

Editorial

Here's To Well-Lit Holidays!



It has been a great pleasure for me to write your DVNNewsletter every week this year, and I hope you've enjoyed it. I try my best to cover the full scope of what is happening in the vehicle lighting world and its tangents.

I want to thank all of you reading this, for your ongoing faith in DVN. We gained more and more readers this year, and strong interest from growing markets like India and China.

Established markets in Europe, North America, and Japan are on the increase, too, with newcomers from sectors including display, semiconductors, software, and 'AI'. Lighting's

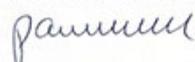
constellation is actively growing larger and more diverse, to comprise the likes of chemicals and materials, and photonics. This is really complex technology, and the interconnection with such a vibrant array of fields is making lighting more interesting and fascinating.

I close the year with this greeting card, which include snowflakes and other road marking symbols from UN R48 annex 16. As 2024 draws to a close, I am focussed on what I consider one of the lighting world's prime opportunities: the possibility to have driver assistance and signalling projections on the road. 2024 was the year of driver assistance projection, regulatorily as part of ADB, and practically possible with DLP and microLED technology. Watch for an overview of the current state of that art in the next DVNNewsletter; I'm working on it now.

I foresee 2025 as the year of signalling road projections: turn indicators, reversing lamps, and welcome sequences. Count on DVN to provide all the details as this technology and its apposite regulations evolve around the world. So to get a running start on that, today I am glad to publish my interview with Polestar's lighting design team. 24th December is the Northern Hemisphere's longest night of the year; and during this long night, the pole star where the car company got their name is shining to bring light into everyone's house and home. How fitting!

All of us at the DVN team wish you great happiness as you celebrate your holidays. See you in 2025 !

Paul-Henri Matha
DVN Chief Executive Officer and Lighting General Editor



In Depth Lighting Technology

DVN Field Trip: Polestar Design Studio



By Paul-Henri Matha, DVN CEO

I went to Gothenburg in August, when southern Europe is enjoying holidays, but northern Europe is already working again. While there, I spent time with Polestar's lighting design team to discuss their latest products.



Exterior Component Design Manager Christophe Ferreira is supported by Lighting Studio Engineer Andrea Camuso, who started his lighting career at Valeo Italy; he was Valeo's resident engineer at Ferrari.





Then he moved to Lamborghini's lighting development team.



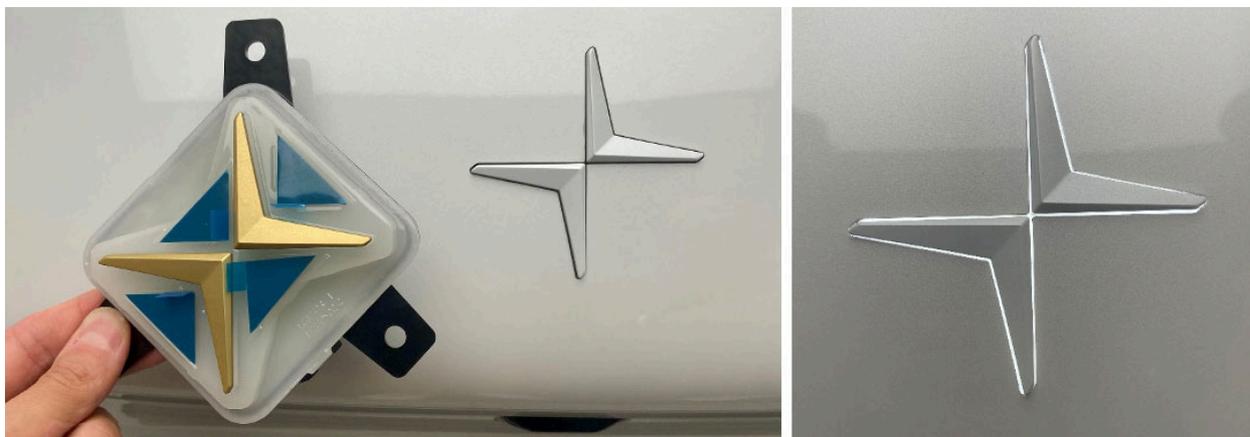
Sports car design is surely a specialty, with lamps embedded in the hood, and rear combination lamps right next to a V12 engine in a 250°C environment.



Perhaps because Italy's weather was too good for him, he decided to move to Sweden in 2022 to develop Polestar's lighting design philosophy.



The latest Polestar models on the road are the 3 and 4. The Polestar 4 has an interesting front logo with a lit contour—really a beautiful effect!



The next models to be launched will be the 5 and then the 6, based on the BST concept shown in July 2024. Christophe Ferreira and Andrea Camuso shared their thoughts with me:



DVN: Can you describe your daily activities?

Christophe Ferreira: Since we are working on advance and production, our day can be varied and some days on a high pace rhythm; the tricky part for me in this case is to quickly switch from creative work to a more rooted, production-oriented topic, and then switch back to creativity, but that's exciting with my role also. I am never bored.

Andrea Camuso: My daily work is fascinating. Engineers and designers don't have the same approach on things, and I am the link between them, it's extremely fun and challenging for me. Working side-by-side with Christophe and the designers is rewarding and productive to get good quality on the final parts on the vehicle. I'm providing them the technical support they need for the pre-feasibility phase, and

keeping an eye on legislative constraints and new future possibilities. Another big part of our job is the perceived quality of the lamps—an important mission for us, to maintain our standards at the highest level.

DVN: Polestar's design centre is not close to the R&D team, as it is in other automakers, and there are different platforms involved; how does the teamwork...work?

C.F.: Our R&D team is linked to the platform we are using. If it's a Volvo platform, then it's Volvo R&D, or same with Geely. Our R&D core team is in the UK and supports us on our in-house platform like the Polestar 5, and also on advance work. They are experienced engineers with expertise in premium brands, and we are happy to have Nick Holland, Benjamin Aubert, and Harry McVicar with us.

DVN: Is it difficult to work with the Polestar R&D team in Coventry, England, on the other side of the North Sea?

A.C.: I would say the workflow is pretty fluid despite the distance. We do a lot of online meetings. The UK team is doing great and supporting us for our lighting strategy and taking care about the Polestar 5 and 6. Their expertise ensures all the interfaces between the lamps and the electronic platform, taking care about the development and the management of the lamps, and keeping the project on track.

DVN: Andrea, you are a lighting studio engineer, which is not a very common position. Some automakers have just a design studio with designers, and R&D with engineers. At Polestar, you have this engineer in the design studio. Tell about that, will you?

A.C.: As you know from your deep experience, exterior lighting is a really complicated and complete field. It's the only component in the vehicle where we develop exterior and interior design. This small illuminated device combines four big fields: mechanics, optics, electronics, and legislation. Due to this complexity, it's fundamental to have a proper pre-development phase, where designers are guided properly during the concept phase. Fighting with the legislation is always tough to understand, and Polestar designers are pushing the boundaries to deliver the best designs. It's crucial for them to know from the beginning of the project where the functions must be placed, and adapt their concept accordingly. We are a design-driven company, and the competition is strong, so having studio engineers walking among the designers is fundamental to keep our leadership in design.

DVN: Christophe, what do you think of this approach? if I am correct, it was different at Renault where you were before.

C.F.: Yes, having an in-house studio engineer is mandatory for me to deliver realistic concepts. For Renault, the borders started to move in the lighting department—Sebastien Leone was with us three days a week, bringing his R&D expertise to design, and I would consider his role at that time like a studio engineer.

DVN: What will come next; what's in your pipeline? What lighting technologies have your attention?

C.F. & A.C.: We are in constant search of innovation, scouting the latest tech that will help us deliver the best designs, and continue to provide innovative solution focusing on compact packaging and top-notch homogeneity; for example, the Polestar 5 rear lamp.

Sustainability and performance are also big pillars in our design. One of our main deliveries will be what we call the Polestar 0 Project, to create a truly climate-neutral car by 2030. Becoming climate-neutral means eliminating all greenhouse gas emissions across our operations and all phases of our cars' life cycles—lamps included! We try to get designers familiar with our main three pillars for a sustainable lamp: keep it light (weight reduction), keep it efficient (power energy reduction), keep it simple (small size, few components, recycled materials). At Polestar, our approach is design following the function, so it leads us naturally to sustainable concepts.

DVN: Considering that in this interview you're addressing the whole vehicle lighting community, what do you think is missing? What do you need or want that doesn't presently exist or could be improved?

C.F. & A.C.: Polestar is well known for our sustainable approach. What we miss today is innovation into new materials. I remember [Ford's 2019 experiment with coffee bean waste](#) to create a lamp housing, so my question would be: where are we today?, How can sustainable materials like Bcomp or Papershell be made compatible with our exterior lighting requirements?

Lighting News

Won Yong Hwang is the new ZKW CEO

LIGHTING NEWS



Won Yong Hwang will take over as CEO of the ZKW Group on 1 January 2025. An experienced manager, he was most recently COO of LG Electronics Vehicle Solution Company, to which ZKW also belong. He has of 15 years' management experience in the automotive industry, gained in various positions at LG Electronics.

He follows previous ZKW CEO Dr. Wilhelm Steger, who has led the company for almost three years and now wishes to take on new professional challenges at his own request. Hwang says, "Dr. Steger was instrumental in initiating the necessary market-oriented restructuring of the ZKW Group during the difficult times in the automotive industry. My goal and priority will be to accelerate the expansion of synergies with the LG Electronics headquarters in VS and to strengthen ZKW's competitiveness".

Steger will hand over his management position to Hwang on 31 December 2024, so that he can devote himself to other projects, including as a member of the Supervisory Board of the ZKW Group.

Nio new brand Firefly

LIGHTING NEWS



Nio just launched its new EV brand Firefly to compete with Renault 5 and BYD Dolphin in Europe.

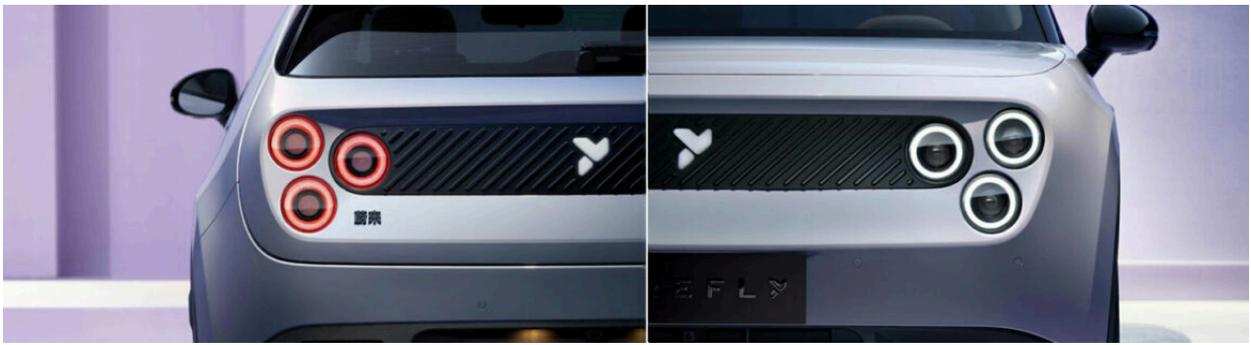
The car has been designed to stand out from rivals, said design director Kris Tomasson, with a “unique” tri-circular headlight and rear lamp design. “All good things come in threes,” said the American, formerly of BMW and Ford.

Elsewhere, Firefly has, like rivals in the class, short overhangs and a slightly raked roofline to maximise range.

Speaking about the design, Tomasson said: “We started with something that was simple yet iconic: a firefly. Firefly is small, electric and buzzing with energy and totally mesmerising. It became the foundation of our design DNA.”

Lamp designed is quite complex. The 3 front round shapes headlamp seems to be integrated into the front module including bumper. Rearlamp is fully integrated into the tailgate, that is requesting additional lamps when tailgate is open (expensive solution)

Further technical details, such as power, range and battery pack size have yet to be announced, but it is thought Firefly could feature swappable battery packs as Nio previously confirmed it was developing a new version of its battery swapping platform to be able to accept smaller batteries. But while that is a key feature of Nio models, the challenge of creating a network of swap stations has been a key reason for the brand's relatively slow rollout across Europe, and it is unknown if the technology will be as key to Firefly.



New foundation of Lightworks Manufaktur GmbH

LIGHTING NEWS



LIGHTWORKS[®]
MANUFAKTUR

Lightworks GmbH, a leading company in the field of lighting system development, is setting the course for a successful future. By taking on employees of the renowned company DCS and its production equipment and opening a modern new location in Ingolstadt on February 25, the group of companies is setting new standards in the industry.

The integration of Lightworks' experienced development team and DCS's highly qualified employees creates an extraordinary expansion of expertise. This alliance combines technical know-how and innovative strength to implement demanding projects in the automotive and non-automotive sectors even more efficiently and in a more customer-oriented manner.

"The takeover of DCS employees including the assets as well as the new location in Ingolstadt are significant steps to further strengthen our market position. Our customers benefit from an even wider range of services and an optimized, state-of-the-art infrastructure," explains Michael Hoefgen, Managing Director of the Lightworks Group.

The new location will offer state-of-the-art production and development facilities and will enable the implementation of complex projects at the highest level. By bringing together teams on a project-oriented basis and investing in advanced technologies, the Lightworks Group is underlining its role as a pioneer in the technological development of lighting systems, prototype construction and small-scale production, and is thus acting as a full-service system partner.

Lightworks GmbH is already certified according to ISO 9001 and TISAX and is extending these to the group. In addition, the KBA manufacturer certification and the certification according to IATF 16949 are in preparation in order to guarantee the highest quality and safety standards in the automotive industry.

The Lightworks Group's well-known customers include well-known premium customers such as BMW, Rolls-Royce, McLaren, Porsche and Red Bull as well as well-known suppliers. With this strategic expansion, the group is focusing on growth and innovation in order to continue to inspire its customers with pioneering solutions.

Osram, Valeo in Dynamic Car Interior Pact

LIGHTING NEWS



Osram and Valeo have announced they will be cooperating on innovative OSP (open system protocol) technology to transform the lighting inside vehicles. With the likes of Osram's Osire 'intelligent LED' and Valeo's dynamic ambient lighting systems, the two companies aim to set new standards for vehicle interior design and functionality.

People want vehicles that are easy-to-use, personalized, and provide clear information adapted to their lifestyle. Dynamic ambient lighting offers many opportunities to meet those wants. 'Smart' LEDs enable a highly controlled system able to create an animation throughout the cabin or in a very specific area. Intensity and colour can be managed for each LED in order to get a warning or a visual feedback. Use cases are numerous: incoming call, personal assistant visualization, navigation or ADAS information, and more.

OSP is an advanced communication framework that allows microcontrollers to manage a series of RGB 'intelligent LEDs' (OSP-RGBi). Each OSP-RGBi includes an IC integrating drivers, a temperature sensor, a memory unit, and a serial bus interface. This integration enables dynamic, animated lighting applications, enhancing the aesthetics and safety of vehicle interiors.

Valeo develops complete ambient lighting systems comprising optics, electronics, and software. The system enables RGB ambient lighting with high optical homogeneity and colour accuracy, while ensuring smooth light animation throughout the cabin.

Osram Senior Product Marketing Manager Hermann Senninger says, "Dynamic interior lighting is not just about enhancing vehicle aesthetics; it's about ushering in a new era of interactive and responsive environments that enhance the passenger experience. We are very impressed with the speed and competence of Valeo Lighting Systems worldwide. Their team expertly adapted the OSP-RGBi technology, delivering a compelling solution to their customer in record time—a process typically spanning two years, completed in just under one".

And Valeo Research & Development Vice President Christophe Le Ligné says, "Interior lighting being a key element of the onboard experience, dynamic applications open up a wide range of opportunities: from a strong brand signature to a highly personalized interior, while delivering visual information on vehicles' status and performance. Thanks to software, the system can be updated throughout the lifetime of the vehicle to deliver additional animations (new functions, personalization). In a fast-paced market such as China, ams Osram demonstrated professionalism and agility in delivering, on time, high-quality products to achieve customer satisfaction".

Osram 'Smart' Lighting, Sensing in Zeekr EVs

LIGHTING NEWS



The Zeekr MIX has ams Osram's Oslon Compact PL light sources in the high and low beam lamps. These SMT (surface-mount technology) emitters are the most efficient headlamp light sources in Osram's LED portfolio, producing up to 460 lm/chip @1A. Its optimized lead frame design also offers outstanding thermal management.

Other Zeekr models have more ams Osram products. For example, the Zeekr 009 and 007 have Osire E3731 I LEDs, which Osram say are 'intelligence empowered'. During the manufacturing process, the colour and brightness of each Osire LED is measured, and the data stored in the LED's on-chip memory. This lets automakers seamlessly conduct system calibrations. As a result, each LED in a network with hundreds or thousands of interconnected ambient lights exhibits unparalleled optical consistency and homogeneity. Zeekr's decision to partner with ams Osram is an acknowledgment of the supplier's leading technology and in-depth experience in vehicle lighting and sensing. This kind of coöperation with ams Osram empowers automakers to provide a more customized driving experience that fosters greater brand recognition.

Zeekr Supply Chain Vice President Cui Li says, "The lighting and sensing technology from ams Osram not only meets our stringent criteria for aesthetics and functionality, but also plays a crucial role in enhancing the overall market competitiveness of our vehicles".

Micro-Optics Summit and Expo '24

LIGHTING NEWS



By Michael Hamm, DVN senior advisor

PHABULOuS organized its first edition of the Micro-Optics Summit & Expo at the Beurs van Berlage in Amsterdam on 2 and 3 December, 2024. PHABULOuS is a part of the European Photonics Funding. It has received funding from the European Union's Horizon 2020 research and innovation program. For about 5 years the objective is to accelerate the validation of technologies and processes, to validate the services of a pilot line, and to establish a unique legal entity as one-stop shop.

During the research various elements of microoptics have been in focus, including:

- **Automotive functional lighting:** headlamps with uniform appearance in their on/off states, yielding a high beam and an asymmetric low beam with a homogenous light distribution and low stray light, low installation space, and low weight;
- **Transport interior lighting:** large-area direct-lit LED luminaires with improved luminance uniformity, thinner form factor and lower cost;
- **Freeform microoptics:** the ability to create (or even print) microoptical components designed with no symmetry constraints gives new chances. New ultraprecision machining in micrometre dimensions will enable new functionalities like non-symmetric illumination and especially miniaturization & integration.
- **Micro-OLED:** a new dimension to consumer's experience by providing the world's highest pixel density AMOLED microdisplays. The technology provides brightness enhancement and control of angular light emission, e.g. in see-through optical systems for wearable AR (augmented reality).
- **Virtual and augmented reality:** thin, freeform optical lenses with improved image resolution and reduced volume and field of view for VR/AR headsets.
- **Solid-state lighting:** LED downlights with tunable white light sources creating uniform light distributions in a very compact shape.

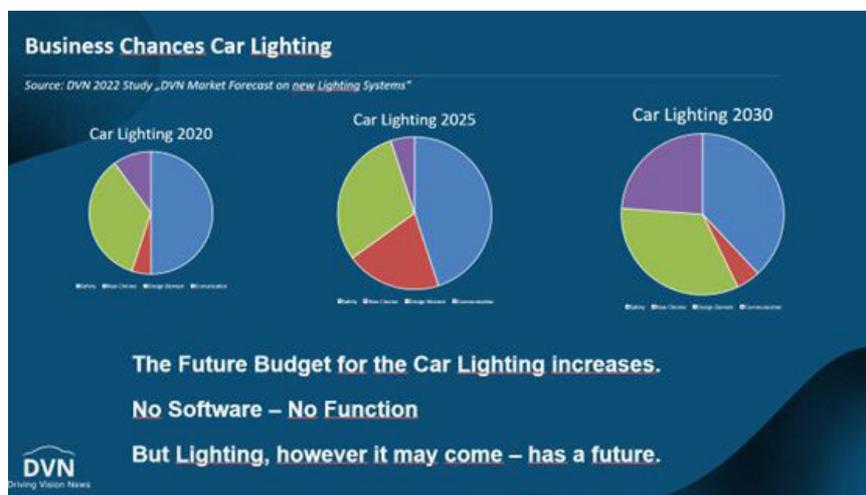
Here's a look at some of the research results presented at the conference:

Automotive Applications

DVN Senior Advisor Michael Hamm started the automotive session with an outlook on markets and technology. Especially this conference on microoptics with many startups and companies active in nanostructures, microoptical elements in 3D printing, roll-to-roll processes, and carving with femtosecond laser machines are part of the innovation process for new automotive applications. The market development shows interesting options for micro technology. Small and miniaturized functions would enable more design flexibility. New functions (small enough to integrate into the car body) will be enabled to improve safety. Especially ground projections—welcome lights, door-opening warnings, turn indicator projection, warning symbols, reversing lamp improvements, and more—will be possible with the help of microtechnology.



Only possible with microoptical technology: new safety contributions via lighting. In this case the idea is to warn cyclists about the turning intention of a large truck. Even when the truck driver has the obligation to take care, it is for sure better the cyclist should clearly see the truck's intent to turn.



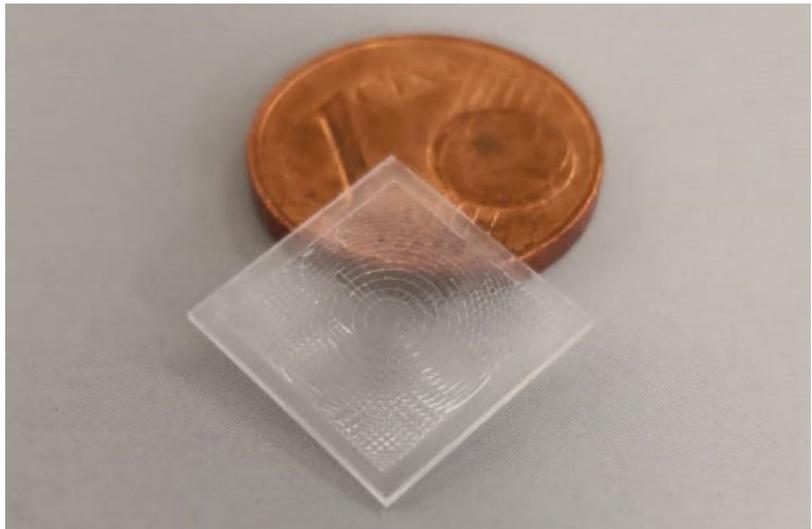
From 2022 DVN Study, "Market Forecast on New Lighting Systems"

Microoptics for automotive applications

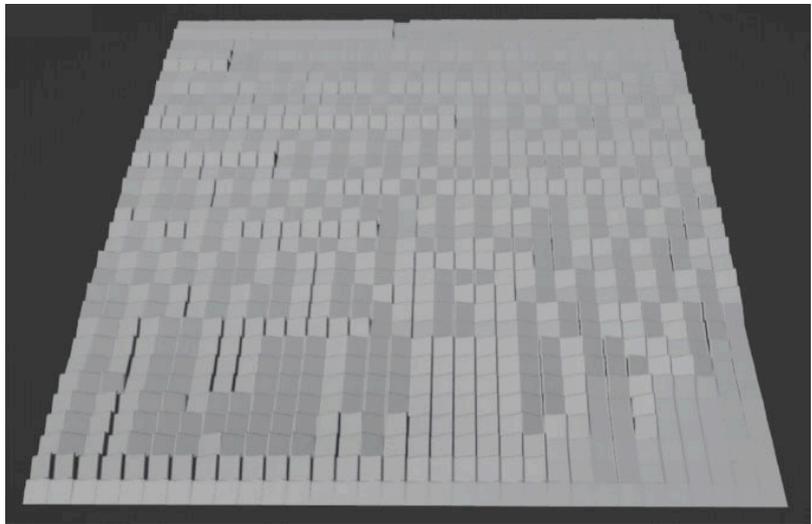
For the research project, the target was to combine primary and secondary lenses and shutters in one microoptical component. At the same time, the process of the pilot-line is being tested from design to replicated components.

The idea of the Helladesign is to use the light input side of the component as primary optics and the light output side as secondary optics to shape the light distribution. High- and low-beam distributions were investigated with different optical structures as part of the project. In initial testing, a micro-Fresnel lens was used on the first surface

and a freeform facet structure on the second surface. The figure below shows an example of a facet structure for generating a low beam distribution:



Double-sided freeform microoptic as small as a 1¢ coin, and thinner



A first state freeform microoptic with a structure of 300- μm facets to generate a low beam.

Project partner UPMT took over generation of the master of the Fresnel lens, and PowerPhotonic the mastering of the freeform microstructure. With their ultra-precise machining technique, UPMT produced an excellent shape and surface finish.

FFMOS FOR AUTOMOTIVE LIGHTING SYSTEMS
Challenges

Why don't we have a widespread use of Micro-optics in automotive applications?

- > Transfer from macro to micro scale
- > Manufacturing: Required structure sizes vs. manufacturing limits
Slope angles are a limiting factor especially for Fresnel-like / facet structures in the mid and upper μm -range

Sectional Cut of Triangular Micro-Structure

Height in μm

x-coordinate in μm

— Design — Sample

© 10 | Micro-Optics Summit - D. Karthaus - December 02, 2024

FORVIA
HELLA

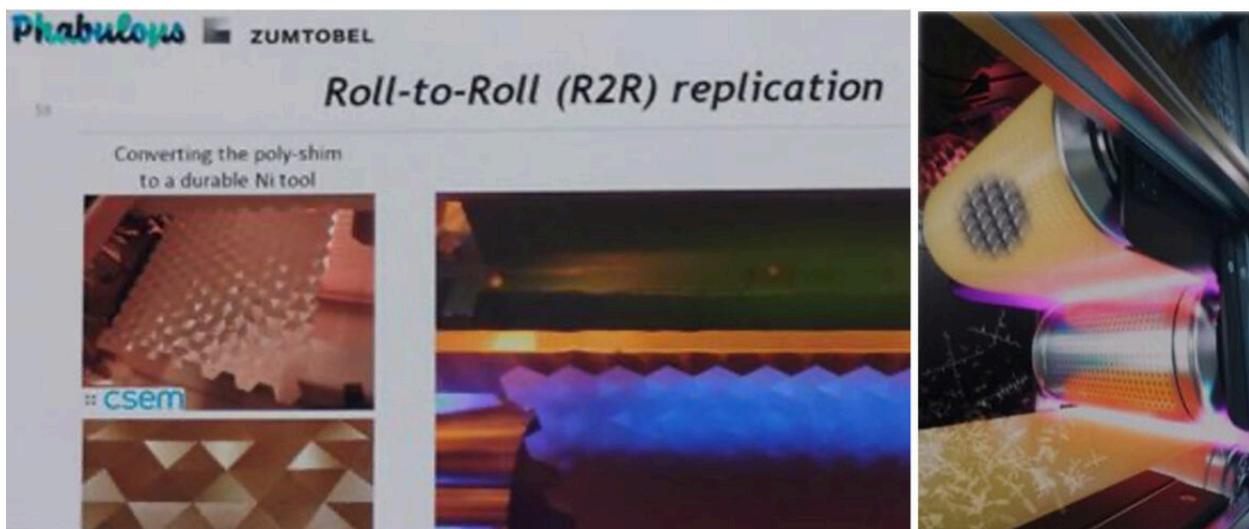
Forvia Hella showed big improvements and still big challenges to address

Hella's partners for the replication are Suss MicroOptics and Nanocomp. A special aspect of the replication was the combination of the two masters into one component. Even though the Fresnel lens generates theoretically parallel light, a high precision in the alignment of the optical surfaces to each other is required to avoid scattered light and a reduction of efficiency. This seems to be the biggest challenge in optical design.

New Applications: Freeform microoptics and roll-to-roll process

In many presentations the advantage of creating a mass production process was addressed. Freeform microoptics are extremely small, complex optical elements that enable precise control over light distribution and intensity. These optics are designed with non-symmetric surfaces, allowing for greater flexibility in shaping the light output.

In the context of lighting for mobility interiors, freeform microoptics play a crucial role in creating innovative lighting designs, enhancing passenger comfort, and improving safety. Joanneum Research, CSEM, Seisenbacher, Morphotonics, Nanocorp, Zumtobel, Swarovski showed their interesting approaches.

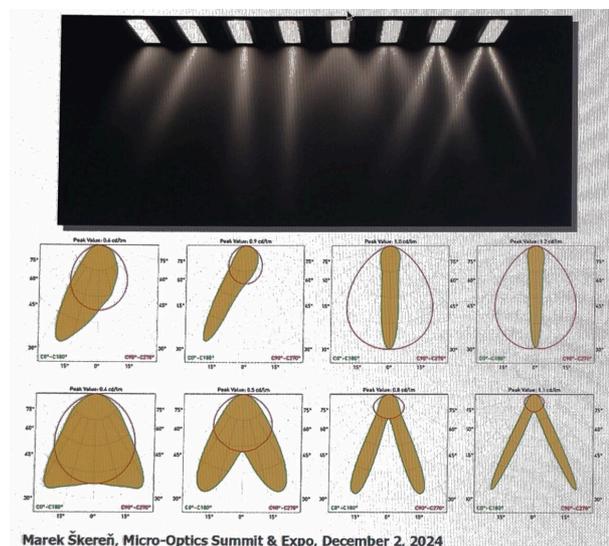


Zumtobel's project for roll-to-roll replications; Joanneum Research on roll-to-roll printing

The large-area roll-to-roll (R2R) and roll-to-plate (R2P) replication technologies offered by the PHABULO μ S line are very interesting for large-area products (for e.g. interior walls). The microstructures can be replicated cost-effectively with high quality. Results presented by Zumtobel.



Upscaled poly-shims by Joanneum Research



Marek Škereň, Micro-Optics Summit & Expo, December 2, 2024

flat optics for linear luminaires from NanoOptics

'Smart' transport interior lighting, combined with microoptics, can be used in various modes of transportation such as airplanes, trains, buses, and other vehicles. This is a significant gain for the entire industry, which, thanks to advanced LED technology, is also energy-efficient and environmentally friendly.

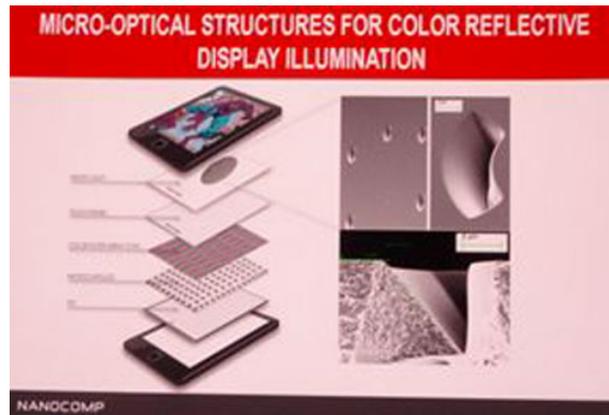
3D Printing and microoptical display structures

Another application is highly precise nanoprinting solutions. Maybe they will not be applicable in large-scale automotive applications, but the precision is worth a look.

A laser optic with outer size of some 100 μm was demonstrated. The inner optical elements showed to be much smaller. For displays, the optical output elements were in a range of 2 to 5 microns.



3D-printed laser optics—shown scale is 50 microns (=50 μm !) from Nanoscribe



microoptical structures for improved display illumination by Nanocomp, about 2 to 5 μm .

Renault 5 @ Maison Renault

LIGHTING NEWS



From June to September, it was possible to see the Renault 5 in Paris' rue saint Dominique. The exhibit presented the original 1972-'85 R5, and a new one from 2024, with a special focus on the lighting.

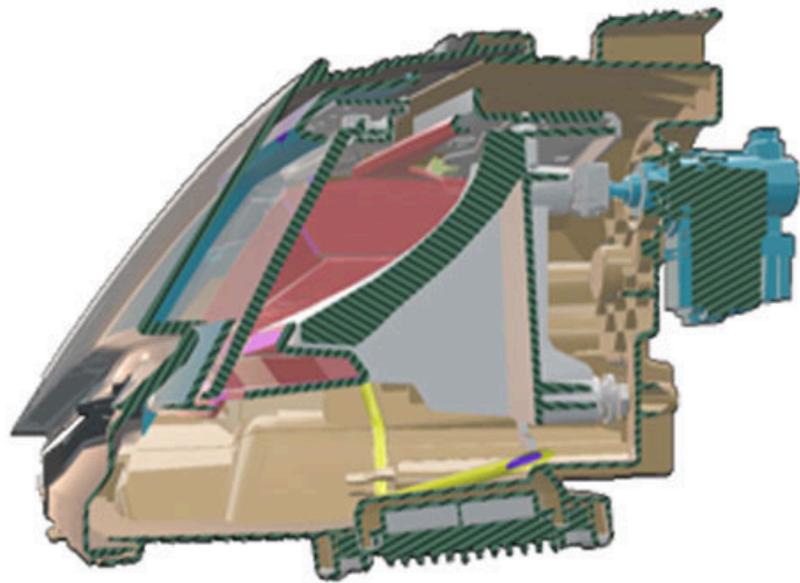


Renault have kept the rectangular headlamp shape and the split between lighting functions in the upper area, and signalling functions in bumper.

If you were a bit curious it was possible to see more details like headlamp labels and mounting concept on the bumper (With staples). There was interesting information presented, too. The lamps are made in France.



In the headlamps, the front position lamp is done by an integrated transparent inner lens with microoptics in front of low beam and high beam reflectors, as described by Francois Bedu, Renault lighting expert, at DVN's 2024 Munich event.



DBM Reflex gave us additional pieces of details about this microoptics; they collaborated with Valeo on the new Renault 5. Valeo contacted DBM Reflex on an early stage of a new lens design with microoptics for which they provided the optical prescription and 3D surface design.

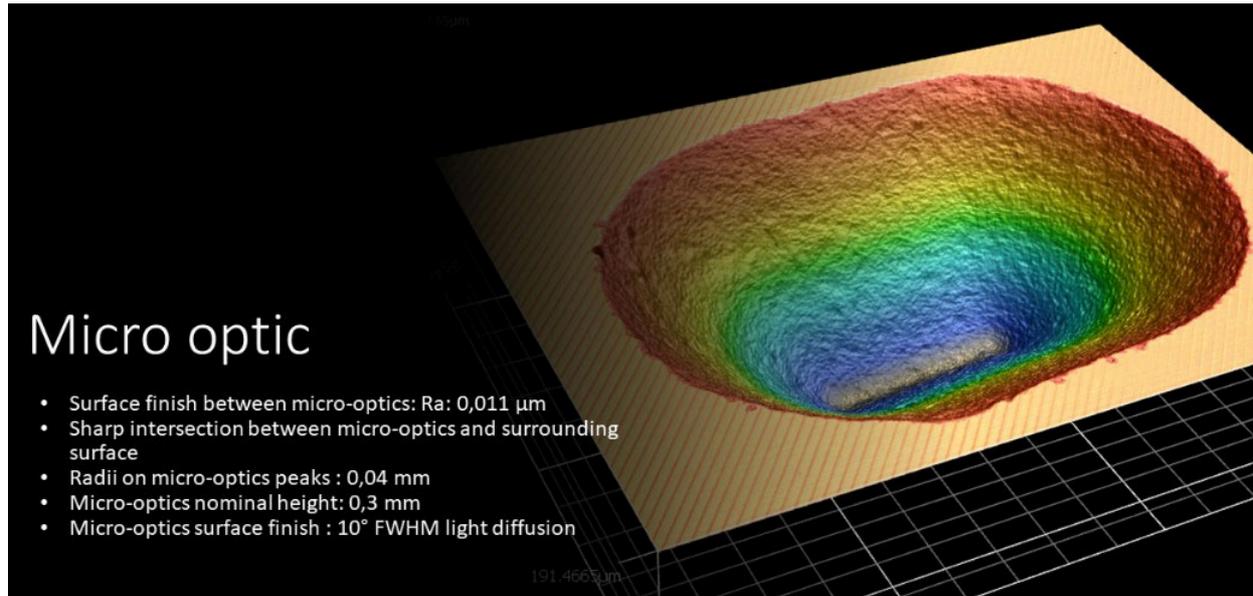
To guarantee precision, DBM Reflex provided a custom-machined plastic sample with the prescribed optics with a variety of optic density and surface finish qualities. This allowed to validate the optical performance and visual appearance of their design.

After getting validation for the prototype, stabilizing geometry and the surface finish specifications, DBM Reflex provided the injection moulding inserts for the series production moulds, ensuring seamless transition into large-scale production.

Some additional details about geometry specifications:

- Surface finish between microoptics: Ra 0.011 μm

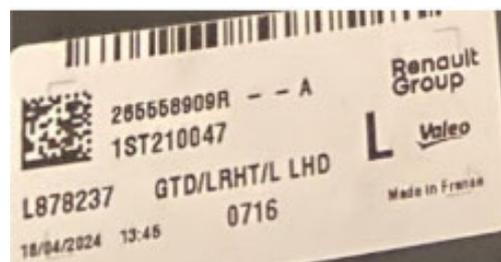
- Sharp intersection between microoptics and surrounding surface
- Radii on microoptic peaks: 0.04 mm
- Microoptic nominal height: 0.3 mm



A similar approach can be seen at the rear of the car. The previous car's upper grille space is now taken by the rear lamp to provide stop, tail, and turn indicator functions.



The rear lamps, too, are produced in France.



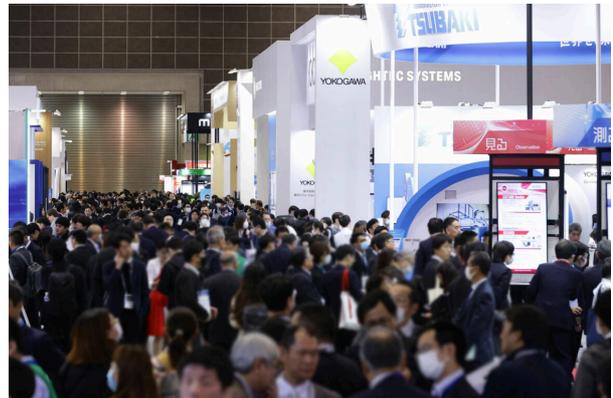
General News

Semicon Japan 2024

GENERAL NEWS



Semicon Japan, at Tokyo Bi Sight, gathered more than 1,100 exhibitors and organizations on 11-13 December. On the first day there was an opening session.



Ajit Manocha, president and CEO of SEMI, said, "The third trend following IoT and AI is the era of quantum. Through these three trends, the semiconductor industry will grow strongly and reach USD \$2tn by 2040". On the other hand, the keyword for 2024 was "uncertainty," and that "geopolitical risks are particularly increasing, and there are concerns about supply chain problems resulting from this. The semiconductor industry is entering an unpredictable era." However, even in such circumstances, semiconductor investment continues to accelerate, and he explained that 108 new factories will be built around the world by 2027. He also said that this is not enough, and that 50 more factories are needed by 2030. "11 out of the 108 will be built in Japan. This number is quite important as it represents expectations for Japan. There is a good chance that some of the 50 factories that are said to be lacking will be built in Japan," emphasizing the importance and attention of Japan in semiconductor manufacturing.

Shigeru Ishiba, Japanese Prime Minister gave a video message. He cited the economic impact of attracting TSMC's factory to Kyushu, saying that semiconductors will be key. The government has announced its intention to provide more than 10 trillion yen in public support for the AI/semiconductor field by 2030. Prime Minister Mr. Ishiba emphasized that the government will fully support semiconductor investment.

Akira Amari, a former member of the House of Representatives and Honorary Chairman of the LDP Semiconductor Strategy Promotion Parliamentary League made a speech. The speed has been the top priority in semiconductor policy. Looking back on six or seven years ago when I became involved in the semiconductor industry, the government's response was quite shabby. Now, the prime minister is giving keynote speeches and sending video messages. I hear that this year's SEMICON Japan will be the largest ever, suggesting that the tide has completely changed. Furthermore, he said about the semiconductor industry, Today's number one does not guarantee tomorrow's number one. How fast the speed of competition is! Only companies that have the tension to catch and incorporate changes in innovation, and the fear (of being overtaken), are guaranteed a future. We are entering an era in which two of the common sense of the semiconductor industry will be overturned. The first common sense is that fabless semiconductor manufacturers will dominate this world, which he quickly denied, saying, I don't think so. Currently, Nvidia holds a large share of the AI semiconductor market, but there are always companies looking for an opportunity to enter the market. He then sounded a warning that it was too risky for TSMC to be solely responsible for the manufacturing of cutting-edge semiconductors such as the 3nm process. He said that the key is how to create a foundry with technology equivalent to or close to that of TSMC, and expressed his expectations for Rapidus, a Japanese semiconductor manufacturer. The second common sense is that up until now, the front-end process has been responsible for improving the added value of semiconductors, but "in the future, that role will be played by the back-end process. The back-end process will be responsible for innovation."

Takeaways from the exhibitors:

- **Disco** had the largest booth at the exhibition, showcasing a wide range of applications through displays of precision processing equipment, precision processing tools, and processing samples.
- **Advantest** is known for developing test equipment for Nvidia's 'AI' semiconductors. They develop and provides cutting-edge measurement technology.
- **Towa** has strengths in moulding equipment that electrically insulates and seals semiconductors from the outside. They hold top global market share in this field and will introduce technologies for advanced packaging that will be used in generative 'AI' and other applications.
- **Rapidus** was founded in August 2022 and subsidized by the Japanese government. They manufacture cutting-edge semiconductors. Their main business activities include research, development, design, manufacture, and sales of electronic components such as semiconductor elements and integrated circuits. At the Rapidus booth, there was an update on the progress of IIM*-1, a facility currently under construction in Hokkaido for the development and production of cutting-edge semiconductors; an overview of the mass-production-compatible EUV exposure tool that will be installed at IIM for the first time in Japan within the year; and 2-nm GAA (gate-all-around) prototype wafers, for which mass production technology is being developed in Albany, New York, together with IBM.
- Ion Technology, part of Sumitomo Heavy Industries, presented ion implantation equipment for medium current, high current, and high energy. Next year, the company will launch an ion implantation equipment for silicon carbide (SiC) power semiconductors.

To go further ...

Stanley Electric's Light Tunnel

To go further ...

It's only 30 seconds long, but an [online video](#) gives a quick, entertaining peek at Stanley's light tunnel and the things they use it for. Give it a look!

