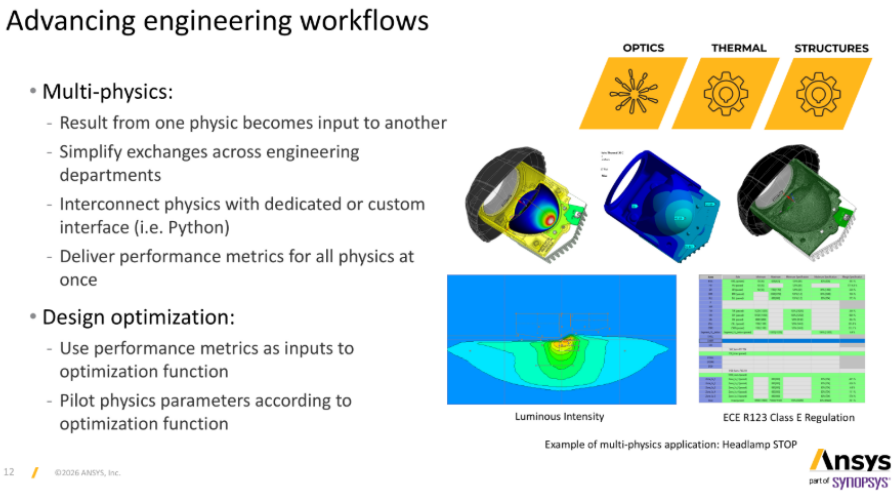
Contribution analysis under different lighting conditions to detect daylight artifacts

Ansys (Part of Synopsis) – Mathieu Reigneau

“Acceleration in Digital Engineering: What AI & Software Customization can truly deliver in Lighting?”



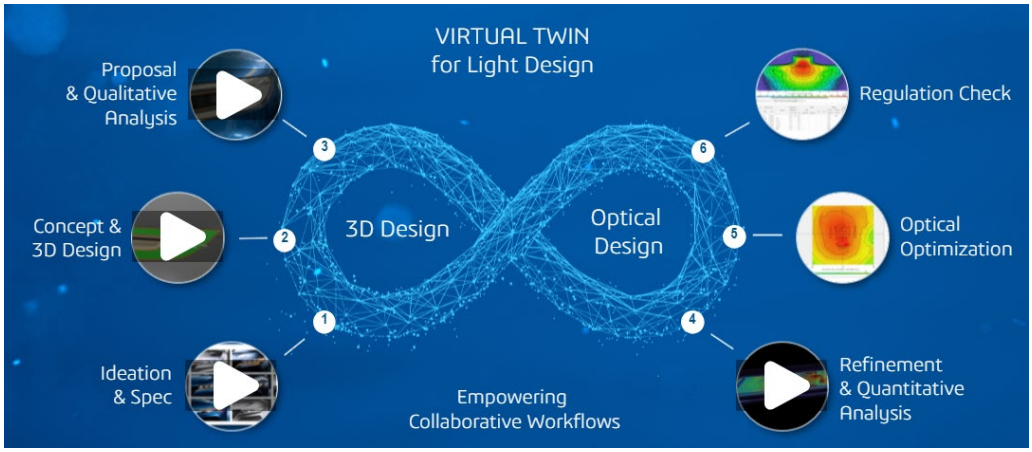
Following the acquisition of Ansys, the new core Optical simulation at Synopsys now consists of Lumerical, Zemax and Speos, spanning from chip creation to optical design to illumination system design and integration.
Automotive lighting industry requires to drastically reduce product development time. For this, Speos contributes with faster simulation, open ecosystem integration, and seamless data exchange.
First with HPC and GPUs: Speos has leveraged NVIDIA innovations from the earliest days of GPU computing to now achieve high fidelity, fully unbiased simulations that match the certified Speos CPU reference. Much faster simulation does not diminish the importance of accuracy and the critical target to not miss any potential flaw. Tracking those with Human Vision based visualization with realtime light animation, HDR and VR inspection, then allowing precise colorimetric and photometric measurements same as in-lab conditions. And above all, allowing in-depth analysis of flaw origin directly within the 3D design environment, ready to take immediate corrective action.
Strong from its past integrations into major CAD platforms, Speos now offers a new approach with PySpeos: part of the broader PyAnsys initiative, it provides opensource, APIdriven integration into any platform, for automation, cosimulation, and Multiphysics workflows. This open API approach leverages a vast variety of accelerators: Artificial Intelligence further enhances engineering and simulation efficiency through tools such as AnsysGPT, OptiSLang AI+, and SimAI. Then open integration connects workflows beyond engineering, letting Engineers examine Style submission much earlier on, and offering Designers the tools to review optically accurate digital twins integrated within their own virtual mockup.



Dassault Systems & Keysight – Stephan Ritz & Tobias Schmid

“3DEXPERIENCE CATIA & LucidShape – A Paradigm Shift for Lighting Design Workflows”

Dassault Systems and Lucidshape are proposing a complete tool called Virtual Twin for Light Design including the 3D Design and the Optical Design.

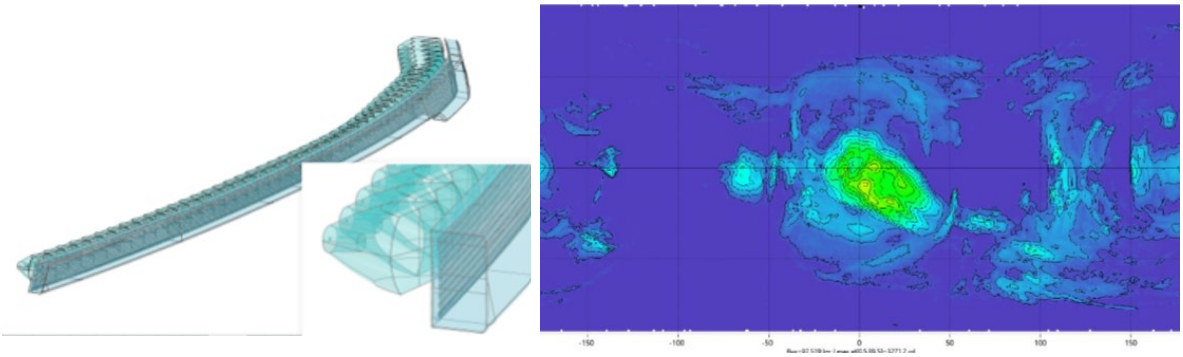


They are currently introducing AI, still in a beta version. AI is considering the targeted concept, previous references, market specifications and requirements impacting the appearance to help to the definition of the new product in a generative shape design process.

Naturally, there is a validation rendering to have a qualitative analysis of the proposal.

The optical lamp model is realized with Lucidshape for 3DExperience.

Design alternatives can be proposed, for instance for a DRL, starting with reflectors with limited light collection, an improved version with TIR with inner lens optics can be proposed with as output the light distribution.



These tools are so integrating:

A Modelling App for model setup including the reference geometry, light sources, sensors, actors, the optical material with their library

A Simulation App for simulation and analysis that performs Monte Carlo simulations to produce the light distribution for the defined scenarios, and the analysis of light distribution including the regulation compliance checks and custom analyses.

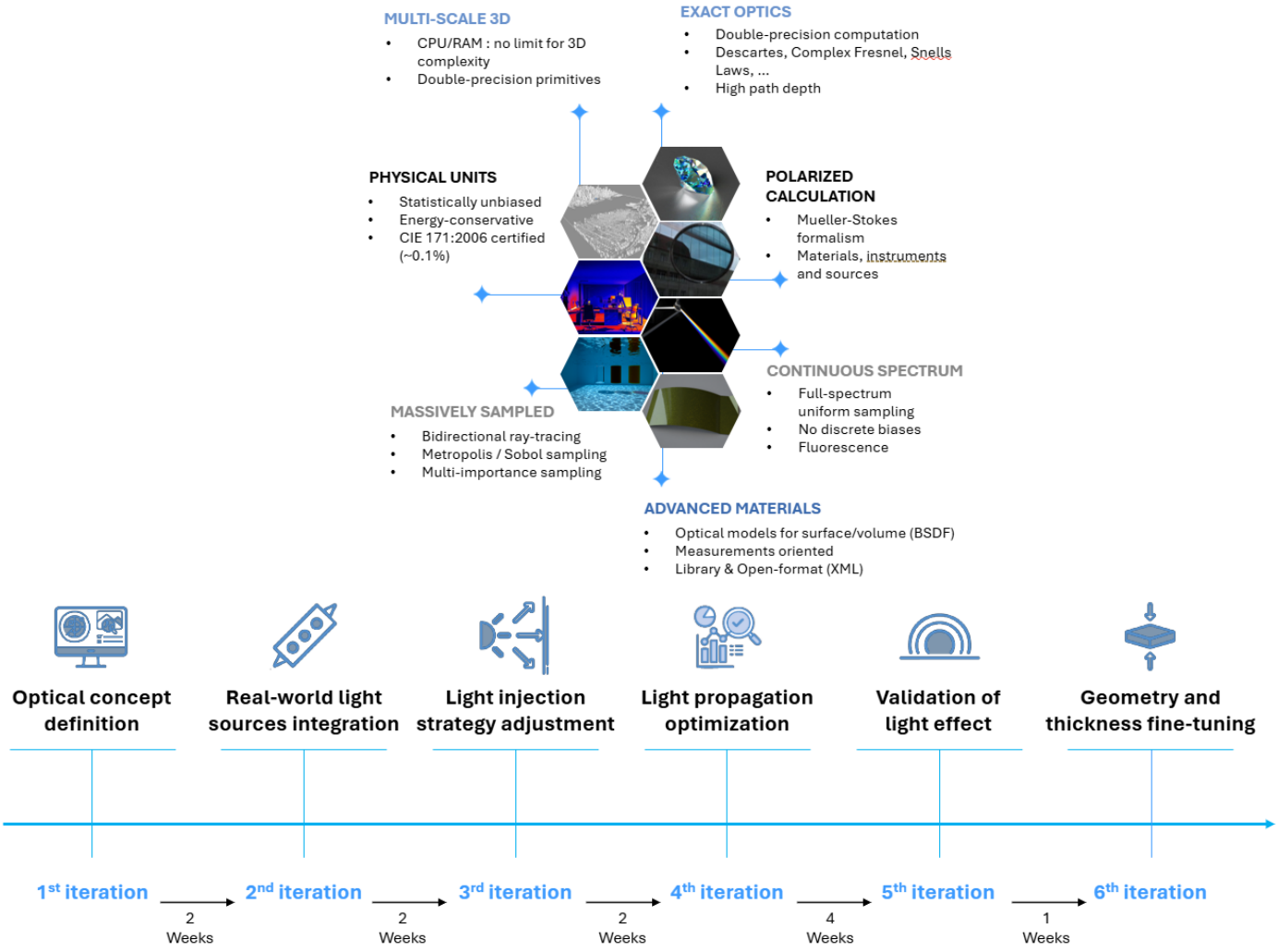
Eclat Digital & Covestro – Romain Hivet

“Covestro & Ocean : From Pixel to Real Part – Eliminate guesswork in design with predictive optical simulation”

The goal of this development was to digitally simulate infinity light effects with thin, mono-material designs in order to accelerate time-to-market and ensure more efficient and collaborative workflows.

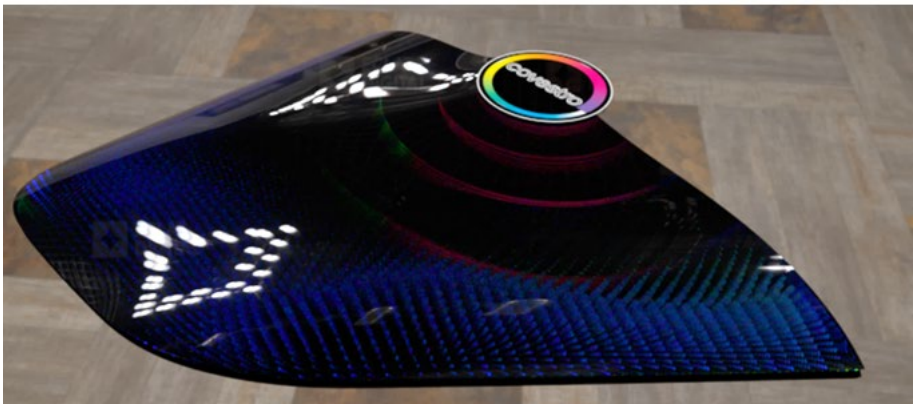
In this process from the ideation with the concept-visual intent to the production, the center part of the process is the validation traditionally realized by iteration and prototypes, and now realized with the Ocean Optical Simulation & Engineering.

When the first results are not considered perfect, Ocean can iterate digitally on materials properties, on µ-patterning, on pattern shape, on injection strategy, on parts thicknesses, …



They gave an example of an initial concept with the assembly of a thin tinted polycarbonate part, and a mirror coated clear part laminated with a semi reflective film.

There was a high correlation between the simulation and the physical reality, with a near-perfect match between Ocean™ digital prediction & physical result.



Savings from this process are estimated at - 70% for physical prototyping iterations, - 40% for time-to-market, and - 30% for development costs

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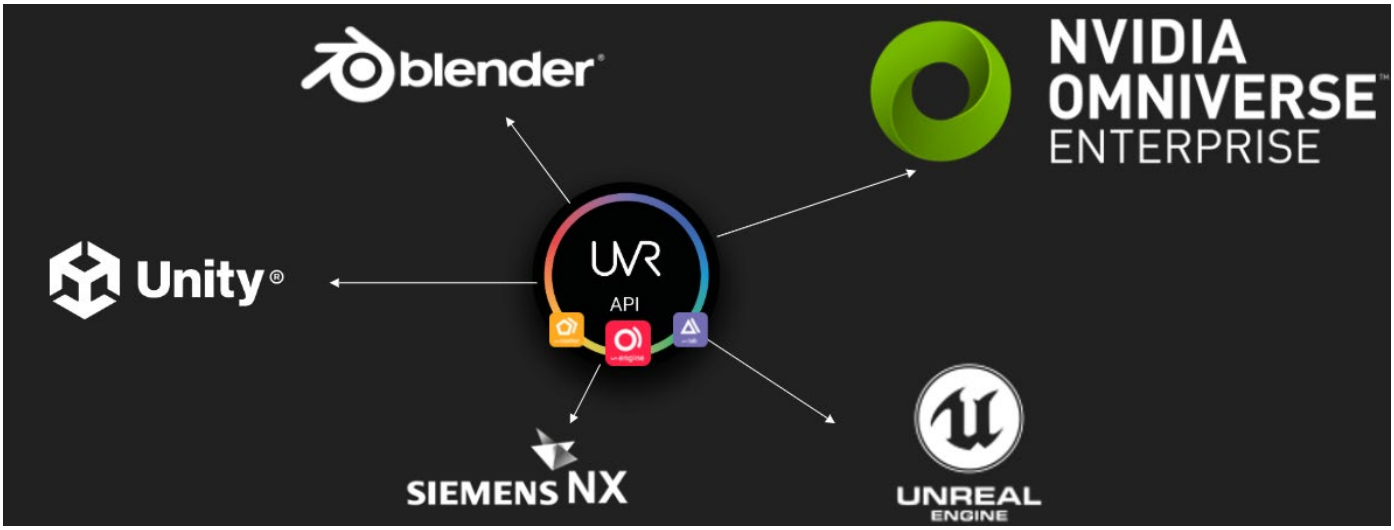
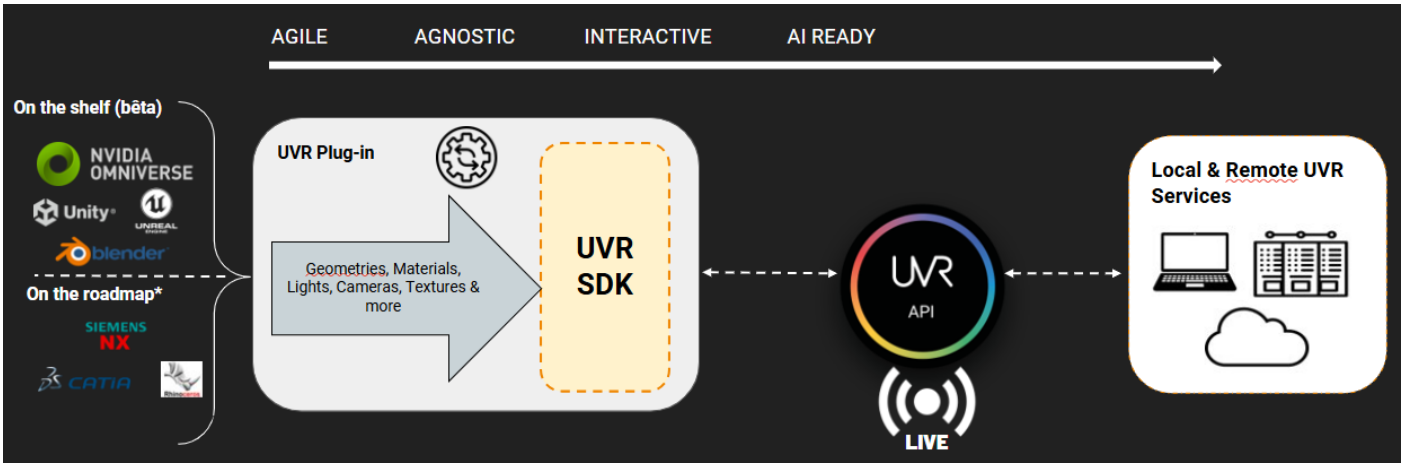
United Visual Researchers – Thomas Labardens

“Predict on Omniverse: Leveraging USD for Lighting Design”

UVR Predict API is a USD (Universal Scene Description) and GPU-based software enabling spectral, polarized and measurement-based rendering that can be integrated into any platform. It fully integrates with existing workflows to reduce silos between design and lighting engineering for a fast collaborative and interoperable visualization workflow



The goal of UVR is to be at the crossroads of optical simulation and iso-photographic visualization, with an unbiased and hyper-realistic solution which emphasis on generating True-to-Life predictive imagery. For that, all parameters including spectral, polarization and material properties are measured and characterized



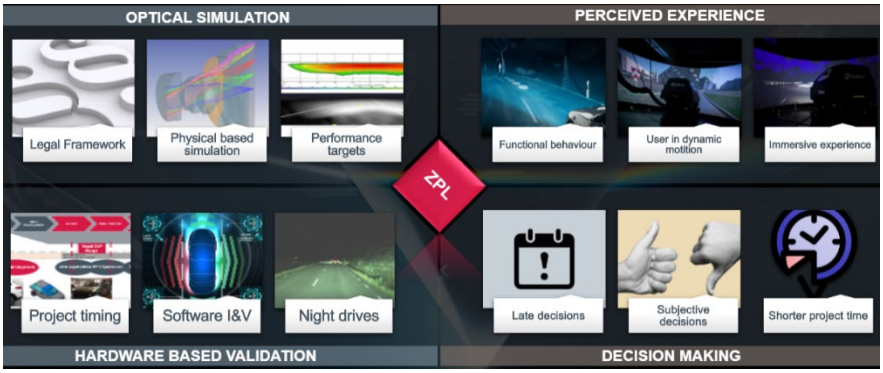
As USD (Universal Scene Description) has become a standard format to define, store, and transport all the resources (materials, light sources, sensors, measurement data…) required for simulation purposes, it a perfect basis for UVR Predict API with the following advantages: Extensibility, Multi-representation, Backward and forward compatibility, Scalability, Cross-platform compatibility, Cross-ecosystem compatibility.
The UVR's endgame through the use of USD is optical simulation and predictive lighting visualization in Real Time, without compromising physical accuracy.

They are using a full GPU computation for Iso-Photographic Appearance Design, with parallel processing, hardware acceleration, scalability, and In Path-Tracing for performance and energy efficiency.

Edag – Jannes Buthmann

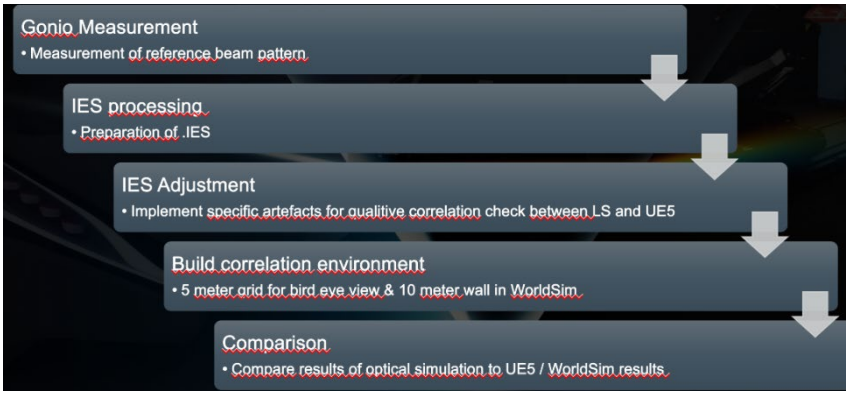
"Advantages and Challenges of Real-Time Virtual Night Drives with Unreal Engine 5 in EADG's ZeroPrototypeLab"

New lighting systems are no longer based on photometry alone, with now a complexity increasing due to the added functions. The user experience must be validated in motion, in the context and under dynamic driving conditions.
The current simulations can be accurate, but they are lacking experimental validation, while the virtual environment even if offering immersion sometimes are lacking physical correlation.
The targets of Edag was to correlate both worlds, ensuring that virtual night drives represent what is calculated in optical simulation.



The ZPROTOTYPELAB process is working for these different use cases:
- Development and benchmarking for beam patterns based on IES real-time rendering, with the correlation between optical simulation and Unreal Engine 5 World Sim verified,
- Generic development for projections in main functions using luminous modeler,
- Development of functional behavior for main functions (LB, HB, AFS, ADB)

For the use case 1, after measurement and IES files, the correlation environment is defined at 5m for bird view and with a wall at 10m.
In case of too many artifacts, it could be necessary to adjust the compression rate and the real-time operation performance.

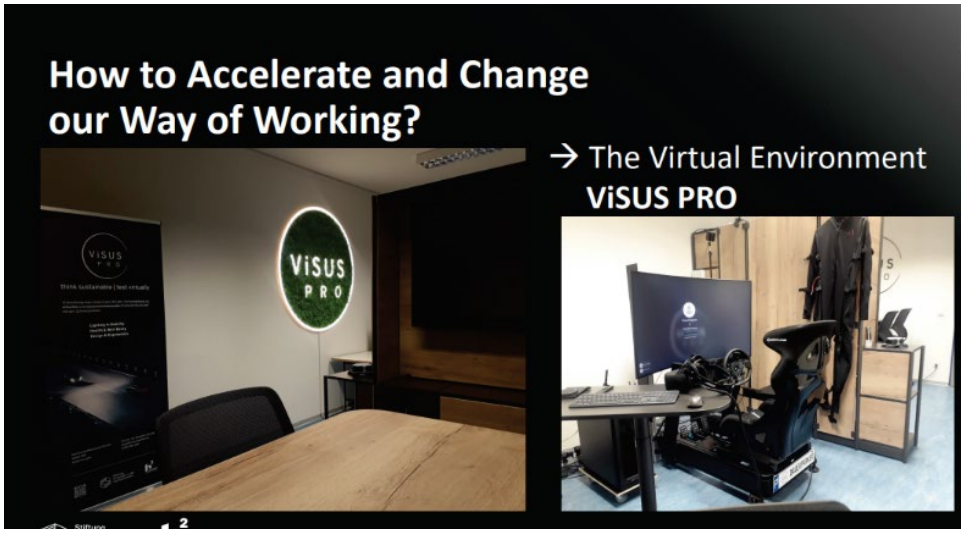


The use case 2 is in relation to road projections and is targeting to answer the question: how can we effectively comprehend and advance the human-machine interface with regard to projections in exterior lighting at an early stage?
Three steps are followed: Luminous algorithms à IES import à WorldSim Unreal Engine 5

After these developments, a robust correlation between optical simulation (IES-based) and Unreal Engine / WorldSim visualization was successfully demonstrated, and the Zero Prototype Lab enables early, perception-based lighting decisions without physical prototypes, and the extension of the approach will be done for ADB functions, using likely Mathlab Simulink logic including SIL.

Hochschule Madgeburg-Stendal – Benedikt Lamontain

“VISUS PRO – The potential of XR-Technologies”

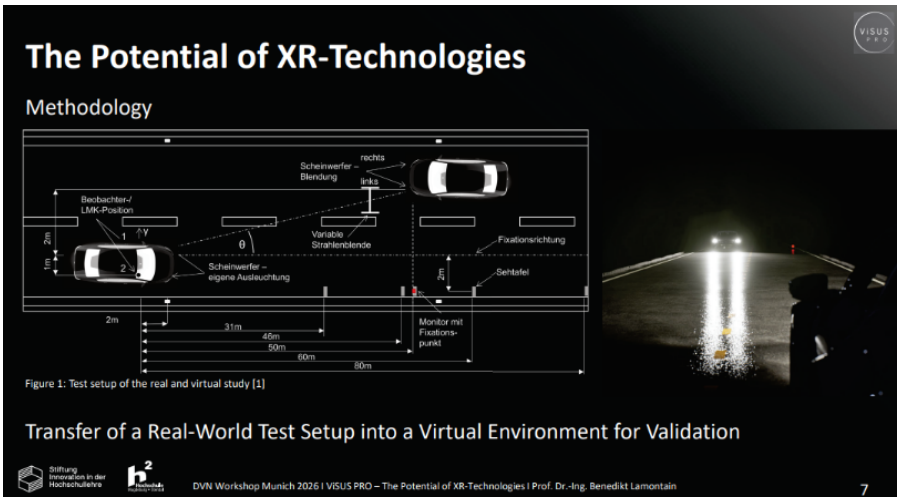


The presentation “ViSUS PRO – The Potential of XR-Technologies” introduced a novel virtual testing environment designed to accelerate the development and validation of advanced automotive lighting systems. The motivation arises from the increasing complexity of lighting functionalities and the need for faster, reproducible, and user experience-oriented evaluation methods that go beyond traditional night-time field measurements.

ViSUS PRO enables the transfer of real-world experimental setups into a controlled virtual environment, allowing researchers and industry partners to conduct perceptual and physiological studies under highly reproducible conditions. The platform is based on ultra-high-resolution extended-reality technology (Varjo XR-3), supporting high frequency data acquisition and advanced eye-tracking capabilities, which enable detailed analysis of driver perception, glare evaluation, and behavioral responses.

Preliminary investigations demonstrated strong potential for correlating subjective glare ratings with physiological indicators such as pupil diameter, highlighting the suitability of XR-based methodologies for assessing innovative lighting concepts and user experience. Furthermore, the approach facilitates collaborative design workflows between academia and industry, reducing development cycles while maintaining experimental rigor.

Beyond methodological research, the presentation also showcased the visualization and development of new lighting concepts, exemplified by a collaborative remote phosphor rear-lamp concept. Overall, ViSUS PRO represents a scalable framework for 24/7 virtual experimentation, enabling faster innovation cycles and evidence-based design of future lighting systems.



Luminous Algorithms – Ingo Steiner

“Specification-Driven Engineering – Automated Generation of Freedom Optical Surfaces for Lighting”

The target is to achieve automated generation of optical surfaces by the following process:

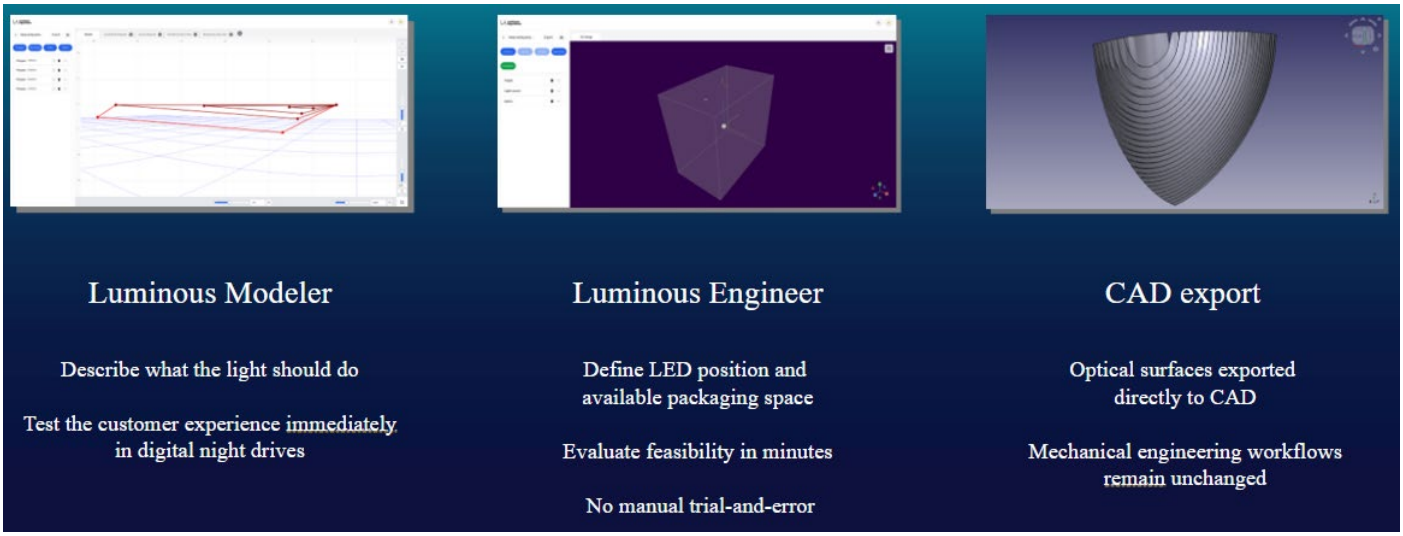
Definition of illumination goal for light distribution, intensity and performance

Definition of the mechanical constraints like available space, LED placement, surrounding geometries

And then automatic compute of optical surfaces with a single click, with no manual tweaking and no iterative simulation loops

The pilot project was realized for auxiliary headlight for racing for Gerg Lighthouse with design goals of broad illumination, high geometrical efficiency, sharp cut-off-line, and tight packaging.

A Luminous Modeler was used to describe the light target, a Luminous Engineer defined the LED position, the packaging and the feasibility, and finally, the optical surfaces were exported directly to CAD.



The results were good with:

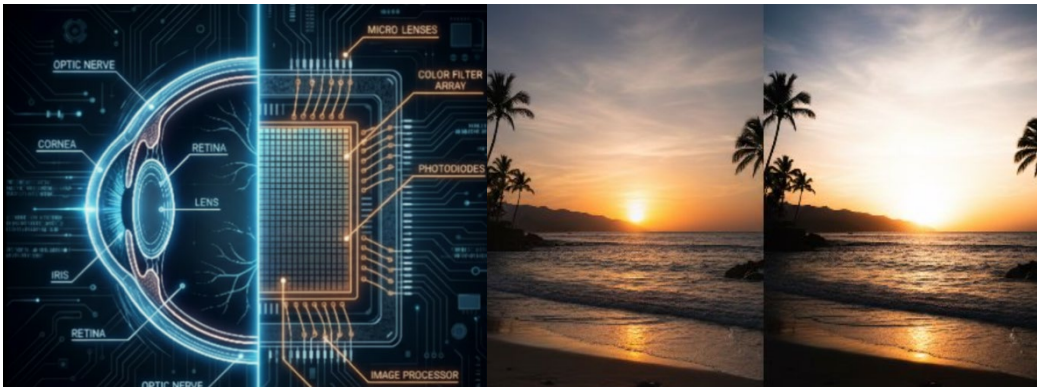
- Broad illumination 10 to 60 deg. outboard,
- High geometrical efficiency: 84%
- Sharp cut-off line: AK31 = 0.14
- Light flux output: 1800lm
- Space required: 50 x 80 x 80 mm for reflector

Luminous Algorithms is so confident to extend that application in order to automatically define CAD-ready optics from specifications, replacing iterative optical design with a linear workflow, allowing faster time-to-market with predictable results.

BSCA – Michele DITaranto

“Differences between human visual perception and camera capture. Why this gap matters”

Even with perfect simulation, what is seen by a human eye is different from what is captured by a camera.



The above images are an example of what each person noticed when reviewing the photographs.

To explain that difference, we need to understand that the eye is only the sensor, and the vision actually happens in the brain, which interprets, corrects, and enhances what we see in reality.

The camera is only a device that captures the image, but the image treatment is done by another processor.
And humans have many strong characteristics compared to cameras:

The dynamic range is much better for human eyes: human eye can perceive detail in very bright and very dark areas almost simultaneously. Conversely, cameras must choose, often losing detail in one area.

Eyes adapt differently to different parts of a scene. Cameras apply a single exposure setting for the entire image.

Humans perceive colors relative to surrounding colors and lighting, whereas cameras record absolute color values.

Humans perceive colors as stable even under different lighting conditions, cameras rely on white balance which can easily be incorrect.

There are other important differences between humans and cameras:

For humans, when all the cones are simultaneously activated at their maximum, the brain can no longer distinguish the color and interprets the signal combined as blinding white.

Our brains focus on contrast and edges, and two identical brightness values can appear completely different depending on context

Humans perceive motion smoothly over time. Cameras sample time in discrete moments, which can look unnatural.

In low light, the brain suppresses visual noise, cameras amplify sensor noise making the images worse than the real perception.

So, the human eye interprets reality whereas cameras measure it: Bridging this gap is essential to create images and systems that truly look right to people. Consequently, any system where machines capture images for humans, or train AI, must account for perceptual differences. It is so necessary to overcome traditional approach of virtual cameras synthetic data set, train AI that can drive virtual cameras.

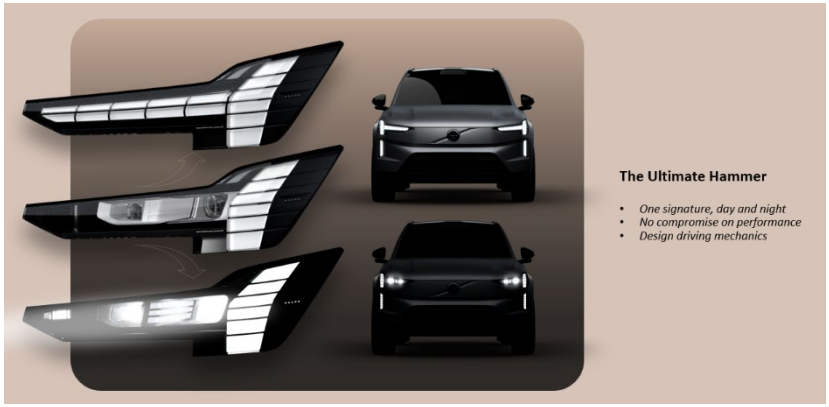
SESSION 4 – NICHE MARKET AND SPECIAL NEEDS

Volvo Trucks – Berk Keskin

“One Light, Two Worlds: Car and Truck Lighting from a Designer’s View”

The presentation explores automotive exterior lighting from a designer’s perspective, comparing passenger car and truck lighting through two Volvo projects: the EX90 and the Volvo FH. While both vehicles share the same brand values and safety focus, they operate in very different worlds, demanding distinct design priorities.

Using the EX90 as a starting point, the talk highlights how lighting acts as the first interaction between car and user. The Thor’s Hammer DRL was designed to deliver a consistent light signature both day and night, creating recognition, emotion, and trust without compromising performance or functionality. In this context, lighting becomes more than a technical component — it becomes part of the relationship between the vehicle and its owner.



The Thor’s Hammer DRL design on Volvo EX90

The focus then shifts to trucks, where lighting serves a different purpose. A truck is a working tool, operating long hours under demanding conditions. Here, lighting must communicate clarity, responsibility, and reliability. The Volvo FH’s V-shaped light signature demonstrates how strong brand identity can be expressed through the entire front face — proportions, grille, badge, and lighting working as a system — while meeting strict durability, visibility, and aerodynamic requirements.

V-shaped light signature for a strong brand identity on Volvo trucks

The presentation concludes by looking ahead to the future of truck lighting, where harmonizing all exterior lights into a coherent system can enable smarter, more efficient lighting solutions. Ultimately, the talk emphasizes that successful lighting design is not about size or complexity, but about creating the right expression for each vehicle's purpose.

Aspoeck – Kevin Riepl

"Lighting and Assistance Systems on Heavy Trailers"

Modern trailer lighting goes far beyond regulatory compliance, becoming a key enabler for efficiency, distinctive design, and advanced functionality. The new FlexLED Side Marker Lamp integrates multiple lamps, mounting brackets, and wiring into a single flexible solution of up to 15 meters, allowing fast installation, improved protection against collisional damage, and enhanced trailer aerodynamics. At the rear of the trailer, solutions such as the EcoLED III rear combination lamp highlight advanced LED technology, dynamic direction indicators, and customizable design options. The lighting concept is completed by the FlexLED Top-Multifunction Lamp, which combines several functions in one compact product while significantly reducing wiring and installation effort.

Multi-lamp and multifunction FlexLED applications

Trailer lighting systems are evolving from pure signaling functions into an intelligent platform for trailer lighting combined with assist functions. ECU-based intelligence and CAN communication enable the automatic, situation-dependent activation of lighting functions, enhancing safety and driver comfort. One such application is a radar-based ramp docking system that enables autonomous trailer assist functions. It supports the driver during gate maneuvering by using the existing rear outline marker lamps, which flash depending on the distance to the ramp. In addition, it performs active brake interventions in combination with the EBS to enable soft docking. The system continuously monitors the entire rear area, including cross-traffic situations. As a result, the trailer is becoming an active, intelligent partner within the truck trailer ecosystem.

Radar-based ramp docking system for autonomous trailer assist functions

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Wipac Technology, Lanzante & LESS – Simon Baker

“OEM, Tier 1 and Tier 2 – First to market technology collaboration”

Wipac presented their contribution on the development of the hypercar Lanzante 95-59. Starting from requirements of a renowned and respected automotive designer, Paul Howse, Wipac realized “floating” rear lamps enabling the maximum amount of hot air to be expelled from the rear of the car. The ultra slim package of “LuxiBright” technology by L.E.S.S. enabled a super thin and homogeneous Stop / Tail / Direction indicator lamp that was previously not possible in production. It allowed aerodynamic surface integration and contributed to the strict weight targets of this vehicle.

Lanzante 95-59: rear view

The realization of the lamps in only 18 months from start of design concept to testing and validation of the lamps has been possible thanks to an early engagement and a strong collaboration between OEM, Tier 1 and Tier 2 to achieve the target.

The presentation enters in the details of the concept of the rear lamp and with an exploded view Wipac shows how package size has been minimized to meet the necessary ECE requirements and to achieve homogeneous functions in only 2 kg total weight.

Rear lamp exploded view: integration of Luxibright optical fibers and remote light sources

The key enabling technology for this thin, long and homogeneous design is the “LuxiBright” technology provided by LESS, a nano-structured optical fiber, illuminated by a remote light source, which allow the customization of angle, length, color and intensity of the emission.

SESSION 5 – INNOVATIVE TECHNOLOGIES INCLUDING EE TO SUPPORT

OPmobility – Andreas Schramm

“The smart way to do an LDM-less headlamp: How the next-gen E/E architecture enables a more efficient approach”

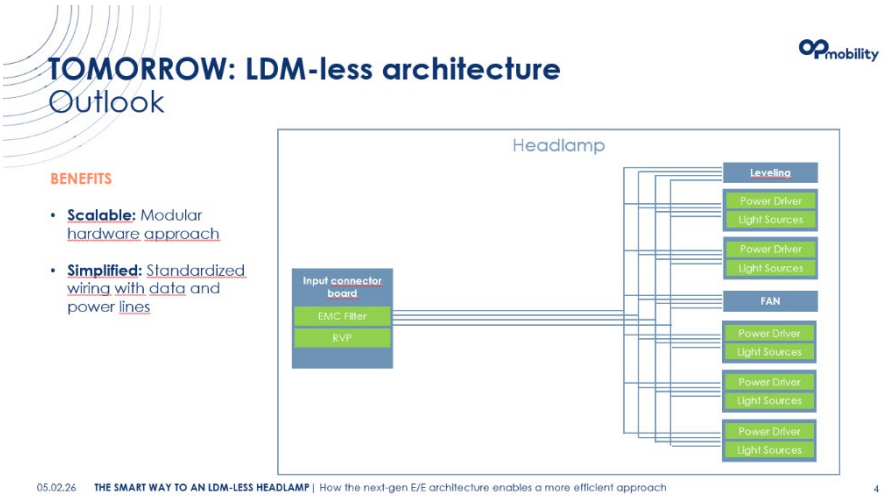
OPmobility’s strategic vision for advancing automotive lighting architectures is the transition from today’s MCU-less designs toward a fully LDM-less headlamp system. Historically distributed systems with many standalone control units have gradually shifted to centralized, MCU-less setups, where zonal controllers handle computation and enable Software Defined Vehicle functionality. This transition has already reduced complexity, BOM cost, and development effort.

Despite these improvements, current architectures still depend on an external Light Driver Module (LDM) as an intermediary between zonal controllers and light sources which are identified as a source of unnecessary weight, wiring complexity, cost, and architectural constraints, like fixed LED channel limits.

The proposed LDM-less architecture eliminates this component by integrating power drivers and communication electronics directly into each light module. Enabled by modern highly integrated LED drivers and high speed multidrop networks such as 10Base T1S, this approach supports scalable, modular configurations and allows standardized wiring schemes, potentially including daisy chain topologies that further reduce harness complexity.

The concept introduces engineering challenges, especially thermal management and repairability. Solutions such as shared heat dissipation and future 48-volt vehicle architectures could significantly improve efficiency and reduce component count.

OPmobility sees the LDM-less headlamp as the next logical step toward smarter, more efficient, and cost-effective lighting systems, with benefits including lower system costs, shortened time to market, and plug and play light module integration.



The next logical step: the LDM-less headlamp

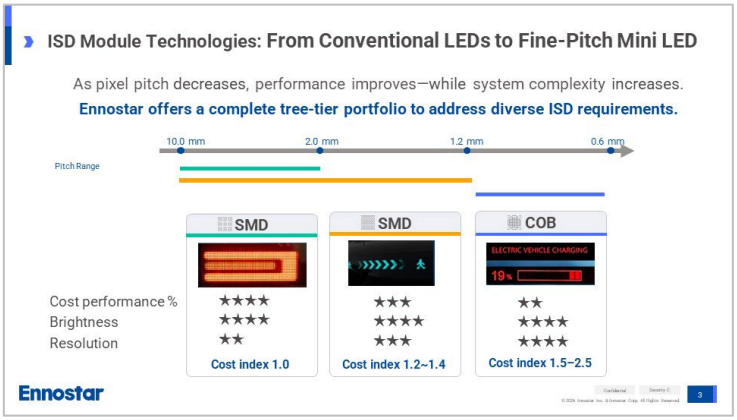
Ennostar – Meng-Yu Ho

“Mini LED ISD for Automotive: A Chip-to-Module Framework”

Ennostar shared insights from its presentation, highlighting how Intelligent Signal Display (ISD) is becoming a key enabler as vehicle exterior lighting evolves from illumination toward communication.

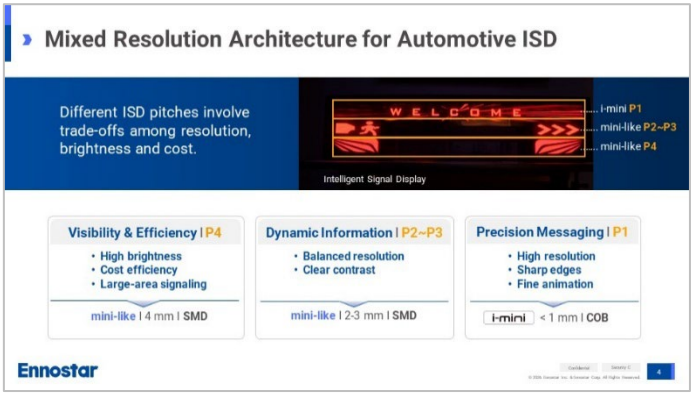
With the rise of software-defined vehicles and advanced driver assistance systems, ISD is increasingly used to convey vehicle intent, status, and warnings to pedestrians and surrounding traffic. This shift places new demands on exterior displays, requiring a careful balance of high brightness, resolution, contrast, reliability, and cost, while ensuring consistent visibility under diverse environmental conditions.

Ennostar reviewed the technology landscape from conventional LED solutions to fine-pitch mini LED architectures, emphasizing that mini LED currently represents the most commercially viable and technically mature solution for exterior ISD. Compared with alternatives such as OLED or micro LED, mini LED offers superior outdoor brightness, robust lifetime performance, scalable manufacturing, and proven automotive reliability.



ISD module technologies: from conventional LED solutions to fine-pitch mini LED architectures

The presentation introduced a mixed-resolution ISD architecture, in which different pixel pitches are strategically combined to optimize performance for various signaling needs—from high-brightness large-area messaging to fine-resolution dynamic graphics. This tiered approach allows system designers to balance performance and cost at the module level.



Mixed resolution architecture for Automotive ISD

A core focus was Ennostar’s vertical integration from LED chip design to automotive-grade ISD modules, enabling system-level optimization in optical performance, thermal management, and long-term reliability. Supported by AEC-Q compliant design and automated manufacturing, Ennostar’s chip-to-module framework provides a scalable foundation for future ISD applications as exterior lighting continues to evolve into a vehicle communication interface.

Robert Bosch – Gregor Sunderdiek

“CAN FD light for next generation E/E architectures”

As automotive E/E architectures evolve towards centralized, Software Defined Vehicles (SDVs), a critical need has emerged for highly integrated, cost-effective end-node communication.

CAN FD Light addresses this by introducing a simplified CAN FD protocol. It operates with a single commander controlling multiple responders, which can utilize inexpensive on-chip oscillators due to relaxed clocking requirements. This allows for highly integrated, devices, dramatically reducing costs by consolidating transceiver, CAN FD Light IP, state-machine, and analog components (oscillator, voltage regulator and sensor/actuator) in a mixed-signal ASICs. Instead of 3-5 discrete parts on the PCB (Transceiver, MCU, Clock, voltage regulator, actuator/sensor) you only need one CAN FD light responder device (figure 1). Furthermore, CAN FD light enables MCU-less end-nodes and thus reducing SW maintenance and update function.

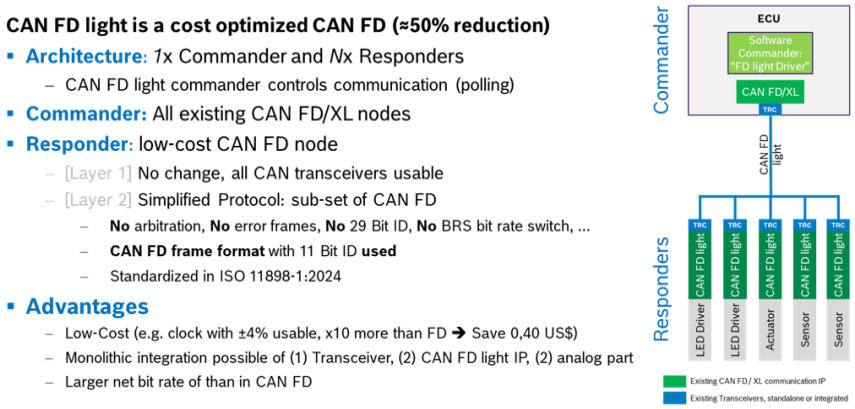


Figure 1: what is CAN FD light?

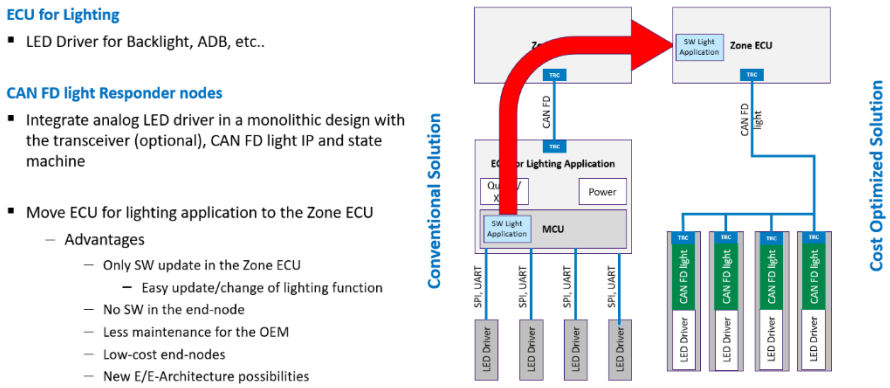


Figure 2: SDV (Software Defined Vehicle) – Lighting Example

In the Figure 2: SDV (Software Defined Vehicle) – Lighting example, the Lighting ECU in the conventional solution is not needed anymore. The application software is shifted to the zone controller and can directly control the CAN FD light LED drivers in the cost optimized solution.

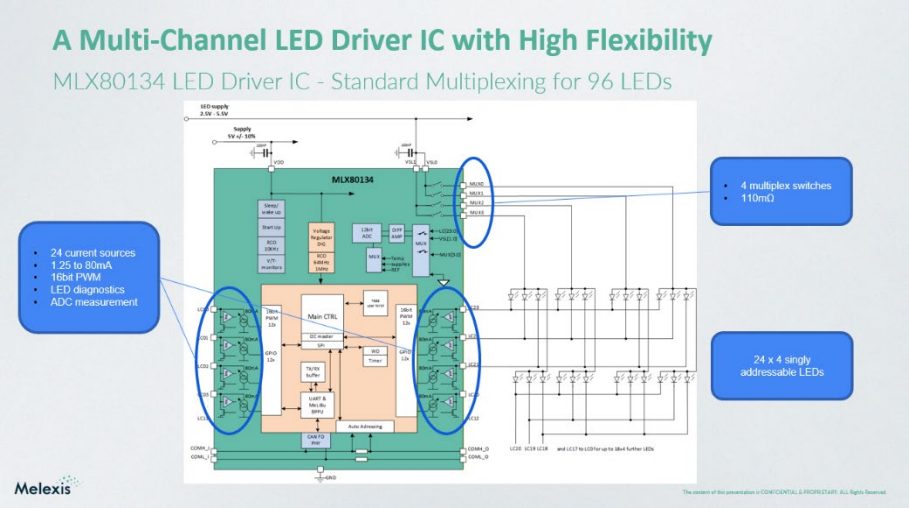
This offers numerous benefits for SDVs: simplified end-nodes, reduced maintenance, lower overall system cost compared to traditional solutions, and the flexibility for over-the-air software updates and changes managed centrally by the zone controller to the light application SW.

Consequential, CAN FD light is the new low-cost solution for next-generation automotive lighting applications in centralized E/E architectures.

Melexis - Andreas Laute

“A Multi-Channel LED Driver IC Approach for Exterior Lighting with High Flexibility”

Melexis presented exterior lighting applications and use cases, which require a high flexibility: front and rear signaling functions, exterior displays, lit grilles and front bars, illuminated logos and ground projection. Aside these exterior lighting design needs, there are typical system requirements: resolution from 200 to 2.000 pixels on different LED supports, high speed interface to commander unit and support of local and remote commander (e.g. 10BASE-T1S endpoint topology), ability to drive high number of single-color LEDs and optionally also RGB LEDs, AEC-Q100 qualification and functional safety ISO26262 for ASIL-B compliance. Additional features for the development of a LED driver IC are the availability of integrated code-free feature sets (mainly for single-color LEDs) and of user programmability features (potentially for RGB LEDs). An important aspect to consider is the scalability of the system: Melexis Lighting Bus (MeLiBu), a high-speed UART-over-CAN communication protocol has been designed to allow scaling up to 254 LED drivers to address a high number of LEDs. The set of requirements include the small package size (QFN), a wide range of LED current (typically 1 to 100mA), high resolution PWM (e.g. 16bit at 1kHz) channel building for high-current use cases and control of external DC/DC converters.



Characteristics of MLX80134 LED driver IC

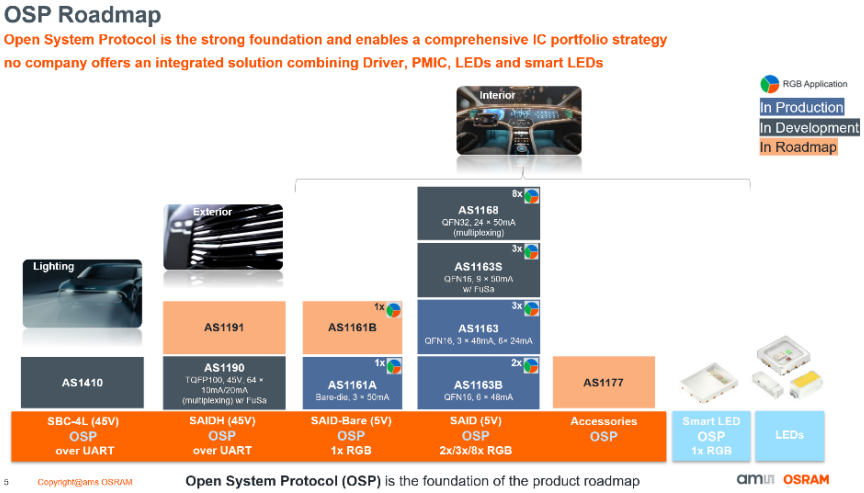
To provide a solution for all these requirements, Melexis introduced in the lecture a new multi-channel LED driver series, featuring the MLX80134: LED driver IC, which allows to individually address 24x4 LEDs with 24 current sources driving 1.25 to 80mA and supporting the16bit PWM dimming at 1kHz. This IC can be stacked to scale-up the addressable pixels, features a UART-over-CAN communication, may controls external DC-DC converters and can be used to select LED color in bi-color applications with multiple switches embedded in the QFN package.

The large portfolio of LED driver ICs has been also synthetically represented by Melexis with a schematic conclusive slide of the possible lighting applications listed in the preface of his presentation.

ams OSRAM – Lufei Shen

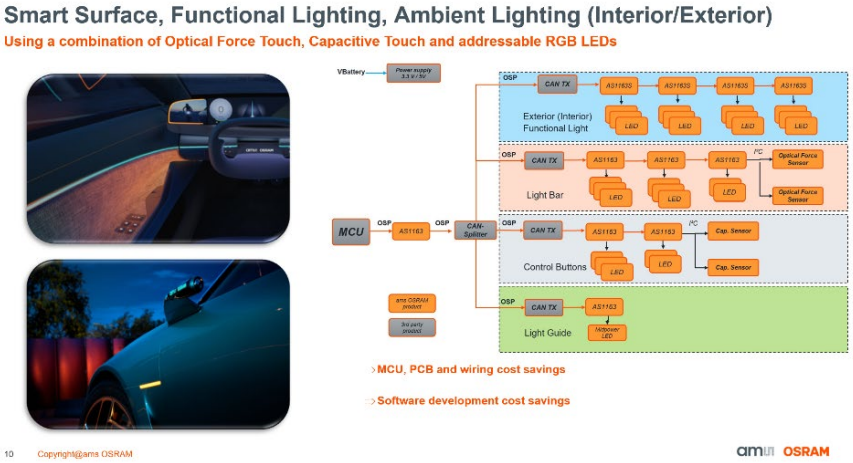
“Cost-effective System Solutions using OSP-based LED Drivers”

OSP (Open System Protocol) is a fast (2.4Mbit/s up to 1000 nodes), low cost (free and open) and (soon) standardized local communication bus optimized for lighting with many light points. OSP-based LED drivers with their unique features (e.g. AS1163, AS1163S and AS1190) and together with increasing OSP ecosystem expansion have created a solid foundation towards system benefits with significant cost-savings. Not only traditional applications in automotive lighting are experiencing a revolutionary change through OSP ecosystem, but also new innovations in lighting and more are being fostered by advanced OSP devices.



OPS Roadmap

ams OSRAM has a comprehensive OSP IC portfolio strategy, no other company offers an integrated solution combining Driver, PMIC, LEDs and smart LEDs. With increasing OSP ecosystem including MCU, Endpoint etc., there is high flexibility on system architectures for designers. Parallel branching directly in OSP daisy chain, or parallel connections on system level through Ethernet to OSP Endpoints. Various examples with significantly reduced system complexity demonstrate accordingly cost savings regarding hardware and software. With the commitment to automotive lighting, ams OSRAM is expanding its OSP-based IC portfolio to serve increasing customer demands.

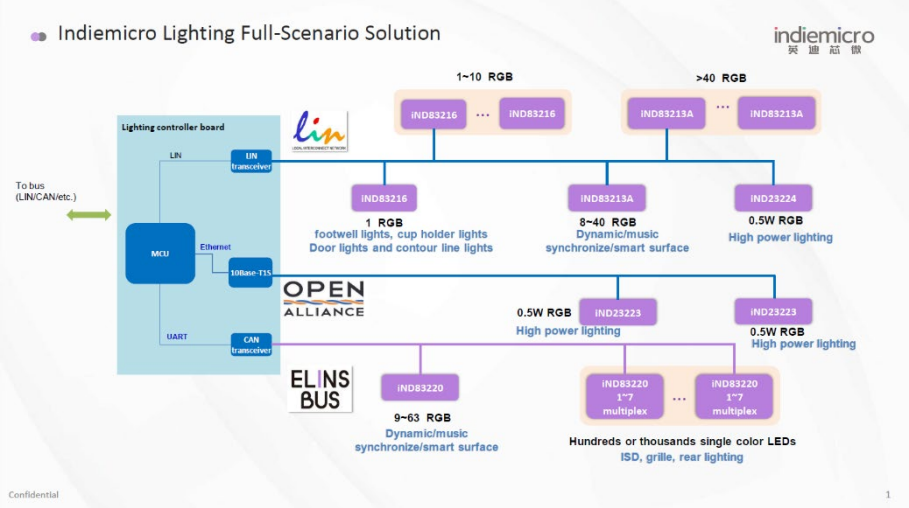


Interior and Exterior Applications

Indiemicro – Lingjun Wang

“Innovation Amid New Trends in Automotive Lighting”

Founded in 2017, Indie Microelectronics is focusing on automotive grade Mixed-signal processing chips and total solutions. Their first automotive device has been in production since 2019. Their products, covering lighting and motor control application, have entered the mainstream car OEM supply chain, with cooperation with over 100 domestic and international automotive TIER1. In addition, to maintain the market and technology barriers of existing cash flow products, the company is also going to introduce new breakthroughs in a number of new in-vehicle applications each year. Indiemicro Lighting full-scenario considers LIN, ELins (UART-over-CAN) and 10base T1S as illustrated in the following scheme.



Lighting full-scenario solution

The observation on new ambient lighting trends has been considered in the presentation and Indemicro presented and detailed their products for the different needs:

- **OTA support**: iND83229B and iND83213BCS01 are the world's first ambient light driver ICs equipped with 128KB Flash.
- **More complex display effects** with mode RGB applications, pixelization and fast communication: UART-over-CAN Driver IC iND83220 features up to 2Mbps communication, a single chip drives up to 72 RGBs or 216 LEDs
- **High brightness** (from 0.2W to 0.5W or even higher): the 4-Channel 200mA RGB driver IC iND23224 perfectly supports high-brightness RGB requirements and features a built-in high-current buck to solve the heat dissipation issue of discrete solutions.

New ambient lighting trends

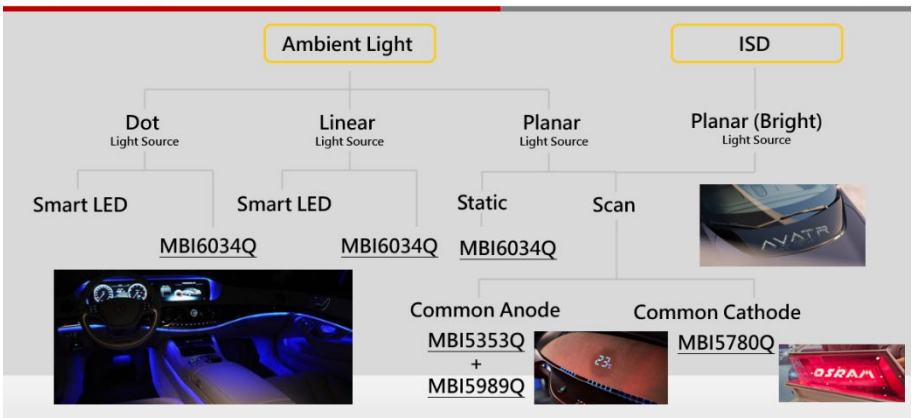
Macroblock – Gary Chang

"Macroblock LED Driver ICs Enable the Next Generation of Intelligent Signal Displays"

Gary Chang introduced Macroblock: founded in Taiwan in 1999, the company is a market leader for micro-LED technology and a pioneer in LED Driver ICs. Their expertise has been illustrated with success stories in the field of LED traffic signs, full color displays for public areas and automotive interior displays (e.g. Zeekr 7X), interior ambient lighting (e.g. Honda Ye P7) and exterior Intelligent Signal Displays (e.g. Lync & Co 900).

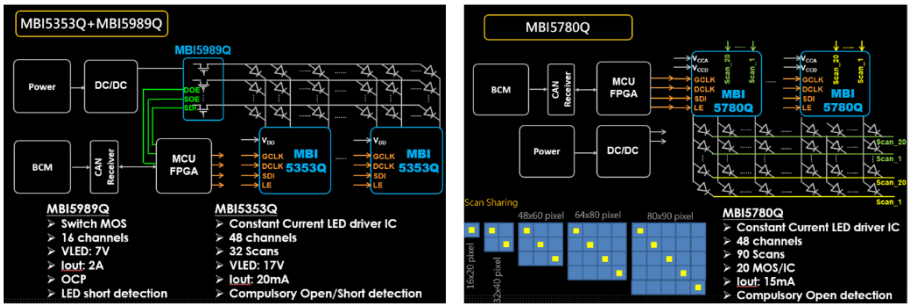
In the central part of the lecture, Macroblock demonstrated the dependency of wavelength shift in RGB LED applications on current applied to each color on the bench-test of grayscale image. To reach the correct color point for each chip of an RGB-based display, it is necessary to compensate the power supply mix of each chip to equalize the current-related shift dependency.

Macroblock presents a part of their product portfolio for interior and exterior lighting with a schematic diagram of ICs recommended for the different applications.



Interior and exterior LED Lighting: possible applications in automotive

In particular the lecture focuses on two different possible architectures for a typical 48-channel lighting application with scan feature and main characteristics of each topology have been illustrated: separate LED driver MBI5353Q and Switch MOS MBI5989Q (common anode LED matrix architecture) compared with integrated switching MOS with scan sharing MBI5780Q (common cathode LED matrix architecture).



Interior and exterior LED Lighting

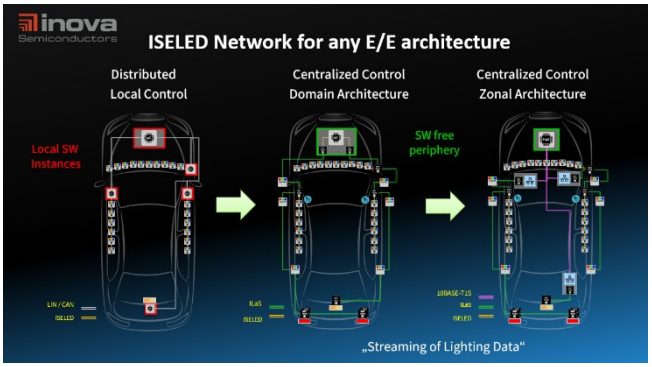
Inova Semiconductors – Gerhard Nill

“ISELED – The De-Facto Industry Standard Most Adopted, Most Cost-Efficient Solution for Software-defined Lighting”

The lecture of Inova Semiconductors is focused on ISELED, the Smart RGB LED technology for dynamic automotive lighting, and on ILaS transceiver. The ISELED Ecosystem with a multitude of integrated devices offers total freedom of choice and reduction of supply chain thank to the integration of a wide list of LED manufacturers. The production of ISELED 1.0 started in 2021 and have now more than 500 Mio of sold Smart RGB LED driver units, whilst ILaS and ILaS-RGB went into volume production in 2025 and they are ramping in 2026.

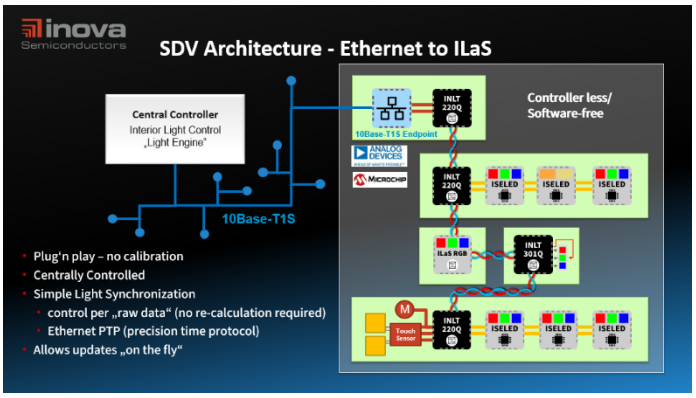
Implementing all HW functions for fully SW defined lighting applications, the ISELED/ILaS technology provides manufacturer-calibrated ISELED Smart RGB LEDs for automotive grade RGB LED applications. The user simply sends a digital color value to the addressable LEDs, which autonomously performs all color mixing and temperature compensation. Cabled connectivity between lighting boards or directly cabled single ILaS LEDs are supported by the ILaS transceiver INLT220W, including very power efficient DC/DC conversion from 12V battery voltage as well as communication resilience to board power failures. Synchronized streaming of lighting information from a central ECU is supported via software-free Ethernet bridges.

ISELED & ILaS adopts to the changing automotive E/E architecture, still keeping its advantages. Different architectures are possible for ISELED components, but centralized control and zonal architecture allow to take the full advantages from ILaS bus.



ISELED adaptation to different architectures

SW-free 10BASE-T1S bridges in the zonal gateway provide light synchronization and local connectivity into lighting elements via deterministic, auto-addressing ILaS bus. The benefits of this technology are: easy integration into vehicle E/E architecture, fully centralized lighting network for updates „on the fly“, integration of ambient and functional lighting with Smart LEDs, sensors and actuators on one „virtual bus“ and further reduction of wire harness and cost.



Software Defined Vehicle Architecture – Ethernet to ILaS

SESSION 6 – SUSTAINABILITY AND HOW TO MOVE FORWARD

Covestro & Forvia Hella – Jan Helmig & Mathias Niedling

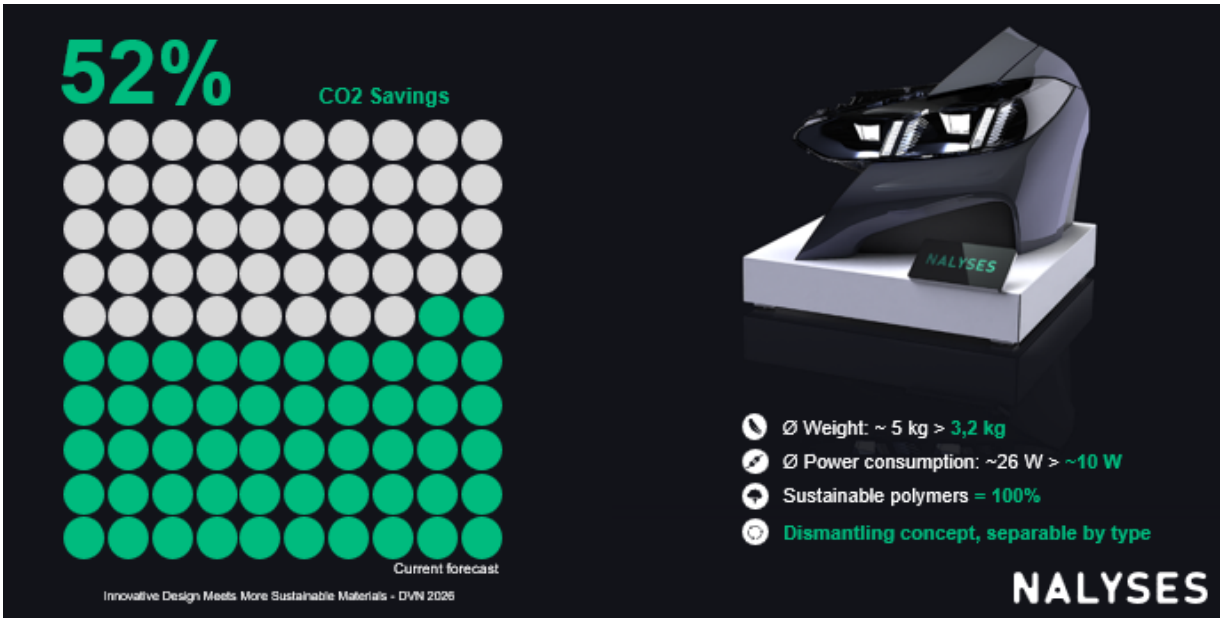
“NALYSES Sustainable Headlamp Demonstrator: Innovative Design Meets More Sustainable”

The presentation introduces the NALYSES funded research project, which focuses on the sustainability-optimized life cycle assessment (LCA) of technologically complex mechatronic products, using an automotive headlamp as a representative case study. The project, running from October 2022 to December 2025, is a collaboration between industrial partners with the overarching objective of significantly reducing the CO_2 footprint of automotive lighting systems while enabling circular economy principles under strict technological and regulatory constraints.

A classical cradle-to-grave life cycle model is used as a reference framework. The baseline LCA results for a conventional reference headlamp (excluding the electronic control unit) indicate a total global warming potential (GWP) of approximately 340 kg CO_2-equivalents over a 100-year horizon according to IPCC 2021. The study identifies production and use phases as key contributors to environmental impact.

Key sustainability strategies include lightweight construction, advanced optical design, and the use of more sustainable polymer materials. Gas-injected molding enables material savings of up to 25%, while the replacement of conventional lenses with Fresnel lenses achieves up to 80% material reduction without compromising optical performance. Additionally, alternative polycarbonate variants are implemented in approximately 76% of the components, incorporating different recycling pathways while maintaining near-virgin optical and mechanical properties.

The presentation also addresses critical challenges related to post-consumer material reuse, including optical degradation, chemical contamination, and regulatory compliance (e.g., REACH, SVHC, UN/ECE). Through a “drop-in” material approach and a dismantling concept that allows separation by material type, the final demonstrator achieves up to 52% CO_2 savings, reduces average weight from 5 kg to 3.2 kg, and lowers power consumption from 26 W to approximately 10 W. Overall, the NALYSES project demonstrates that sustainable product design can be successfully integrated into high-performance automotive lighting systems.



Nalyses final demonstrator

Valeo – Grégory Planche & Laurent Barré

“Circular Polymers in Automotive lighting : New Circular Value Chain”

This presentation provides a comprehensive scientific overview of how circular economy principles can be systematically implemented in the automotive lighting industry, with a particular focus on polymer materials and headlamp systems. Against the background of climate change and increasing resource scarcity, the authors outline Valeo’s strategic commitment to extending product lifetime and preserving material value as long as possible. Circularity is positioned not as an isolated recycling activity, but as a holistic value chain integrating conception, operation, business models, and end-of-life strategies.

Remanufacturing Headlamp: How it works?

Central to the approach is a hierarchy of actions: robust design, repair, remanufacturing, and recycling as a last resort. Robust design aims to increase product lifespan, dismantlability, and recycled material content from the outset. Remanufacturing of headlamps is presented as a key enabler, allowing end-of-life products to be collected through reverse logistics, disassembled, cleaned, tested, and reassembled to “as-new” performance. This process delivers significant environmental benefits, including up to 50% savings in new material use and approximately 70% CO_2 savings, while maintaining equivalent functional performance.

Importantly, the presentation emphasizes the role of remanufacturing as a bridge between reuse and recycling. By pre-sorting materials during disassembly, high-quality post-consumer plastic feedstocks are secured for closed-loop recycling, particularly for polycarbonate and polypropylene components. Both open-loop and closed-loop recycling streams are discussed, alongside challenges such as feedstock fragmentation, contamination, quality consistency, and economic viability.

ISO FAMILY	AVAILABILITY	KG CO2eq./KG	READINESS	FITTING RATE	SUBSTANCES
PP	OK	-	ONGOING	HIGH	Fluor
PC	LIMITED	---	ONGOING	MEDIUM	Free BPA
PBT	OK	--	YES	LOW	To investigate
PMMA	LIMITED	-	YES	HIGH	Legacy colors

Sustainable Headlamp - Materials Trend Table

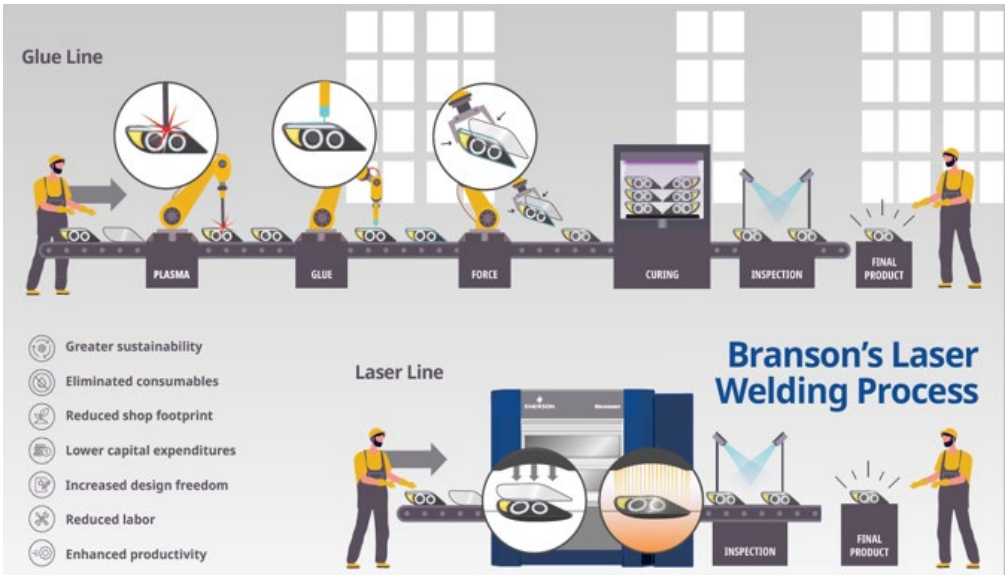
Finally, the authors outline future perspectives, highlighting design-for-disassembly, alignment of specifications, and adapted recycling processes as critical enablers for higher circularity. Overall, the presentation demonstrates that integrating remanufacturing with advanced recycling strategies can unlock substantial environmental and economic value.

Emerson Branson – Marian Blasko

“Innovating the Future: Sustainable Headlamp Assembly Process”

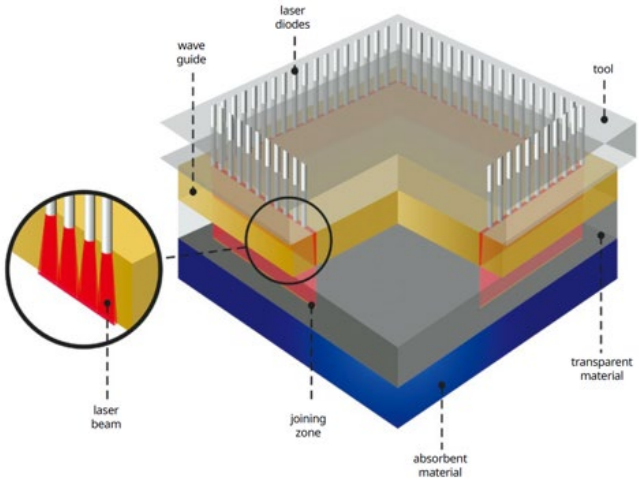
This presentation provides a scientific overview of an advanced manufacturing approach for automotive headlamp assembly based on Simultaneous Through-Transmission Infrared (STTIr+) laser welding technology. The central objective is to demonstrate how STTIr+ represents a technologically and environmentally superior alternative to conventional adhesive bonding processes. Developed and industrially implemented by Branson, a brand of Emerson, the technology addresses critical challenges in efficiency, sustainability, and production reliability.

STTIr+ laser welding operates by transmitting laser energy through a transmissive polymer component, which is subsequently absorbed at the interface of an absorptive component. This mechanism enables simultaneous heating and plasticization of the entire joint surface under precisely controlled pressure. As a result, highly uniform and mechanically robust welds are achieved within extremely short cycle times, typically between 0.5 and 5 seconds. The process is scalable to a wide range of component sizes without compromising throughput or quality and demonstrates high tolerance to surface imperfections such as minor scratches or particulate contamination. Reported yield rates exceeding 99.5% underline the stability and repeatability of the technology.



Alternative to adhesive bonding -Through-transmission Infrared laser welding technology

A key focus of the presentation is the transition toward mono-material headlamp designs, developed in collaboration with Covestro. This design philosophy reduces part complexity, supports simplified recycling, and contributes to overall weight reduction. Compared to adhesive bonding, STTIr+ eliminates adhesive-related costs, reduces manufacturing steps, minimizes waste, and enables easier repair and reclamation of high-value components. Collectively, the presented approach highlights how laser welding can significantly advance sustainable, cost-effective, and future-oriented automotive lighting production.

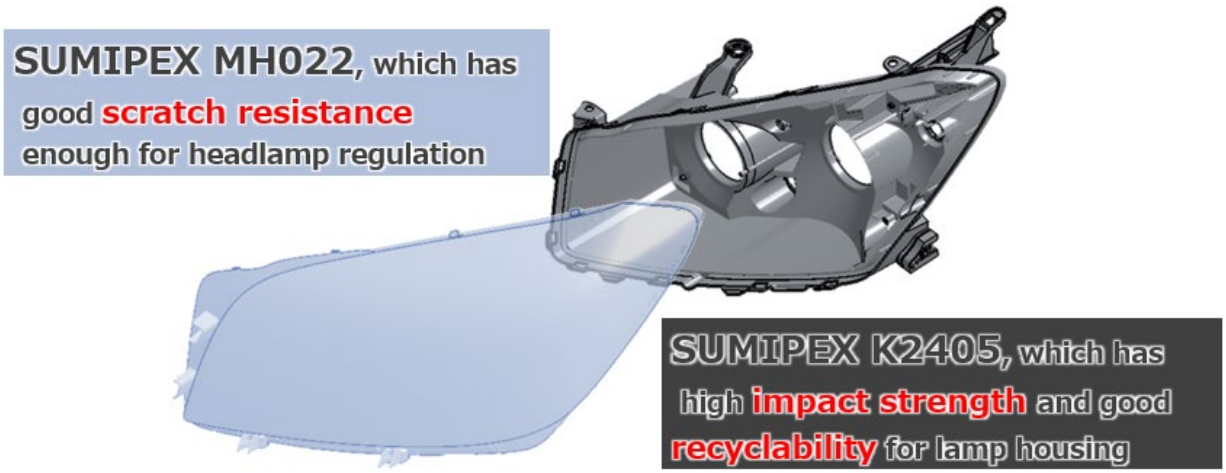


How STTIr Laser Welding Works

Sumitomo Chemical – Oliver Vollmar

“A solution for sustainable lighting - proposal from New PMMA materials”

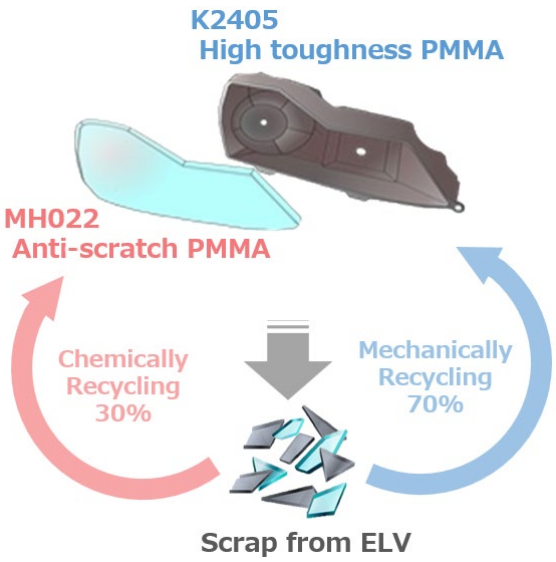
This presentation outlines Sumitomo Chemical’s strategic approach to sustainable innovation in the field of automotive lighting, with a particular focus on new polymethyl methacrylate (PMMA) materials. It situates the development of advanced PMMA resins within the broader corporate commitment to Green Transformation (GX) and the long-term objective of achieving carbon neutrality by 2050. Central to this vision is a targeted reduction of greenhouse gas (GHG) emissions, both through internal operational improvements—such as energy conservation and best available technologies—and through the positive downstream impact of products and technologies that enable emission reductions across the value chain.



Sumitomo Chemical’s PMMAs for headlamp lens and housing

The presentation emphasizes the evolving challenges faced by the automotive lighting sector, including stringent durability requirements, high CO_2 emissions from coating processes, cost pressures, and increasing regulatory and societal demands for recyclability. Sumitomo Chemical proposes innovative PMMA-based solutions under the SUMIPEX™ brand that aim to reconcile performance, aesthetics, and sustainability.

Two newly developed PMMA grades are highlighted as key enablers. SUMIPEX™ MH022 offers enhanced scratch resistance sufficient to meet headlamp regulations without the need for hard coatings, thereby reducing process complexity, costs, and associated CO_2 emissions. SUMIPEX™ K2405 provides high impact strength and excellent mechanical recyclability, making it suitable for lamp housings and compatible with end-of-life vehicle (ELV) recycling streams. Together, these materials support the concept of mono-material lamps, which simplifies separation, sorting, and recycling while extending product lifespan through reconditioning options such as polishing.



The Concept of Mono-material lamp

Overall, the presentation demonstrates how material innovation can serve as a lever for sustainability, enabling long-lasting, recyclable automotive lighting systems and fostering co-creation of value across the automotive industry in alignment with global environmental goals.

Lumileds – Wolfgang Schiene

“Replaceable LUXEON Go light source modules, easing repairability in a sustainable headlamp architecture”

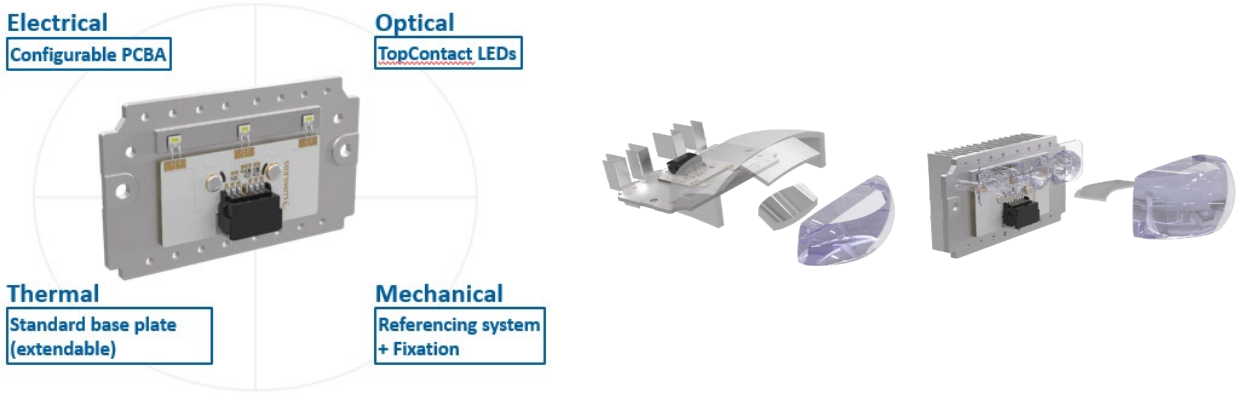
Wolfgang Schiene provides a comprehensive scientific overview of the technological and regulatory transition from conventional automotive light sources to advanced LED-based headlighting systems, with a particular focus on modularity, repairability, and sustainability. The presentation reflects the state of full market maturity in LED headlighting adoption.

The presentation highlights that modern vehicles are designed for lifetimes of up to 300,000 km, corresponding to approximately 7,500 operating hours of continuous light usage. In this context, the traditional concept of regularly replacing light sources has shifted toward solutions that last for the entire vehicle lifetime. However, increasing complexity—especially in premium and adaptive LED headlamp systems—has led to high replacement costs, often exacerbated by labor, calibration, and integrated electronics. These economic and ecological challenges underline the growing importance of modularization in headlamp design.

A central concept discussed is the role of modular LED light source architectures in supporting repairability and circularity. The principle of “separation” is identified as a key enabler, allowing defective components to be replaced without discarding the entire headlamp. The LUXEON Go platform exemplifies this approach by offering standardized headlighting modules with well-defined mechanical, electrical, thermal, and optical interfaces. These modules are compatible with current UN ECE R149 regulations and are designed for compactness, high efficiency, low energy consumption, and simplified supply chains, all of which facilitate faster time-to-market and improved sustainability.

The LUXEON Go : Reference range for reflection applications

Furthermore, the presentation discusses current and future regulatory frameworks, including UN ECE R148 and prospective categories for end-user replaceable LED light sources (L2 and L3 under R.E.5). By combining proven market track records with configurable and scalable designs—ranging from reflector to projection headlighting—the LUXEON Go and LUXEON Pro solutions demonstrate how modular LED systems can reconcile performance, regulatory compliance, cost efficiency, and environmental responsibility in next-generation automotive lighting architectures.



LUXEON Pro – modular solution for projection headlighting applications

DVN – PAUL HENRI MATHA & GERD BAHNMÜLLER

“Synthesis of DVN deep-dive Sustainability”

The DVN Deep-dive Sustainability workshop was attended by around 20 participants from OEM, Tier 1 and Tier 2 suppliers. Four presentations by Covestro & Forvia Hella, Sabic, Momentive, and NanoVents highlighted various aspects of the topic, each followed by a Q&A session. After all the presentations, individual aspects were explored in greater depth in a lively discussion. Here are the key findings:

To date, OEMs have complied with ELVR (End of Life Vehicle Regulation) regulations by using recycled materials for components other than lighting, e.g., bumpers. Therefore, the pressure to act is still limited.

The following points and approaches were discussed:

1. Limits of mechanical recycling of front and rear lighting components
   - No solution or companies for collecting the products yet
   - Disassembly of components is costly and there are no companies on the market
   - Shredded material is difficult to sort because it is contaminated, e.g., by hard coating, 2K components
   - Material properties of a material that has degraded over 10 to 15 years are not suitable for reuse
   - Recycled material from other short-lived products that could be used is more expensive than original material due to its limited availability

2. Chemical recycling
   - Produces a material with identical properties as desired
   - Energy consumption too high and therefore highly uneconomical

3. Bio-Chemical recycling
   - Available volume limited by available base material as tires, cooking oil or frying fat
   - More expensive than original material because still high energy consumption

4. Headlight and taillight alignment more in line with legal requirements
   - Enables more compact products with less weight
   - Lower power consumption due to fewer LEDs

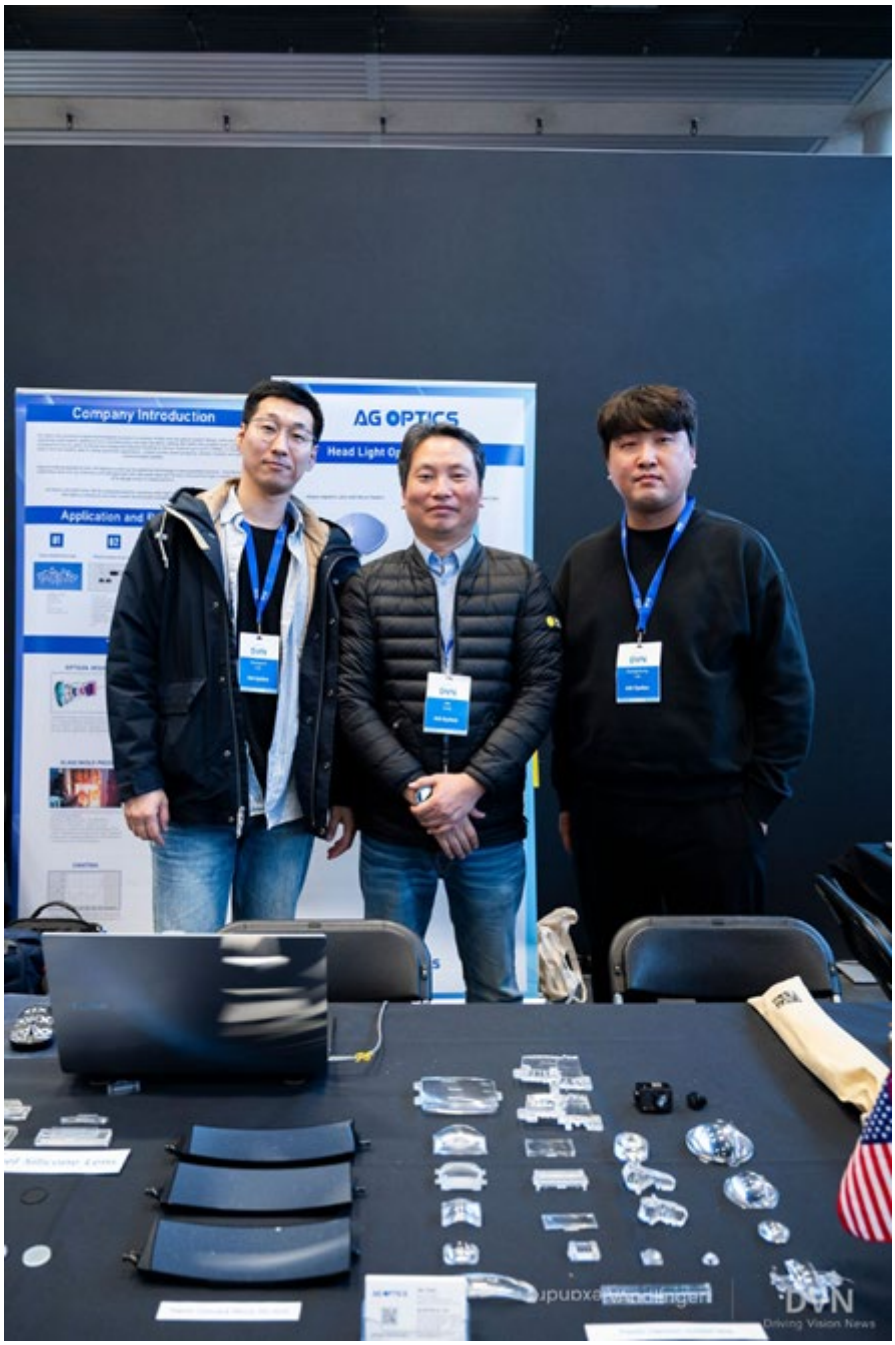
5. Refurbishment of headlights and taillights and/or reuse of components
   - Requires appropriate logistical processes and companies that specialize in this business case.

Speakers: Andreas Haeuseler, Jan Helmig, Mathias Niedling, Gerd Bahnmüller (chairman), Erhard Bruss, Jirí Schirl

Exhibition

AG Optics

AG Optics is a Korea-based company specializing in the design and manufacture of high-precision optical components. With cutting-edge technology and expertise, we provide innovative optical solutions, particularly for the automotive lighting industry.



AL-KOR

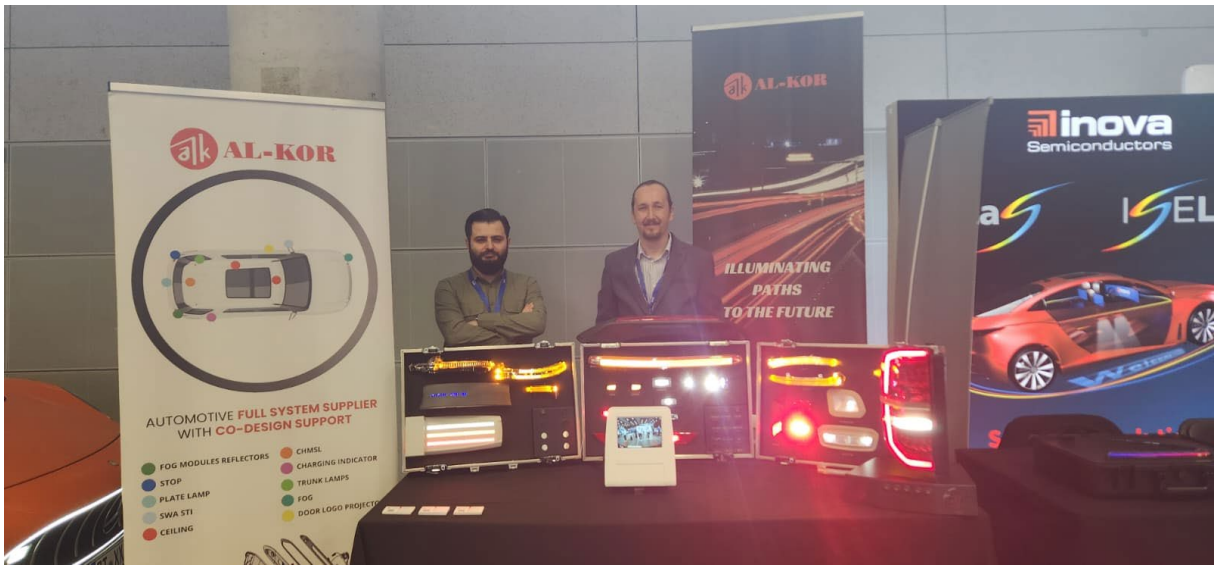
Following our successful participation at DVN Munich 2026, we were pleased to welcome industry professionals to the AL-KOR stand, where we showcased our advanced capabilities and comprehensive solutions in automotive lighting systems.

With over 50 years of industry experience, AL-KOR presented its strong engineering infrastructure, R&D expertise, and full-system supply capabilities to visitors from across the global automotive sector. At the exhibition, we highlighted a broad portfolio of automotive exterior lighting products, including tail lamps, stop lamps, daytime running lamps (DRL), logo projectors, position lamps, and side turn indicators. All products have been developed in close collaboration with our automotive partners and engineered in full compliance with OEM technical requirements and international automotive standards.

Our solutions demonstrated AL-KOR's ability to deliver customized designs that integrate optical performance, mechanical durability, and electronic reliability. Each product reflects our commitment to meeting demanding automotive specifications such as environmental durability, EMC compliance, thermal management, and long-term reliability.

Visitors also explored our latest innovations in efficient LED technologies, modular product architectures, and cost-effective engineering solutions tailored to modern vehicle platforms.

We sincerely thank the DVN organization for hosting a highly successful and well-organized event. It was a pleasure connecting with industry peers, and we look forward to seeing you at upcoming events.

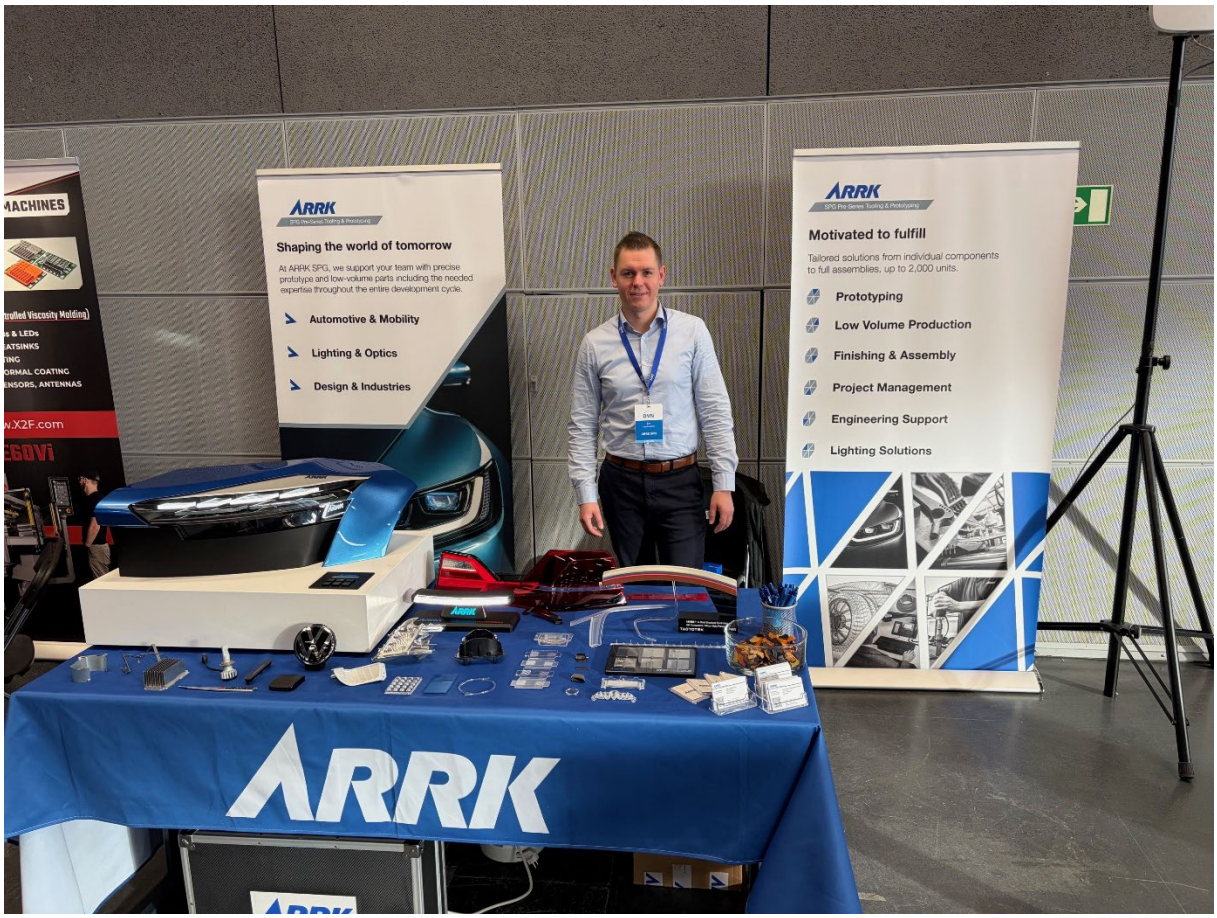


ARRK

At this edition of DVN Munich, ARRK presented its expertise in optical high-precision polycarbonate prototyping. We demonstrated our capabilities in manufacturing complex optical components with tight tolerances, excellent surface quality, and outstanding light performance.

In addition, we introduced our new shared TactoTek IMSE® demonstrator. This solution showcases how functional integration and design flexibility can be combined within a single part.

We also showcased our Headlamp demonstrator, including our own project Bi-LED projector module. This demonstrator illustrates a wide range of prototyping technologies and high-quality finishing capabilities, reflecting ARRK's ability to support customers in the design, development, and manufacturing of customized lighting systems — from concept to retirement.



BrightView Technologies

BrightView exhibited their Computational Optic polymer-based film solutions which are advancing the capabilities of automotive lighting, by enabling thinner, lighter and more efficient lamp assemblies with customizable optical outputs. These optical films incorporate micron scale microstructures embossed into a UV cured photopolymer and enable the precise management of light for a wide range of optical applications. For automotive lighting, these polymer films are applicable for both internal and external applications - front and tail lamp systems, illuminated logo's/emblems and grills as well as for internal lighting. Utilizing these films significantly reduces the quantities of material used in a lighting assembly, resulting in a lighter weight, size, and volume, as well as improving electrical power consumption through their optical efficiency. These polymer films are produced via a high-volume roll-to-roll process and can be cut and thermoformed into specific 3D shapes where required. The BrightView volume manufacturing process means that the optical film is cost effective for the automotive industry, and this price benefit can then be passed to the customer. As well as exhibiting their optical films, BrightView showcased the advanced 'FlatLight' and 'Communication Matrix - CMX' products from Forvia-Hella which nicely demonstrated all the advantages of using the BrightView optical film technology.

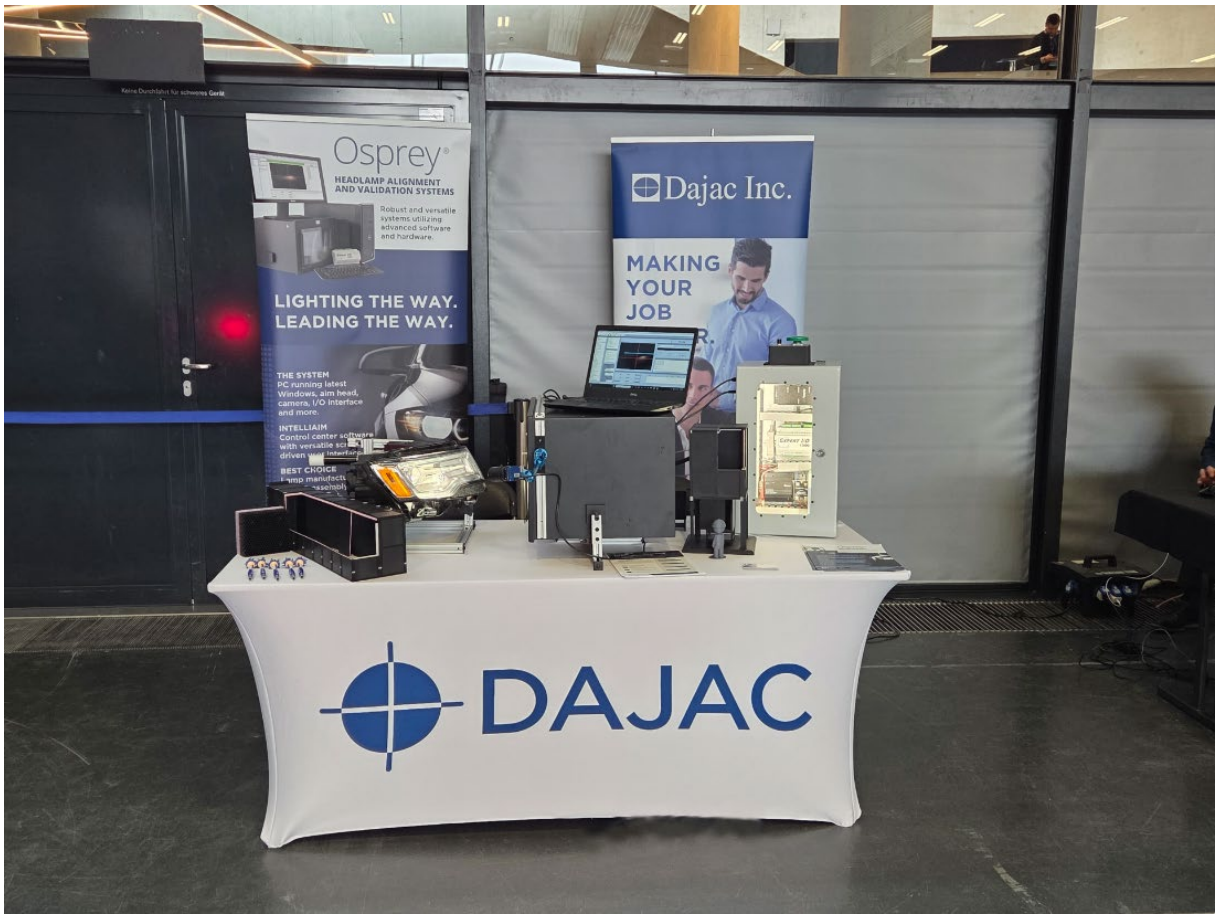
Dajac

The DVN Munich Workshop provided an excellent opportunity for Dajac to demonstrate why we are the industry leader in automotive photometric testing and aiming solutions for manufacturing, laboratory, and quality assurance environments. At our stand, we showcased production-ready systems that combine automation, high-speed imaging, precision optics, and intuitive software to deliver fast, repeatable, and fully traceable results. Our equipment is engineered for environments where cycle time, accuracy, and compliance are critical.

From fog lamp aiming to advanced headlamp systems—including ADB and secondary lighting—Dajac supports intensity, color, homogeneity, projection, interior lighting, tail lamps, and decorative applications. We provide comprehensive solutions trusted across global lighting programs. For more than two decades, OEMs, Tier 1, and Tier 2 suppliers have relied on Dajac to elevate their testing processes. We bridge the gap between optics development and manufacturing, ensuring that laboratory intent translates seamlessly to production performance.

Our continued innovation allows customers to stay ahead of evolving lighting technologies and regulatory demands without diverting internal resources.

We appreciated the opportunity to connect with industry leaders in Munich and look forward to advancing the next generation of automotive lighting together.



DBM Reflex

At DVN Munich, DBM Reflex showcased its latest innovations in precision micro-optics for automotive lighting. As a worldwide supplier of high-precision inserts and injection-molded optics, DBM Reflex supports OEMs and Tier-1 suppliers with fully integrated in-house design, tooling, and manufacturing capabilities.

At our booth, we presented MicroCones, our precision-engineered micro-optical solution designed to create homogeneous light curtains and refined contour lighting. Defined by cones with constant axis orientation and adjustable depth, MicroCones offer advanced design flexibility and precise luminance control. Optimized for side-lighting configurations, this technology enables sharp, clean light signatures and superior surface finish through high-precision diamond machining. We also showcased MicroReflex™, our advanced retroreflector surface delivering crisp photometry with 700 µm reflectors. MicroReflex™ improves visual homogeneity and surface smoothness while reducing lens volume and material consumption by up to 40%. This solution supports faster molding cycles, high-efficiency mass production, and reliable long-term performance.

Finally, we introduced our latest innovation, PixiFlex™, a hybrid optical structure combining spaced reflex elements with lenticular microstructures. PixiFlex™ enables both retroreflection and light transmission, allowing designers to integrate signal and illumination functions within a single component. With its fine, sparkling appearance and hybrid reflector-illumination capability, PixiFlex™ opens new possibilities for distinctive lighting signatures and creative freedom. Throughout the event, our team engaged with industry partners to discuss customized solutions, cost optimization, and scalable production. Our participation at DVN reflects DBM Reflex's commitment to "Sculpting Light to Awaken the Senses" through innovation, precision, and close collaboration with the automotive lighting community.

From left to right: Bernhard Günther, Bernard Caire, Moustapha Kerkri, and Michel-Luc Bataïni.

Docter Optics

As the demand for high-performance yet cost-efficient systems continues to rise, the development of scalable lens solutions for pixel light headlamps has become a strategic priority.

Pixel-based projection technologies enable adaptive, high-resolution lighting but also pose new challenges — reducing system complexity, minimizing weight and installation depth, and managing component diversity — all without compromising optical quality.

In his presentation, CTO Markus Winkler shared valuable insights into how a cost-effective LED pixel light system for automotive front lighting can be realized using aspherical glass lenses. He presented several reference designs demonstrating performance across extra-wide, wide, and spot field-of-view configurations.

Leveraging its in-house optical development expertise, Docter Optics is actively exploring new approaches to optimize lens architectures that combine high optical performance with cost-efficient scalability.

In addition to pixel light systems for front lighting, Docter Optics also showcased its new DOCLaP application — a multichannel dynamic laser projection system for automotive exterior and interior applications, offering 24-bit true color and 60 fps at VGA resolution, with support for up to eight projection heads.

Eclat Digital

At DVN Munich 2026, Eclat Digital presented its approach to predictive optical simulation for automotive lighting development, aimed at validating concepts under real engineering and environmental constraints.

At booth SH8, we showcased Covestro's automotive lighting demonstrator and explained how Ocean™ supported its development. The objective was not to generate visual concepts, but to correlate simulation results with physical behavior and confront design intent with measurable reality. By integrating measured material data, accurate geometry, and real-world lighting conditions, the digital model enables early evaluation of light propagation, absorption, diffusion patterns, light injection strategies, and sensitivity to geometry variations and thickness tolerances.

We presented a fully digital workflow linking CAD data, measured optical properties, and simulation results within an iterative validation loop. This approach enables comparative analysis between design options, quantitative assessment of optical performance, and faster convergence before tooling.

The demonstrator use-case illustrates how physically accurate simulation with Ocean™ supports informed decision-making, reduces physical iterations, and strengthens confidence between digital predictions and real parts in automotive lighting programs.

Rather than isolating components testing, Ocean™ allows system-level simulation, that accounts for surrounding materials and assemblies. This supports early identification of optical risks, and reduces late-stage design corrections, including control of parasitic reflections and unwanted light interactions within the full vehicle context.

Elmos

Elmos presented numerous demos with new products at the DVN Workshop Lighting in Munich. Above all, our new 48-channel (O)LED drivers E522.96 & E521.46 with high speed interface (CAN/FD or UART over CAN) combined with OLED modules or RGB-LEDs provided a very positive response.

In addition, our innovative solutions for dynamic lighting in glass applications in vehicle interiors with our 12-channel E521.38 IC and V2X communication displays based on our E521.46 attracted many interested visitors.

Congratulations to Mercedes Benz & Gerhardi on winning the DVN Best Technology Award for the GLC grille application that is powered by Elmos ICs.

ENNOSTAR

At the DVN Lighting Workshop, Ennostar shared insights from its presentation “Mini LED ISD for Automotive: A Chip-to-Module Framework,” highlighting how Intelligent Signal Display (ISD) is becoming a key enabler as vehicle exterior lighting evolves from illumination toward communication.

With the rise of software-defined vehicles and advanced driver assistance systems, ISD is increasingly used to convey vehicle intent, status, and warnings to pedestrians and surrounding traffic. This shift places new demands on exterior displays, requiring a careful balance of high brightness, resolution, contrast, reliability, and cost, while ensuring consistent visibility under diverse environmental conditions.

Ennostar reviewed the technology landscape from conventional LED solutions to fine-pitch mini LED architectures, emphasizing that mini LED currently represents the most commercially viable and technically mature solution for exterior ISD. Compared with alternatives such as OLED or micro LED, mini LED offers superior outdoor brightness, robust lifetime performance, scalable manufacturing, and proven automotive reliability.

The presentation introduced a mixed-resolution ISD architecture, in which different pixel pitches are strategically combined to optimize performance for various signaling needs—from high-brightness large-area messaging to fine-resolution dynamic graphics. This tiered approach allows system designers to balance performance and cost at the module level.

A core focus was Ennostar’s vertical integration from LED chip design to automotive-grade ISD modules, enabling system-level optimization in optical performance, thermal management, and long-term reliability. Supported by AEC-Q compliant design and automated manufacturing, Ennostar’s chip-to-module framework provides a scalable foundation for future ISD applications as exterior lighting continues to evolve into a vehicle communication interface.

Filtration Group – Oxyphen & FlowDry

Filtration Group, through its Oxyphen and FlowDry divisions, showcased innovative solutions for lighting protection and moisture management at DVN Munich 2026. Our portfolio is attracting strong interest from companies seeking reliable, cost-effective, and sustainable technologies.

Featured Solutions:

OptiClear® Passive Condensation Management Device

Generation 1 and generation 2 of the OptiClear device. The device controls humidity within headlights and taillights without any electrical power. It is fully regenerative and lasts for the lifetime of the light module.

Oxyphen Track-Etched PFAS-Free Membranes

Precision venting with proven automotive protection. Enables OEMs to meet performance targets while supporting compliance with PFAS regulations.

Commitment

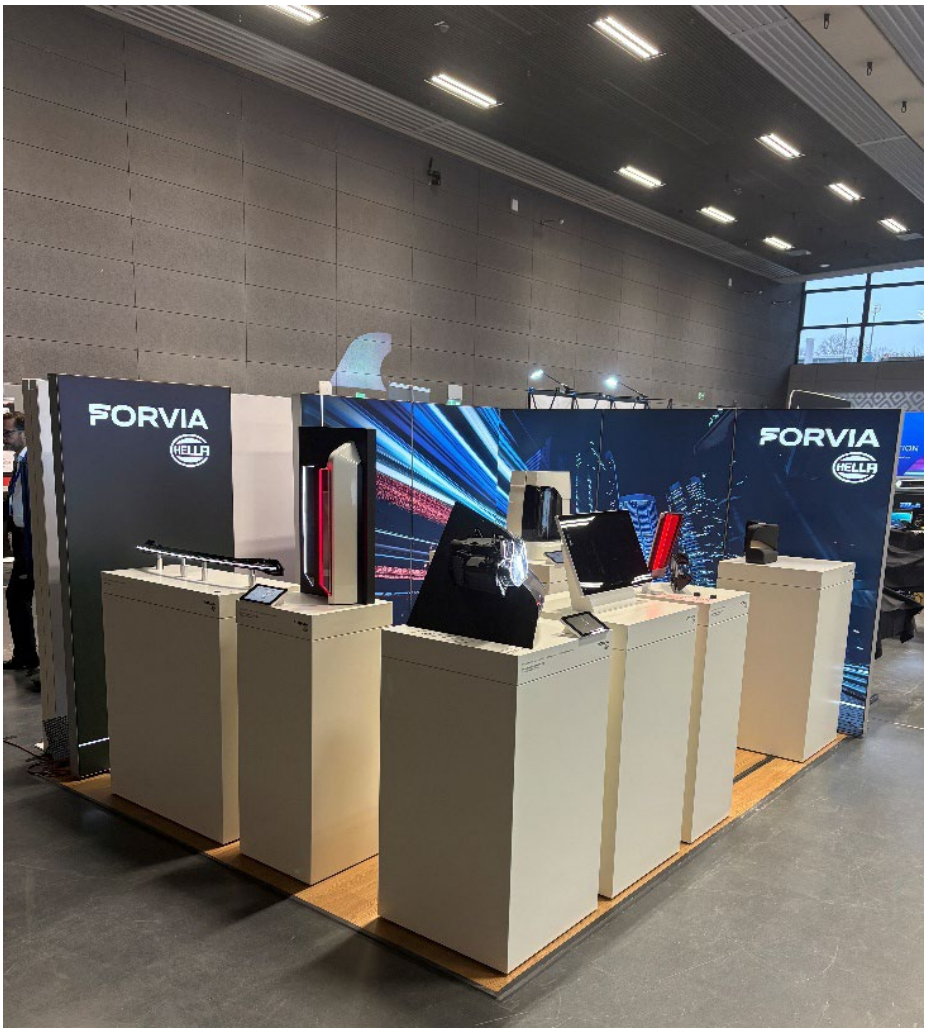
Filtration Group helps customers meet next-generation lighting challenges by controlling humidity, simplifying venting, and providing solutions that align with sustainability and regulatory demands.

FORVIA HELLA

Sustainability was a key theme at the FORVIA HELLA stand, highlighted through a headlamp and rear lamp concept representing the “tool box” approach to sustainable exterior lighting.
The concepts include multiple levers to make products more responsible across the full lifecycle: reducing power consumption, integrating more sustainable materials, cutting overall material use and weight, and designing for circularity. This includes thinking ahead about reuse, repairability, and recycling-friendly architectures so that lighting components can remain in value loops instead of becoming waste.

Essential EdgeLight, an innovative light-guide concept that removes the need for an outer lens, was the second major theme. With that, it enables sculptural signal functions for front and rear applications, supporting homogeneous illumination while also creating new freedoms in styling and form.
In the interior, attention turned to the next generation of smart lighting that can be flexibly integrated into the vehicle cabin. The solutions can be used as direct, indirect, or backlighting and can follow complex 3D shapes, enabling seamless ambient effects across trims, panels, and functional surfaces.

Finally, CMX Display technology demonstrated the convergence of lighting and display. It enables V2X communication alongside legally required functions, illustrating how dynamic, informative surfaces can enhance interaction, safety, and brand differentiation. Overall, visitors valued the combination of sustainability, design flexibility, and scalable integration potential.



Gerhardi

At the DVN Munich Lighting Workshop, Gerhardi presented a range of production-ready solutions demonstrating the functional integration of galvanised chrome surfaces with lighting technology for exterior and interior automotive applications.

The core message was the repositioning of galvanic chrome as a modern and sustainable surface technology. Compared to PVD coatings or decorative foils, galvanised chrome offers proven durability, high surface stability and established industrial processes, making it well suited for high-volume series production. In addition, galvanic systems enable material separation at end of life: polymer substrates and metallic layers can be separated, and the metallic fractions can be recovered with a purity of more than 98 percent. This allows individual material streams to be recycled efficiently and supports circular economy concepts.

Many visitors were surprised to learn that several exhibited parts are realised by electroplating, which triggered in-depth technical discussions.

The main exhibit was the illuminated GLC panel shown in two colour variants, combining decorative chrome surfaces with integrated lighting in a single component. Additional demonstrators included structured chrome samples, coloured chrome variants and smart components with integrated lighting, such as a very flat Maybach logo and a Maybach interior light with three selectable lighting scenarios.

Gerhardi positioned itself as a development partner and system supplier for complex lighting modules, extending beyond decorative electroplated parts. Capabilities cover design support, material and process development, validation and industrialisation.

The exhibits stimulated intensive technical exchange and highlighted Gerhardi's competence in bringing advanced chrome and lighting concepts into series production.

GVS

At DVN Munich 2026, GVS showcased its Energy & Mobility Division with a strong focus on electronics protection and venting solutions for automotive applications, addressing the growing complexity of modern vehicle systems.

GVS highlighted its long-standing expertise in membrane-based filtration technologies, built on more than 40 years of industrial experience. The presentation focused on a broad portfolio of venting membranes and components designed to protect sensitive electronic systems, such as lighting modules and electronic control units-from water ingress, dust, contaminants, and pressure differentials.

A key topic at DVN Munich was the impact of vehicle electrification and the increasing integration of electronics. As systems become more compact and powerful, effective venting is essential to ensure stable performance and long-term reliability. GVS solutions enable controlled air permeability while maintaining high levels of environmental protection, supporting durability under demanding operating conditions.

The Energy & Mobility Division also emphasized its strong customization capabilities, with many products engineered to meet specific customer requirements. Combined with high-volume manufacturing and a solid patent portfolio, this approach allows GVS to serve both OEMs and Tier 1 suppliers with solutions optimized for performance, quality, and cost.

Through its presence at DVN Munich 2026, GVS reinforced its position as a trusted partner for electronics and venting applications in the automotive industry.

Idemitsu

Idemitsu shared it's next generation TARFLON™ light guide polycarbonate materials, with improved durability properties. Based on market requirements for high flow polycarbonates with excellent optical properties and a high durability we commercialized our latest light guide grades recently. To broaden up Idemitsu's portfolio we also launched a light guide material with a blue color shade.

In the field of translucent materials, Idemitsu presented an extract of it's TARFLON™ light diffusive Polycarbonates. To meet the necessity of higher chemical resistance, translucent PC Copolymers were developed and displayed as well during the DVN show.

Inova Semiconductors

Inova Semiconductors presented how ISELED® enables scalable digital lighting networks and supports modern E/E and SDV architectures.

One demonstration showed an actual series production interior piece part with various light animations, while the second showcased the first ISELED® 2.0 Smart RGB LED samples from our partners Ennostar and Everlight working together with already mass production ISELED's and the ILaS-RGB Smart RGB LED directly connected to the ILaS network of LEDs.

In a static display the breath of available calibrated Smart-RGB and tuneable-White-LEDs from all members of the ISELED® Alliance was shown.

Gerhard Nill / Product Manager – Lighting

Instrument Systems

At DVN, Instrument Systems presented advanced measurement solutions for comprehensive automotive lighting evaluation, focusing on vehicle-level headlamp testing and exterior lighting characterization. A key highlight was the STA Screen Photometer System, designed to support accurate and reproducible photometric measurements directly on the vehicle. By enabling reliable assessment of headlamp performance under real-world conditions, the system supported manufacturers throughout the entire development cycle, from early-stage design and verification to homologation and quality assurance. Its ability to capture consistent and traceable results at vehicle level made it a valuable tool for ensuring compliance with regulatory requirements and maintaining high product quality.

In addition, Instrument Systems showcased the LumiTop X30 imaging colorimeter for automotive exterior lighting applications. The system combined a fast, high-resolution 31-megapixel luminance camera with spectrally enhanced measurement capabilities and an exceptionally wide dynamic range spanning from mcd/m² to Mcd/m². This enabled precise 2D luminance and color measurements across a broad spectrum of light intensities, from very low-level signals to high-brightness regions. As a result, the LumiTop X30 proved ideally suited for capturing fine light details as well as intense light sources within a single measurement. Together, these solutions supported efficient, accurate, and application-oriented validation of modern automotive lighting systems.

Dr. Marc Lünnemann, the new CEO of Instrument Systems GmbH, was also available for discussions at the DVN Munich booth. Marc Lünnemann is no stranger to the lighting community due to his previous roles at Osram and DocterOptics.

Keysight Technologies

Learn how our latest innovations are helping optical engineers solve today's toughest challenges for automotive lighting application and see live demonstrations of our optical design solution.

You can find on the booth the LucidShape product family, which provides a complete set of tools that enable optical engineers to design, simulate, and analyze innovative automotive lighting solutions. Streamline the design process, then simulate, verify, and optimize those designs before entering testing and fabrication stages. The SmartStart Library also provides designers with materials and media commonly used in automotive lighting system designs. These elements include refractive index and absorption data, as well as predefined volume scatter and bidirectional scattering distribution function (BSDF) materials.

We present also LightTools Illumination Design solution to create, analyze, and optimize illumination designs. With Keysight LightTools illumination design software, optical engineers can create virtual prototypes, simulations, and photorealistic renderings of complex illumination applications to delivery accurate, high-performance optical designs. LightTools can help you accelerate your time to market with an intelligent, easy-to-use solution.

You can also find our solution VisionSym to Create Virtual Optical Prototypes with Speed and Accuracy. With today's complex optical components, it is not cost-effective to manufacture multiple physical prototypes when verifying the lit appearance of optical illumination systems. VisionSym - Visualization System Simulator solves this challenge, providing physics-based, photorealistic simulations so you can assess both qualitative and quantitative metrics virtually. Gain unparalleled accuracy in validating the lit and unlit appearance of illumination optics models.

LEONHARD KURZ

At the DVN Munich Lighting Workshop, LEONHARD KURZ—global expert in thin-film technology—showed how design, technology, and sustainability can converge in scalable manufacturing processes to create sophisticated solutions for future mobility and brand differentiation. Visitors experienced this up close through two innovative exterior lighting concepts from KURZ.

The FrontIQ Light Concept, realized with Swarovski Mobility and lighting specialist SP3, links premium aesthetics with functional expression. The lighting system relies on customizable crystals from Swarovski, which not only enable targeted light control but also create brand-specific visual signatures. Holographic carbon structures on the inner edge of the headlight and the futuristic design language give the FrontIQ a unique signature. The design remains completely flexible and can be adapted to any vehicle design. Technically, the concept is based on a series-ready, highly efficient 3K process that combines decoration, functionality, and protection in a single step, significantly reducing production time, costs, and CO_2 emissions. A PUR coating protects the surface permanently without reducing its visual depth or brilliance. The process can be integrated into existing production lines, allows for the addition of heating elements for possible radar sensors, and enables the use of recycled materials.

The Rear Light Concept, developed with ams OSRAM, demonstrates a hidden-til-lit rear design where individually programmable signatures appear only when activated. ALIYOS™ LED foils with mini-LED technology—back-integrated using the Functional Foil Bonding Adhesive process—enable compact integration, homogeneous illumination, and dynamic light effects. In combination with In-Mold Decoration, the result is extensive design freedom for even three-dimensional geometries, supporting a wide range of design expressions such as visual depth, graphic structures, or gradients.

L.E.S.S.

Our L.E.S.S. team was proud to take part in the DVN Workshop in Munich alongside our CEO Dr. Yann Tissot and our Head of APTD, Dr. Jelena Vukajlovic, showcasing our latest breakthroughs in automotive lighting powered by our unique LuxiBright® technology. A major milestone was reached during the event as we unveiled, together with Lanzante and Wipac, our first series production collaboration on the Lanzante 95-59.

L.E.S.S. SA is proud to power the iconic Lanzante 95-59, the first production vehicle equipped with LuxiBright® technology. Designed by McLaren Group veteran Paul Howse, the 95-59 perfectly blends heritage, performance, and modern vision. Its signature “Floating Rear Lamp” highlights the unmatched precision of LuxiBright®. The ultra-slim Stop/Tail and Turn Indicator delivers perfectly uniform, finely detailed illumination, performance that sets a new benchmark for series production lighting. We confirm we are design enablers thanks to our lighting innovation but also confirm to be committed and trustful development partners that deliver now in series without compromise.

The #FearLESS Team engineered a seamless integration into complex aerodynamic surfaces while achieving demanding weight and performance targets, proving that innovation and design excellence can go hand in hand.

Stay connected with us on LinkedIn and be the first to discover our latest innovations, milestones, and future announcements. https://www.linkedin.com/company/l-e-s-s-/

L.E.T. Automotive

At DVN Munich, L.E.T. Automotive presented its latest innovations in headlamp testing and aiming solutions for both the aftermarket and automotive manufacturing environments. At our booth, we showcased the new Luminoscope PRO and Luminoscope AUTOMATIC, highlighting our newly developed Matrix Mode. This functionality enables workshops to independently measure and adjust matrix headlamps, an increasingly important topic in workshops as advanced lighting systems become standard across new vehicle models. The new mode was designed to provide greater flexibility in measurement methodology, ensuring workshops can service modern adaptive lighting systems across car brands.

Beyond the aftermarket solutions, we also presented our end-of-line headlamp aiming systems for vehicle production plants. These fully automated systems demonstrate our expertise in integrating optical measurement, mechanical positioning, and software control into high-throughput manufacturing environments.

In addition, we introduced our redeveloped scanning 10 m wall concept for audit in car plants. As headlamp technology evolves, the requirements for auditing in car plants are also changing. DVN provided an ideal platform for open discussions with multiple car manufacturers about future needs, performance expectations, and measurement criteria. The feedback gathered will help us in the next phase of development, ensuring our solutions remain aligned with emerging regulatory standards and OEM requirements.

LG Innotek

At the DVN Workshop in Munich, LG Innotek presented its latest Nexlide lighting innovations, emphasizing slim form factors, advanced optical engineering, and new possibilities for expressive communication lighting. The booth featured a broad portfolio, including Nexlide Pixel, Nexlide Air, Nexlide Cube, Nexlide C+, GL3 Front CTR Lamp (Nexlide A), and CV PE Rear Lamp (Nexlide M).

Nexlide Pixel, LG Innotek's ultra thin 3 mm pixel lighting module and CES 2026 Innovation Award winner, showcased a high resolution 2×2 mm pixel array built on a white silicone optical architecture. This enables detailed animations, icons, text, and bi function lighting for DRL, rear lamps, and V2X communication.

Nexlide Air demonstrated a silicone based all in one design that removes conventional housings, achieving major reductions in weight and thickness. With multi sided emission, flexible structures, and hidden until lit integration, Air supports illuminated logos, grilles, bumpers, and future seamless exterior signatures.

Nexlide Cube combined silicone-based Nexlide technology with injection molded optics to create 3D lighting effects and dynamic animations, offering OEMs expanded styling freedom.

Nexlide C+ introduced multi-effect surface and 3D lighting through a light redirecting film, enabling differentiated signature elements within compact modules.

LG Innotek also highlighted mass production-ready applications, including the GL3 Front CTR Lamp (Nexlide A) featuring slim, efficient surface illumination, and the CV PE Rear Lamp (Nexlide M) enabling curved, uniform rear lighting.

Together, these demonstrations reflected LG Innotek's commitment to innovation in slimness, optical performance, communication capability, and platform evolution—driving the future of premium automotive lighting.

LMT & TechnoTeam

At the DVN Munich Lighting Workshop, LMT Lichtmesstechnik Berlin and TechnoTeam presented their joint portfolio for advanced photometric analysis in automotive lighting, combining rapid camera-based methods with high-precision goniometric systems.

The main focus at our booth was indirect screen goniophotometry using TechnoTeam's LMK luminance camera systems. By projecting the light distribution onto a calibrated screen and stitching photometrically corrected images, complete luminous intensity distributions (LID) can be captured much faster than with conventional point-by-point goniophotometry. This approach is particularly suited for ADB systems, symbol projection, and complex adaptive light functions.

In addition, we showcased an LMK system for direct measurement. Direct luminance and color measurements are becoming increasingly important in exterior applications, such as homogeneity assessment, exterior displays, illuminated logos, and light guides. The high spatial resolution and calibrated imaging enable objective evaluation of uniformity, contrast, and fine optical structures directly on the component.

Complementing the camera-based solutions, LMT presented the new GO-A goniometer platform, designed for automated and precise measurement of large and complex lighting components. With enhanced mechanics and robotics, the system supports efficient handling of headlamps, rear lamps, and illuminated panels, addressing the growing size and integration level of modern lighting systems

Together, LMT and TechnoTeam demonstrated how the patented screen-based method, direct luminance measurement, and advanced goniometric systems form an integrated solution for development, validation, and regulatory compliance—representing the "Best of Two Worlds" in automotive light measurement.

From left to right: Bianca van der Grinten (TechnoTeam), Carolin Tatulla (TechnoTeam), Christian Schwanengel (TechnoTeam), Stephen Dahle (LMT)

Luminous

At DVN Munich, we presented our approach to Specification-Driven Engineering—a fundamentally new workflow for developing automotive lighting optics. Instead of starting with geometry and iterating through countless simulation loops, we begin by defining what the light should do: illumination goals, light distribution, intensity, performance, and mechanical constraints such as packaging space and LED position.

With Luminous Modeler, engineers describe and visualize the intended light distribution and immediately evaluate the customer experience in digital night drives. In Luminous Engineer, LED placement and packaging constraints are defined, and feasibility is assessed within minutes. Based on these inputs, optical surfaces are generated fully automatically—without manual trial-and-error. The resulting freeform surfaces are exported directly as CAD-ready geometries, keeping mechanical workflows unchanged.

As a pilot example, I showcased auxiliary racing headlights developed with GERG Lighthouse. The system achieved broad illumination from 10° to 60° outboard, 84% geometrical efficiency, a sharp cut-off line (AK31 = 0.14), 1800 lm output, and a compact reflector size of just 50 × 80 × 80 mm.

Optical engineering can move from iterative design cycles to a linear, specification-driven workflow—delivering predictable results and significantly faster time-to-market.

Marelli

At the Marelli Lighting booth, we presented a range of breakthrough technologies in innovative series products that demonstrate our commitment to advanced lighting innovation in design, user experience, and electronics. Highlights included the “One Piece” headlamp across the entire width of a vehicle for the new Changan Qiyuan A06, featuring standard bi-function thin light-modules, animation for welcome and leaving scenarios and the fully integrated touch sensor technology. Further the brand-new Volkswagen T Roc rear lamp with its illuminated emblem was presented and Marelli´s prototype of a pixel rear lamp including the first OLED TFT technology, first time showcased public 2025 at Auto China in Shanghai. Finally, with the MCU-free lighting electronic solution we demonstrate the capability to fully support software-defined vehicles.

Melexis

Melexis recently participated in DVN Munich, an event that once again demonstrated how dynamically the automotive lighting ecosystem is evolving—and how essential strong partnerships are for driving innovation. Collaborative Innovation A standout highlight was the joint demo with Nissha. By merging Melexis LED drivers with Nissha's advanced surface and fi lm technologies, the collaboration showcased stunning "hidden-until-lit" effects. This breakthrough enables seamless design integration for both interior and exterior automotive surfaces, where lighting remains invisible until activated. Technical Leadership Melexis hosted a dedicated booth (Stand S1), providing a hub for networking and industry trend discussions. A key company presentation on February 5th further detailed the latest developments in dynamic lighting architectures. Central to this vision is the MeLiBu® LED driver portfolio, which offers:

- High Performance: Precise current control for multi-channel RGB and pixel-based systems.
- Robust Communication: A real-time light bus designed for animated rear lamps and communicative signaling.
- Next-Gen Functionality: Smooth animations and reliable synchronization across entire lighting modules.

Melexis is defi ning the next generation of vehicles. By combining MeLiBu® technology with a scalable IC portfolio, they are delivering the robust, safety-compliant architectures required for the future of intelligent mobility.

Andreas Laute & Roland Steger

Microrelleus

At DVN Workshop Munich, Microrelleus will showcase how femtosecond laser microstructuring is enabling new possibilities in automotive lighting — directly at production scale.

At our stand, we will present Lightmatch, our service for matching optical prototypes to serial production by transferring microstructures from PMMA samples to injection molds with high fidelity. Visitors will also discover Microscatt, our family of microscopic textures designed to precisely control light diffusion, homogeneity, and visual appearance, already implemented in multiple production projects. We will introduce a new development where freeform micro-optics are engraved in the mold and become fully encapsulated inside the injected plastic part, sealed by the material itself during molding. This approach enables protected, embedded optical functionalities directly within the component, eliminating secondary assembly steps while improving robustness and repeatability. In addition, we will present anti-glare surface textures designed to enhance visual comfort without compromising optical efficiency. Beyond lighting performance, attendees will discover Microauthenfy, our embedded optical authentication technology. By combining microstructures with controlled illumination angles or part rotation, Microauthenfy generates distinctive visual effects, enabling lighting-based identification, traceability, and brand protection directly within molded components. Some real production examples will be displayed, illustrating how femtosecond laser processing bridges prototyping and mass manufacturing, delivering functional optical surfaces that cannot be achieved with conventional technologies.

Microrelleus will be represented by Massimo Pizzin (Business Development Manager), Jordina Boveda (Senior Optical Engineer), and Raúl García (CEO). We look forward to connecting with OEMs, Tier-1 suppliers, and lighting experts to discuss current challenges and explore future collaborations.

MIND

MIND Opto-Electronics is a professional supplier of lighting, modules, and electronic systems catering to the global automotive industry. its portfolio includes research and development as well as manufacturing of a comprehensive range of automotive lighting solutions, electronic controllers, 4D imaging radar, and ADAS cameras etc. By 2024, the company achieved a revenue of 5.3 billion RMB, boasting 9 R&D centers and 10 production bases worldwide, employing approximately 7,500 employees.

At 2026 DVN Munich Exhibition, MIND showcased a variety of innovative lighting products tailored to meet diverse market needs. Highlights included the Spaceport 3D Floating Display, Slim HL Module Lighting/Signaling Integration, Eco-HD Module, and Dynamic Logo Light GEN2. Among the latest mass-produced offerings were the Headlamp and Rear lamp designed for the Renault Twingo. These components feature a unique semi-circular design reminiscent of the agile “frog eyes,” while honoring the classic round headlamps of the original 1993 Twingo, effectively blending futuristic aesthetics with superior safety performance.

These products exemplify only a fraction of the market applications offered by MIND Optoelectronics. The company remains devoted to expanding its research and development initiatives in the realms of automotive lighting, electronic system, ADAS cameras, and sensors. MIND Optoelectronics looks forward to pursuing innovation and establishing collaborative partnerships with industry peers to advance technology and drive progress in these critical sectors.

MPLD

MPLD is a leading and independent manufacturer of vibration fixtures and validation jigs for quality tests.

Thanks to the know-how we gained in more than 20 years of experience, the continues investments in technology and human resources, we offer high quality products and services with certified processes according to ISO9001.

Most of our manufacturing takes place internally in our departments of R&D, production, assembly, dimensional control and dynamic validation.

We like to work with our customers as a consultant in the whole validation process to define together the jigs necessary to validate the product in order to optimize all the cost parameters.

Each fixture is realized in order to maximize performance, ensure repeatability, minimize time setup and facilitate the work of the validation engineers.

In this event, our focus was on the optimisation of vibration testing, with particular attention to multi-sample vibration fixtures. These solutions are designed to reduce overall test time, use all the power of your equipments, and improve laboratory efficiency, helping customers optimise testing budgets where time-on-equipment is the main cost driver.

Designing multi-sample fixtures means dealing with increased size, complexity and performance constraints. This is exactly where our expertise comes into play: we specialise in the design and in-house manufacturing of complex vibration fixtures that ensure performance, repeatability and reliability, even in demanding test configurations.

MPS

MPS's leadership in advanced power management and control solutions for automotive applications includes showcasing cutting-edge automotive lighting solutions at this year's DVN event, enabling highly efficient, flexible, and intelligent vehicle architectures.

Key demonstrations highlight dynamic styling, robust integration, and enhanced functional safety:

- State-of-the-art adaptive driving beam (ADB) systems powered by the new MPQ76400FS-AEC1 LED matrix manager
- Production-proven rear lighting based on the MPQ7225-AEC1, a 16-channel linear current regulator delivering best-in-class current per channel, already featured in the Kia EV6 and Leapmotor C10
- The MPQ76300FS-AEC1, an advanced 24-channel linear LED driver with superior digital and communication features for dynamic taillights and illuminated grilles

These exhibits illustrate MPS's commitment to simplifying design, accelerating time-to-market, and enabling distinctive lighting signatures, giving OEMs and Tier 1 suppliers production-ready platforms to build safer, smarter, and more visually striking vehicles.

Murata

At the DVN2026 event, Murata introduced its latest software-defined MEMS inertial solution for automotive headlight levelling, highlighting its role as a global leader in inertial sensors and advanced sensor-fusion algorithms. With decades of experience in automotive safety-critical applications, Murata provides high-performance MEMS technology and algorithms that enable OEMs and Tier-1 suppliers to design their own in-house, scalable headlight-levelling systems. This approach allows vehicle manufacturers to meet evolving UNECE R48 regulatory requirements without reliance on mechanical levelling components, while retaining full flexibility over system architecture, cost optimisation, and long-term product evolution.

In order to meet these needs, Swoboda Technologies was presented as Murata's first partner offering a standalone module concept that integrates Murata's inertial sensor into a standard package. Their contribution focuses on easing the adoption phase for customers seeking a retrofit-friendly solution for regulation compliance. Swoboda module helps streamline early integration work, bridging the gap for OEMs and Tier-1s that aim to accelerate market entry.

By combining Murata's sensing and algorithmic expertise with Swoboda's integration and packaging experience, the industry gains a flexible roadmap: retrofit capability today, and full OEM-defined system architecture tomorrow.

Swoboda HIMU datasheet:

Murata Headlight Levelling Solution:

Nissha

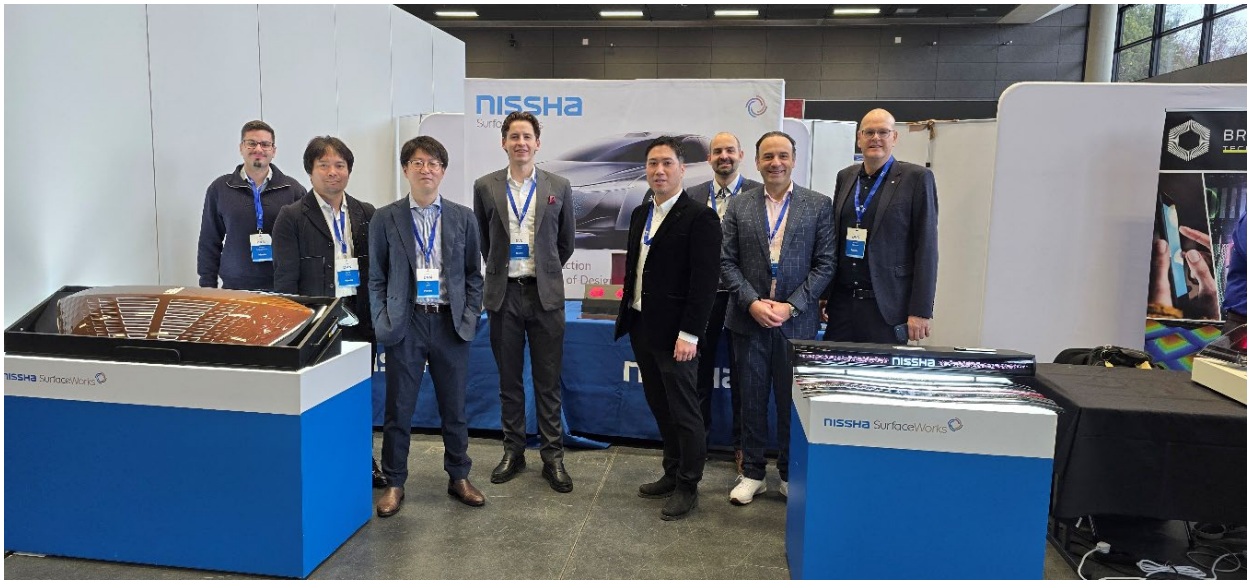
At DVN Munich, Nissha team showcased mobility lighting products and technologies with following demonstration line up.

Highlights

1. Exterior lighting/functional panel, with large PUR (Polyolefin)+ 2K in-molded products, to design OEM front face with advanced effect and ensuring surface requirement.
2. Translucent car body panel, backlit function by harmonizing car entire body color for exterior front panel and ornaments, less deviation of surface color matching.
3. LumiStyle, named based on “luminous with styling” which is applicable inner lens of car rear lamp, contributing advanced backlit effect, playing with lighting effects. Because of IMD technology, this technology contributes cost optimization approach in supply chain.
4. Advanced 3D lighting, innovative 3D design effect for lamp applications, using special texture on surfaces.
5. mutech (which is combined wording “mute” and “technology”), representing display, icons and graphics for interior applications. Our technology is to hide unnecessary information and make it visible only when needed.
6. Light effects with film (cube shaped demonstrator), creating depth effect by special ink system with lighting device.

Nissha is achieving above valued surface with special effects, especially using ink system, film, in-mold (injection) and lighting solutions with CMF styling (Nissha in-house design capability) which will be contributing OEM’s product surface of both exterior and interior.

Our team are open to support new products and design and development, utilizing Europe (Germany) and Japan innovating center, including commercial and high level engineering support. Thanks for your questions and any inquires to us.



OLEDWorks

At DVN Munich, OLEDWorks showcased its latest Atala Digital and Atala Wave OLED technologies, emphasizing design freedom, modularity, and brand-forward lighting solutions for automotive applications. The demonstrations highlighted how OLED's inherently ultra-thin form factor, precise segmentation, and uniform luminance enable highly intentional designs—from expressive signatures to sculptural brand elements. Atala Digital and Wave demonstrations underscored production-ready modularity, and customization opportunities, giving OEMs scalable examples that can transition from early studio exploration to program-level integration.

The exhibit featured large red Atala Wave panels paired with amber signaling, demonstrating digital control, high contrast, and rapid switching suitable for tail, stop, and turn applications. Modular Digital tiles reinforced how OLED high-contrast digitalization creates opportunities for versatile communication and symbology. A standout theme was bendable capability, with the Atala Wave variant conforming to curved surface geometries while maintaining luminance uniformity and wide off-angle performance. This opens new territory for visibility on the road and signature lighting that follows body contours or integrates seamlessly into premium materials.

Brand lighting was brought to life through illuminated Cadillac front and rear badges—crisp, thin, and high contrast—and high-impact brand-forward concepts, proving how OLED can function not merely as a light source but as a defining signature element.

OPmobility

OPmobility's presence at DVN Munich underscored its strong commitment to innovation in advanced lighting and mobility solutions. At one of the industry's leading events, the company showcased new achievements in design integration, performance, and system efficiency.

The booth clearly reflected OPmobility's strategy: merging cutting-edge engineering with iconic design. The exhibits showed how lighting has evolved into a core driver of vehicle identity, safety, and user experience - with solutions focused on aerodynamic integration, intelligent functions, and distinctive visual signatures.

DVN Munich also provided a high-value platform for discussions with OEMs, technology partners, and industry experts.

OPmobility used this momentum to reinforce key partnerships and explore new collaboration opportunities in the shift toward electrification and smarter mobility.

Through active engagement throughout the event, the team highlighted a forward-looking mindset centered on scalable innovation, efficient integration, and differentiation through design.

In a rapidly evolving competitive landscape, OPmobility demonstrated its ambition not only to keep pace, but to help shape the future of intelligent mobility.

Proell

IMD/FIM Technology – Film Insert Moulding

a consistent and persistent method for decorating products

Proell is a German manufacturer of screen and pad printing inks as well as specialized ink systems, adhesion promoters and protective lacquers for IMD/FIM technology.

At our booth and in our presentation, we showed:

IMD/FIM Screen Printing Inks and Lacquers for the Decoration of Automotive Front Modules and Lighting Applications

The IMD/FIM process steps, from screen printing to high-pressure forming, trimming and back molding will be shown by means of serial automotive parts.

Dr. Hans-Peter Erfurt, IMD/FIM Manager, showed layer constructions to improve interlayer cohesion with optimized climate & hydrolyses resistance. Hans-Peter presented special inks and lacquers for automotive front modules and lighting applications. The new light scattering lacquer NORIPHAN HTR N 093/800 was the highlight!

The white (transparent) formulated screen printing lacquer is part of the one-component NORIPHAN® HTR N IMD/FIM ink range and therefore back moldable. The lacquer is used to diffuse punctually LED spots into a homogenously spread light area. The diffusing lacquer can be used instead of cost-intensive light management films. The lacquer shows high light diffusion/scattering & transmission values!

Advantages of IMD/FIM parts:

- Second surface ink layer combinations, with optimized climate & hydrolyses resistance and improved interlayer cohesion
- Day and night design, dead front effects, ambient lighting
- Light diffusing (scattering) lacquers with high transmission
- IR & radar transmitting black color shades
- Non-conductive black and silver color shades for functional panels and displays

Reichle Technologiezentrum

At DVN, Reichle presented its expertise in laser technology for lighting applications at a shared booth with SP3, highlighting its role as an established technology partner in Europe. Using advanced laser systems, including femto laser systems, Reichle develops solutions for interior and exterior lighting with a strong focus on precision, efficiency and design.

The presented technologies enable high-quality surfaces, accurate light diffusion and outcoupling structures and cost-efficient manufacturing concepts. Laser-based processes support the creation of fine textures, sharp details and three-dimensional surface structures, addressing current requirements in automotive lighting design.

Building on extensive project experience in the lighting sector, the showcased solutions reflect a high level of technological maturity and application relevance. Recognition through multiple industry awards further underlines the established use of these technologies in current lighting developments. At DVN, the focus was on practical, production-oriented approaches that can be integrated into existing development and manufacturing environments.

A key aspect of the showcased solutions is the ability to achieve repeatable and simulation-proof results, supporting consistent quality from early development stages through to series production. Centralised processes and standardised workflows contribute to reliable implementation across projects.

In addition, sustainability plays an important role, with energy-efficient laser processes and minimal material waste compared to conventional methods.

Through its presentation at DVN, Reichle demonstrated how its expertise and laser-based technologies support modern lighting concepts and contribute to the ongoing development of automotive lighting applications.

Saint-Gobain Sekurit

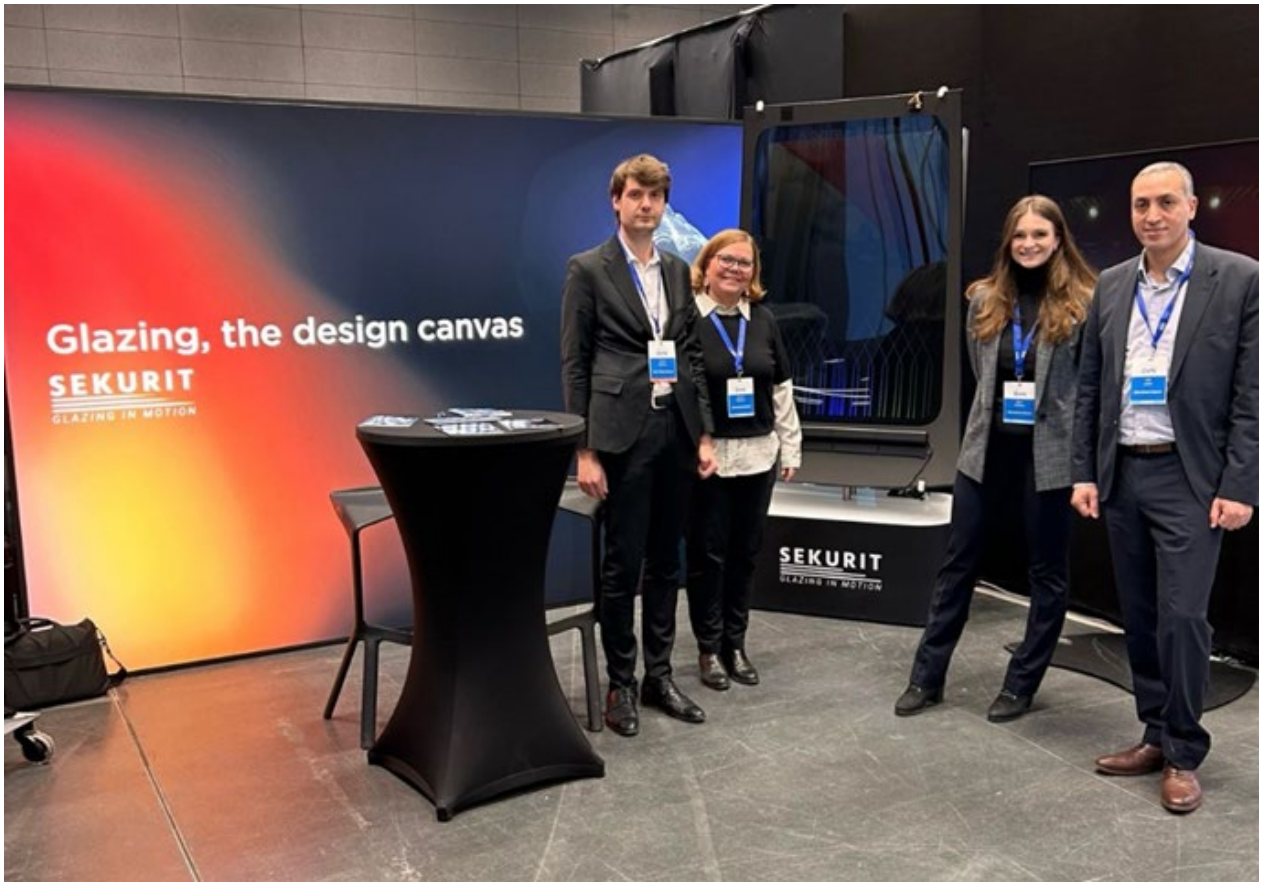
It was the first time Saint-Gobain Sekurit participated in the DVN Lighting Workshop in Munich, contributing to discussions around Light in Glazing and its future perspectives — particularly how large illuminated glass surfaces can enhance exterior and interior light signatures, strengthen brand identity, and enable new interaction scenarios.

The booth in the open exhibition area was centered around the message “Glass as a Design Canvas,” inviting visitors to rethink the role of glazing in overall vehicle design and experience. A full-size panoramic roof demonstrator combined Light in Glass and Switchable technologies, allowing participants to experience lighting, transparency, and surface continuity at scale. A TV screen continuously displayed videos illustrating selected democar applications, providing visual context without entering a product-focused approach.

In addition, Saint-Gobain Sekurit hosted private meetings in a dedicated dark room. This space featured a curated excerpt of the Sekurit Imagine Lab — an experiential platform for automotive designers, where glass is explored as a creative medium rather than a simple component. Three active demonstrators illustrated how light and transparency in glazing can build intensity, interact with its environment, and shape atmosphere and emotional connection. A second full-size roof demonstrator completed the immersive setup.

Fabien Geniaux, Marketing Portfolio Manager, also contributed to Session 1 with a keynote presentation titled “Light in Glazing: New Horizons for the Automotive Experience.”

The event enabled meaningful dialogue with designers and industry experts, reinforcing glazing as a living surface shaping future vehicle identity.



Sony DADC

At the Driving Vision News event in Munich, Sony DADC presented its advanced Micro Lens Array (MLA) technology and mass manufacturing platform for automotive projection solutions. Known as a leading global manufacturer and service provider for optical media, Sony DADC brings nearly 40 years of experience in the entertainment industry, with a strong focus on quality, innovation, and customer satisfaction. Building on this expertise, the company has expanded into precision polymer micro-optics, offering refractive and diffractive components on full polymer wafers.

Production takes place at Sony DADC's 41,000 m² manufacturing campus in Thalgau, Austria, which includes a 6,000 m² ISO 7 cleanroom and high-level security standards. Supported by more than 30 engineers, the company ensures efficient large-scale production and a strong "Made in Europe" footprint.

In Munich, Sony DADC introduced its mass manufacturing platform for MLAs designed for static and semi-dynamic (segmented) open-market automotive lighting platforms. The technology is available in monochrome amber for turn-signal projections and in white light for welcome carpets and puddle lamps. The polymer-based MLA systems combine illumination lenses, metallic apertures (masks), and projection lenses, all manufactured using injection molding and nanoimprinting technologies.

Through wafer-level optics manufacturing on polymer substrates, Sony DADC delivers high-quality and state of the art, lightweight, and thermally stable components with high design flexibility. These precision polymer optics offer optical performance properties comparable to glass while enabling scalable, robust solutions for next-generation automotive lighting and projection applications.

Swarovski Mobility

At this year's DVN Munich Lighting Workshop, Swarovski Mobility showcased three breakthrough demonstrators that illustrated how crystal-integrated technologies are reshaping both exterior and interior automotive design.

The FrontIQ Headlamp drew significant attention as a next-generation exterior lighting concept merging advanced optical engineering with signature crystal aesthetics. Featuring radar-permeable, fully customizable crystal elements and a turquoise automated-driving status line, the system demonstrated how precise light guidance, holographic textures, and distinctive visual signatures can elevate brand identity while enabling new communication functions.

Also on display was an Interior Elements demonstrator, a visionary control-interface example designed to inspire automakers with its blend of refined aesthetics and functional innovation. The demonstrator features configurable drive-selection layouts, a broad palette of premium materials, and crystal-based shy-tech elements that reveal information only when needed. Its tactile crystal surfaces and elevated design language highlight the future direction of high-end interior interaction.

As a third highlight, Swarovski Mobility introduced the Crystal Rotary Controller, developed for the Marquardt Group. This multidirectional control element incorporates a precision-cut crystal with layered color impressions and a center component that remains visually aligned while the outer crystal rotates. Designed for premium HMI applications, it offers OEMs a scalable, elegant alternative to traditional rotary controls.

Together, these demonstrators underscored Swarovski Mobility's commitment to fusing luxury materials with advanced functionality to redefine the emotional and sensory experience of future mobility.

VueReal

At our booth, we showcased how VueReal's MicroSolid Printing™ platform is enabling a new generation of high-brightness, fine-pitch MicroLED lighting and display solutions for automotive exteriors and interiors. In partnership with Flex-N-Gate, we presented a taillight concept that demonstrates how MicroLED can support thinner form factors, higher resolution "light pixels," and dynamic, segmentable signatures. We also demonstrated several Reference Design Kits (RDKs) used by engineering teams to evaluate performance and accelerate prototyping, including RDK-01 in Red/White/Blue and an Amber RDK-01 Side Mirror demo. Additional exterior demos included our Smart Taillight (Red/Red/Amber) and an RDK-02 kit featuring Amber phosphor conversion, along with an RDK-02 high-resolution demonstration to highlight the path toward higher pixel density and richer animations.

On the system side, we presented our RDK control software used to power, configure, and run content/animations across the demos. For interior applications, we showed an RGB Smart Mirror demonstration and our RDK-04 3.5" transparent active-matrix display, illustrating the potential for in-glass and see-through display integrations where brightness, clarity, and packaging are critical.

LIST OF MAIN DVN MONTHLY REPORTS

Main reports launched in 2008-2020

Koito company profile
China lighting market
The Wonderful World of Passenger Car lighting
Tier 2 and 3 contribution on automotive lighting
ZKW company profile
Simulations in automotive lighting
Mercedes-Benz profile
LED technologies in automotive lighting
LEDs Thermo-Electrics
Interior Lighting
BMW and lighting
Lighting and ADAS
Materials in lighting
Laser Head lighting
Automotive lighting Regulations worldwide
Israeli Startups
Jaguar Land Rover and lighting
Engineering companies involved in lighting
Japanese lighting market
Status of w/w Regulations
Korea Lighting Market
SL Corp profile
ADB/Matrix Beam
India Car Industry and Lighting Market
Vision of lighting 2025-2030
Automotive lighting Regulations
worldwide Vehicle Lighting in USA
New ADB technologies
Interior Lighting
Camera technologies
Varroc profile
Volkswagen profile
US automotive lighting industry
Materials in Vehicle Lighting
The Future of Exterior Lighting
IAA Frankfort Autoshow
DVN Munich WS
GENEVA Autoshow
US Lighting
Marelli AL Profile
50 years Light Styling
ADAS and Lighting

Main reports launched in 2021

Evolution of LEDs
New Models July-October
2020 Audi Lighting & ADAS
Lighting in development countries
ADB Update
DVN Shanghai WS
Innovations in Rear Lighting
Global Landscape of Automotive LED Suppliers

Reports launched in 2022

Technologies presented in CES 2022
Laser light automotive lighting
ISAL report
DVN US workshop
Worldwide Demographic Development
Models launched May to August DVN
Shanghai report
VISION congress
Paris Autoshow + last Vehicle models
L.A. Autoshow

Reports launched in 2023

CES Report
TU Darmstadt Lighting Institute
DVN Paris Workshop
Universities and Lighting
MLA Technology
Models launched in H1-2023
DVN Tokyo Workshop ISAL Report
DVN US Workshop
Osram Company Pro ile
DVN Shanghai Workshop

Reports launched in 2024

CES
New cars of the semester
DVN Munich Workshop
OLED Technology
Beijing Autoshow
Display Week
2024 DVN Detroit Workshop
ALE, June 2024
Indian vehicle lighting market
DVN Pune Workshop summary
New cars 2024
Nichia company pro ile
Test houses
Shanghai DVN event summary

Reports launched in 2025

CES and Bharat Mobility Global Expo
DVN Munich event summary
Dekra testhouse
SPE Plastics in Electric & Autonomous
Vehicles (EAV)
Auto Show Shanghai
RGB LED Report
Japanese Vehicle Lighting Market
IAA 2025
DVN Detroit Report
The Czech Automotive Ecosystem
DVN Shanghai Report

Reports launched in 2026

EICMA 2025 report
DVN CES 2026 Report
DVN Munich event summary

DVN ecosystem and scientific community

DVN is a reference in the world of Lighting, Interior comfort and Lidar

Car Makers

Audi
Avatr Technology
Bentley
BMW
Ferrari
Ford
Ford Otosan
General Motors
Genesis
Hero MotoCorp
Honda
Hyundai
Jaguar-Land Rover
Kia
Lotus cars
Lucid Motors
Mazda
Mercedes-Benz
Mitsubishi Motors
Nio
Nissan
Renault
Rivian
Seat
Stellantis
Subaru
Toyota
TVS
SAIC Volkswagen
Volvo Cars
Zoox

System Suppliers and Tier 1s

Adient
Anrui
Appotronics
Aspöck Systems
Braslux
Cepton
Ceres Holographics
Chongqing Rebo
Continental
Creat
Diode Dynamics
Elba
F2J Industry
Feka
Fiem Industry
Flex-N-gate
FORVIA designLED
FORVIA HELLA
GHSP
Grupo Antolin
Hascovision
Hitachi
Ichikoh
J.W. Speaker
Keboda
Koito
Lightworks
Lumax
Luxit
Maier
Magna
Marelli
Marquardt
Mind
Mobileye
Mobis
Muth Mirror Systems
Nordic Lights
Odelo Farba
OPmobility
Panasonic
Polycontact
Prettl group
Rehau
SL Corporation
SMR Automotive
Stanley
The Lighting Consultants
Toyota Boshoku
Uno Minda
Valeo
Varroc
Weidplas CH
Xingyu
Zanini
ZKW
Zodiac

Light Source Suppliers

ams OSRAM
APT Electronics
Brightek
Dominant Opto Tech.
Everlight Electr.
HC Semitek
Kyocera SLD Laser
LG Innotek
Liteon Technology
Lumileds
Nichia
OLEDWorks
Refond
Samsung LED
Seoul Semiconductor

Tier 2s and service providers

A2Mac1
Ascorium
AML Systems
Ansys
ASAP
ASYST Technologies
Auer Lighting
BASF
Bluebinaries
Brightview Technologies
Capgemini
CLM Search
Coindu
Covestro
Dajac
DBM Reflex
Delo
Die haptiker GmbH
Docter Optics
Dow
Edag
Elmos
Endego
Ennostar
Euro Moulders
EV Group
Flow Dry Technology
Focuslight
Fusaware
Grewus
HJ Optics
Huawei
Idemitsu
Infineon
Inova Semiconductors
Instrument Systems
Integrity
Joysonquin
Leonhard Kurz
L.E.S.S.
LMT
Luminus
Mektec
Microvision
Maxell Frontier
MD Group
Melexis
Microchip
Microrelleus
Mitsui Chemicals
Mocom
Nalux
NBHX Trim
Oerlikon
ON Semiconductor
Pininfarina
Polyrise
Preh
Ray Group
S&P Global Mobility
Sabic
Schott
Seaborough
Seoyoneh-Ewha
Shihu
SP3
Sunny Automotive Optech
Suzhou Senbo
Synopsys
TechnoTeam
Toshiba lighting
TQ Technology
Uni Tooling
Ventura
W Research Company LLC
W.L. Gore & Associates
WLOPT
X2F
Xunchi

Universities, NGO and labs

Alliance for Automotive Innovation
ARAI
Automotive Research Association of India
BMDV
Bundesministerium für Digitales und Verkehr
CATARC
China Automotive Technology and Research Center
CEA Leti
Darmstadt university
DEKRA
Department for transport, UK
DTI
Danish Technological Institute
DVR
Deutscher Verkehrssicherheitsrat - German Road Safety Council
Estaca
École supérieure des techniques aéronautiques et de construction automobile
Fraunhofer (FEP, IAP, ILT, IMS)
Fudan university
GTB
Hannover Leibniz
Hochschule Aalen
Hochschule Magdeburg-Stendal
Icahn School of Medicine at Mount Sinai
Light and Health Research Center
ICAT
International Centre for Automotive Technology
Idiada
Institut d'Optique
JASIC
Japan Automobile Standards Internationalization Center
KBA
(Kraftfahrt-Bundesamt)
KATRI
Korea Apparel Testing & Research Institute
KIT
Karlsruhe Institute of Technology
Kotsa
Korea Transportation Safety Authority
LCOE
Laboratorio Central Oficial de Electrotecnia
L-LAB
MLIT
Ministry of Land, Infrastructure, Transport and Tourism
NHTSA
National Highway Traffic Safety Administration
OICA
International Organization of Motor Vehicle Manufacturers
Pacific Northwest National Laboratory
Phabulous
RDW
RISE Research Institutes of Sweden
Sapphire STS
SMMT
Society of Motor Manufacturers And Traders
SMVIC
Shanghai Motor Vehicle Inspection Certification
TNO
Traficom
Transport Canada
UMTRI
Université Gustave Eiffel
UTAC
VDA
Verband der Automobilindustrie
VEDECOM
Vrije Universiteit Brussel
YoungNam University

DVN Lighting