NICHIA

DVN
Driving Vision News

DVN Report: Nichia

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DVN
Driving Vision News

1.0 EXECUTIVE SUMMARY

LEDs are a dominant lighting technology, having replaced most competing light sources in many applications. This revolution, which has led to so much progress in the performance and design of lighting in cars, can be attributed largely to Nichia's pioneering innovations. For example, Nichia commercialized the very first high luminous blue LEDs in 1993 and officially produced the first ever white LEDs in 1996.

Founded in 1956 by Nobuo Ogawa, Nichia has remained family-led with current President, Hiroyoshi Ogawa (Nobuo's grandson), now guiding its successful growth. You can read an exclusive DVN interview with him in the following pages of this report. The company's long-standing leadership ensures continuity and strategic focus on innovation and development. Indeed, Nichia has remained prudent, focusing on its core businesses while steadily advancing new technologies.

Nichia operates six factories in Japan's Tokushima Prefecture on the island of Shikoku, the smallest of Japan's four main islands. Clearly, the company has considered the logistics involved in manufacturing and distributing compact electronic components from these locations, ensuring efficiency in both production and transportation whilst taking steps to mitigate against natural disasters. To reduce costs and increase operational efficiency, Nichia integrates its phosphor production and a significant portion of its Metal-Organic Chemical Vapor Deposition (MOCVD) machine production in-house.

The company's primary research and development center is also in Tokushima, with additional R&D facilities in Yokohama and Nagano. Additionally, there is a newly opened Nichia Automotive Innovation Center in Aachen, Germany. By the end of 2023, Nichia employed 9,353 people globally (which includes sales offices around the world).

Originally focused on chemical products, Nichia's early work on phosphors for fluorescent lamps laid the foundation for its future LED innovations. Today, Nichia produces a range of materials, including cathode substances, phosphors, and fine chemicals. However, its primary focus is now optoelectronics, particularly LEDs, laser diodes, and optical semiconductor devices.

For LEDs, Nichia believes most of the improvements in energy efficiency have been achieved, with current levels at 200 lm/W compared to a theoretical maximum of 270 lm/W. The company now focuses on improving light quality, specifically the spectrum, for interior lighting applications.

Nichia has found recent success with its *μ*PLS Micro Pixelated Light Source, a technology enabling advances in high-definition adaptive driving beam (ADB) systems. The company entered the microLED automotive market just recently, quickly making significant strides. It became the first to market in 2023, equipping a Porsche Cayenne with over 16,000 microLEDs, in collaboration with Infineon, enhancing both resolution and cost efficiency.

In contrast, whilst the use of lasers in general lighting is declining, Nichia is exploring several other automotive applications where laser technology is performing well and further success can be attained, such as heads-up displays (HUDs) or other advanced driver assistance systems (ADAS) applications. The company plans to expand its range of RGB lasers to support these applications.

2.0 ABOUT THE AUTHOR

Paul-Henri Matha DVN CEO & General Editor Lighting

Engineer at Mines Saint Etienne in 2000.

15 years in Renault France in the lighting department, from project leader position to lighting expert.

5 years in Volvo cars Sweden as exterior lighting, technical leader.

Member of SAE lighting expert group.

Previous Member of GTB, chairman of working Group installation and co-chair of working group Strategy.

President of SIA VISION Congress.

Member of IFAL organization committee.

Member of ISAL organization committee. More than 10 patents in lighting.

Jean-Paul Ravier DVN Senior Advisor

Jean-Paul Ravier graduated from ISAE SUPAERO and IAE Paris. He worked for over 41 years at Valeo, including 29 years at Valeo Lighting where he held a variety of management positions first in IT and finance, and then in R&D, projects, and innovation, including in Japan from 2005 to 2009 at Ichikoh as a board member and managing director. He retired from Valeo in 2013. Shortly thereafter he was appointed chair of the ELS program (Embedded Lighting Systems) for Advanced Master training and Research in Lighting at the Institut d'Optique Graduate School, ESTACA and Strate School of design. He held that position through the end of 2017 and is now a Senior Advisor for DVN.

3.0 ABOUT DRIVING VISION NEWS

DVN is the vehicle lighting and ADAS industry's journal of record, dedicated to keeping the community informed and communicating about the latest progress and developments.

DVN's three pillars are:

• Technological watch on new emerging technologies, with weekly electronic newsletters bringing news, analysis, and crucial information on innovation in lighting, ADAS, and smart car interiors; there are also monthly technical reports with sharp focus on cutting-edge technologies, company profiles, regulatory matters, and other relevant content available only from DVN.

• Networking of high-level decisionmakers, researchers, innovators, practitioners, academics, and regulators to make new business connections with two workshops per year in rotating locations throughout America, Europe, China, Japan, India, and Korea. DVN Workshops gather over 400 participants.

• Promotion of innovations from DVN's 250 member companies—we facilitate the promulgation of knowledge of innovation, which in turn paves the way for commercialization, enabling to build new relationships through DVN Community to forge new business worldwide. The DVN Gold membership roster includes 180 companies including automakers; lighting and ADAS tier-1 and -2 suppliers, and a wide variety of universities; research outfits, and consultants. DVN Gold members receive all publications and attendance privileges at all DVN Workshops.

4.0 ABOUT NICHIA

4.1 Brief overview

Nichia Corporation, headquartered in Tokushima, Japan, is a global leader in the development and production of a variety of high-performance materials, components and devices, focusing primarily on the key areas of light and energy. Established in 1956, the company began by processing calcium compound materials for the pharmaceutical industry to treat tuberculosis after the Second World War. Soon thereafter, Nichia began producing phosphors for various applications including fluorescent lamps, CRT, and X-rays, and has since expanded its portfolio to include LEDs, laser diodes, cathode materials for lithium-ion batteries, and magnetic materials.

Nichia is especially renowned for its pioneering role in the development of high-brightness blue LEDs and white LEDs, breakthroughs that have significantly impacted lighting and display technologies worldwide.

Corporate Philosophy: "Ever Researching for a Brighter World"

Nichia places a strong emphasis on research and development, with significant investments in both basic and applied research. The company boasts a huge collection of important patents and continues to push the boundaries of lighting and energy saving technologies. It collaborates with academic institutions and research organizations globally, fostering an environment of continuous innovation and development.

Nichia's influence extends worldwide, with several international subsidiaries and offices, including Nichia America Corporation, Nichia Shanghai Corporation and Nichia Europe GmbH. These branches ensure that Nichia's advanced technologies and products are available to a global customer base, supporting various markets including the automotive industry.

4.2 Company Data

Company Name	Nichia Corporation
HQ Location	Anan-Shi, TOKUSHIMA, JAPAN
Website:	www.nichia.co.jp/en
Established	December 1956
Paid-up Capital	JP¥52,026,441,000
President	Hiroyoshi Ogawa
Employees	9,353 employees (As of December, 2023)

Main Business: Chemicals, Cathode Materials, Magnetic Materials, Phosphor, Organometallic Compounds, Fine Chemicals (Electronics Materials, Pharmaceutical Materials, Food Additives), Vacuum Evaporation Materials, Semiconductor Materials, Optoelectronics, LED (Light-Emitting Diodes), LD (Laser Diodes)

Plants	**Headquarters**
	491 Oka, Kaminaka-Cho, Anan-Shi, TOKUSHIMA 774-8601, JAPAN (All in Tokushima Pref.)
Aratano plant (A-PLANT)	3 Nyuta, Aratano-Cho, Anan-Shi, TOKUSHIMA 779-1510, JAPAN
Tatsumi plant (TN-PLANT)	1-19, Tatsumi-Cho, Anan-Shi, TOKUSHIMA 774-0001, JAPAN
Tatsumi plant (TS-PLANT)	1-1,Tatsumi-Cho, Anan-Shi, TOKUSHIMA 774-0001, JAPAN
Tokushima plant (V-PLANT)	224 Hiraishi, Ebisuno, Kawauchi-Cho, Tokushima-Shi, TOKUSHIMA 771-0132, JAPAN
Naruto plant (N-PLANT)	38-2, Kawamukoichi, Ichiba, Oasa-Cho, Naruto-Shi, TOKUSHIMA 779-0315, JAPAN
Domestic Sales Offices	Tokyo Sales Office Osaka Sales Office Nagoya Sales Office
R&D Centers*	Tokushima Research Center (Tokushima Pref.) Yokohama Research Center (Kanagawa Pref.) Suwa Technology Center (Nagano Pref.)

Overseas Locations: United States (Detroit, Los Angeles, Atlanta, San Jose), Germany (Frankfurt), China (Shanghai, Shenzhen), Taiwan (Hsinchu) Korea (Seoul) Malaysia (Selangor), Singapore, Indonesia (Jakarta), Thailand (Bangkok), Vietnam (Ho Chi Minh city), India (Gurgaon)

*In 2024, a new R&D facility – Nichia Automotive Innovation Center – opened in Aachen, Germany.

4.3 Business Units

Nichia is made of multiple business units which work in collaboration with the production sites, R&D institutions, sales, and indirect divisions at the company.

CATHODE MATERIAL BUSINESS UNIT

Development of Cathode Materials

Development of cathode materials for Lithium-ion batteries and development of next-generation materials

Manufacturing of Cathode Materials

Manufacturing of cathode materials for Lithium-ion batteries

Others

Battery material business planning, procurement, and worldwide sales

OPTOELECTRONICS PRODUCT BUSINESS UNIT

Development of LED/LD Products

Development, material development, manufacturing process development, and package development for LED/LD products

LED/LD manufacturing, production technology

Development of Applied Products

Development of light source modules

Others

LED/LD business planning, procurement, and worldwide sales

FUNCTIONAL MATERIALS BUSINESS UNIT

Development and Manufacturing of Functional Chemicals

Development and manufacturing of magnetic materials, phosphors, organometallic compounds, etc.

Gallium Metal and Infrared Epitaxial Wafer Manufacturing

Gallium metal and Infrared epitaxial wafer manufacturing

Others

Manufacturing of epitaxial growth substrate for use in LED/LD

NICHIA RESEARCH INSTITUTE

R&D

Basic research on technologies and materials related to light and energy

OTHER UNITS

Plant Engineering

Design and development of equipment made in-house

Process Technology

Design and development of tooling and glass lenses

Quality Assurance

Inspection/analysis of the products, quality assurance/ management, customer support

Administration

General affairs, human resources, human resource development, accounting, etc.

Legal & Intellectual Property

Intellectual property rights and contractual practices throughout the world

IT Systems

Internal IT system development and management, AI, IoT, big data, robotization

Environment and Safety

Environment, safety and health management

5.0 INTERVIEW WITH NICHIA PRESIDENT & CEO, HIROYOSHI OGAWA

DVN: Tell me more about yourself, your family and your involvement with Nichia.

Born in 1966, I grew up in the neighborhood of Nichia's headquarters in Anan, Tokushima. I spent my childhood there until I moved to Tokyo at the age of 18 to attend university. I graduated from the Faculty of Economics at the University of Tokyo in 1988 and subsequently worked at Mitsubishi Electric for five years.

In 1993, I joined Nichia Corporation, and in November of that year, Nichia made a groundbreaking announcement: the world's first high-brightness blue LED using Gallium Nitride.

My family has a long history with Nichia; my grandfather was president when I was born in 1966, the same year Nichia began mass producing phosphors for fluorescent lamps. The current chairman served from 1989 to 2015. Since the spring of 2015, I have had the honor of serving Nichia Corporation as its president.

DVN: What are the challenges faced by LED makers? How do you see the automotive lighting market evolving and what will be the maximum threshold for lm/W efficiency?

While the theoretical maximum efficiency of LEDs is around 270 lm/W, many companies are already mass-producing products that exceed 200 lm/W. At this level, further efficiency competition becomes less significant. Instead, the focus should shift to the benefits of switching from traditional light sources (bulbs and tubes) to solid-state light source, as well as the quality of light, focusing on the spectrum.

The challenge is not only how to transform and evolve traditional lighting with solid-state light sources such as LEDs and Laser Diodes, but also to enhance the quality of light, rather than merely increasing the quantity of light measured in lm/W.

In automotive applications, the electrification of vehicles requires the development of more efficient lighting and signals with lower power consumption using solid-state light sources. This is related to our concept of μPLS (Micro Pixelated Light Source), a lighting system for automotive lighting that serves both as illumination and a form of Human Machine Interface. It can project signals and messages, functioning as more than just simple lighting—it also acts as a projection system. We are focusing on what can only be accomplished with solid-state light sources like LEDs or Laser Diodes.

DVN's Paul-Henri Matha (left) with Nichia President and CEO Hiroyoshi Ogawa

Beyond automotive applications, we offer products that adjust the circadian rhythm to contribute to comfortable living environments. These products can change their spectrum according to the time of day. In terms of design, we call these 'Stealth Downlights'. What the market demands for lighting fixtures is that they remain as invisible as possible. We believe this principle applies to automotive headlights as well; the lighting units should be as discreet as possible. In fact, hidden lighting units can unlock new design possibilities.

*μPLS Pixeled Light Source, 16,384 μLEDs integrated together with a driving ASIC.

DVN: Can you go into more detail regarding the difference with general lighting (200+ lm/W) and automotive (160 lm/W). Why do we have this difference? Also, which efficiency does Nichia target for 2030?

Regarding these differences, the structure varies depending on the lighting equipment. Generally, indoor lighting fixtures still have enough space to use several LEDs and cannot accommodate large heat sinks, so they are used in relatively efficient current ranges. In automotive lighting, especially in headlights, there is no space to spare, so each LED is used with a higher current, which results in lower efficiency. Efficiency is important, but Nichia believes that improving quality of light, rather than just engaging in an efficiency competition, ultimately benefits the customers and the market.

Additionally, it is crucial to understand that not only LED efficiency but also the overall improvement of the lighting fixture's performance is important in the end.

The target value for efficiency by 2030 is approximately 240 lm/W.

DVN: What do you mean by 'stealth'?

Stealth in this context simply means as invisible as possible. Additionally, through task and ambient lighting, which deliver necessary light to where it is needed, we contribute to energy saving. We believe that our challenge is to continue developing LEDs and Laser Diodes that can contribute greater values in fields other than automotive applications, too.

DVN: Can you tell me about the evolution of the Laser market and innovations at Nichia in this area?

Laser diodes were once used primarily in Europe for additional high beams, but their demand has been decreasing. The need to illuminate distances over 1 km with additional high beams has not been as significant as initially anticipated. Similar to aforementioned Stealth Downlights, the key feature of laser headlights is that they can be miniaturized even more than LEDs. Interestingly, lasers have also gained momentum in other industries, starting with blue pickup lasers for Blu-ray and other optical memory devices, and later in projectors and cinema applications. This technological crossover highlights the versatility of laser diodes as very small light sources with high brightness, which we expect will further expand their potential in future automotive uses.

In the domain of Human Machine Interface, while LEDs are predominantly used for HUD light sources, Laser Diodes are emerging as a superior option for projectors. This shift is expected to gain momentum in the coming years. Additionally, as ADAS (Advanced Driving Assistance Systems), continue to develop, there is a growing market trend to utilize laser projection functions in both white and RGB formats as ADAS evolves. Recognizing this evolution, we aim to provide RGB Laser Diodes for automotive applications.

Of course, ADAS is used in a variety of ways to enhance vehicle safety and improve driving convenience. For example, the technology assists drivers to maintain awareness of a car's surroundings, including the distance to vehicles in front, behind, and on either side, while helping to keep the vehicle aligned centrally. This includes systems such as adaptive cruise control, lane-keeping assistance, and collision avoidance. Additionally, ADAS can extend to the interior of the vehicle, providing features like alerts when the car ahead becomes too close or overtaking is blocked by a fast-approaching vehicle.

Expanding beyond automotive applications, there are niche markets for Laser Diodes in various industrial applications, measuring instruments, medical devices, and light sources for 3D printers. With the rise of vehicle electrification, the demand for copper materials has increased, highlighting the importance of copper metal processing. Given copper's absorption properties, short-wavelength blue Laser Diodes are more effective light sources than the traditional infrared Laser Diodes, particularly in Laser Welding applications where high precision is needed. We are focusing the development of these diodes. Our current focus is on hybrid of blue and infrared Laser Diodes. Besides visible light applications, we will continue to explore new areas in metal and other processing applications.

How does Nichia secure production of LEDs, including wafers, to avoid shortages, and how does the business handle geopolitical risks?

Several years ago, when many companies experienced parts shortages, Nichia remained unaffected. We have consistently maintained sufficient capacity and inventory levels to meet demand.

Fundamentally, we focus on developing comprehensive databases for our supply chain and enhancing traceability management. This effort extends to our suppliers, their suppliers, and even up to the third-tier suppliers, although this process is ongoing.

Regarding the in-house production of key raw materials and components necessary for LED production, while we do source from external suppliers, we are also advancing the in-house production of important industry components within the industry.

In addition to components, we also internalize the production of equipment, including the Metal Organic Chemical Vapor Deposition (MOCVD) system used to form the emitting layer of LEDs.

However, it is impractical to completely end sourcing raw materials from regions with potential geopolitical risks. For resources being developed outside of China, we are willing to accept slightly higher costs to ensure procurement. By utilizing various procurement routes and by maintaining adequate inventory within the supply chain, we aim to minimize geopolitical risks.

DVN: Is equipment such as the MOCVD system produced in-house?

While we do purchase new equipment occasionally, most of it is produced in-house.

Given the relatively small size of optoelectronic devices—unlike cars— we can efficiently manage costs and minimize supply chain risks by concentrating production in this region. We consistently maintain sufficient capacity to meet market demands, so we do not feel the necessity to establish new production bases in Europe or the United States, nor do we have any plans to do so.

Our factories for automotive LEDs and Laser Diodes are equipped with earthquake-resistant or seismic isolation structures. At the Tatsumi factory, which you will visit today, we have implemented tsunami safety measures, including cooperation with national and prefectural authorities to construct levees. Additionally, we have elevated the building as a precaution. We are striving to establish a production system that maximizes efficiency and safety by concentrating operations in this region.

What is Nichia's strategy for sensors such as Led IR and lasers for Lidar?

Currently, our product portfolio does not include Lidar, IR LEDs, or IR Laser Diodes. While the market primarily demands light sources, we have received inquiries about our plans for sensor technology. We have successfully produced red Laser Diodes in-house, and using the same material system, we can extend production to near-infrared (around 1,000 nm). This development provides us with technical foundation to produce both red and near-infrared Laser Diodes and LEDs in the future.

What is Nichia's strategy for combined LED + LED IC (like microLED development with Infineon)?

We are proud to announce that Porsche has adopted our Intelligent Lighting technology for one of their applications. We believe that the potential for expansion of both applications and lineup will be significantly enhanced by strengthening our collaboration with Infineon through our existing alliance.

Additionally, while we are slightly behind our competitors in terms of the lineup of RGB LEDs with IC, we plan to expand our lineup of these general LEDs with IC, alongside our innovative and advanced products.

Nichia Tatsumi Plant

DVN: In terms of trends for display and different technologies used (Mini LED, microLED, and OLED), what is Nichia's strategy and what will the business offer?

We consider that the unchanging value required for automotive displays is safety, meaning visibility as an information display device is the most important aspect.

As for the display application, we have structured our lineup based on different distances. The key elements for all these Nichia solutions are the provision of high brightness and visibility.

Our strength as a light source manufacturer is the ability to consistently offer a comprehensive lineup of high-performance products supporting automotive display applications.

In response to your question about OLED, while it has seen partial adoption, we believe that LCD currently offers more advantages for automotive display applications. This assessment considers factors such as high brightness essential for visibility, as well as reliability, cost, supply chain, stability and power consumption. We are actively developing thin, high-brightness LED products specifically designed for automotive backlighting.

Our showroom features μLEDs, and we have successfully commercialized displays in the several hundred-inch class. However, their adoption for automotive use will require extra time, primarily due to cost considerations. A significant breakthrough is needed for wider implementation.

Nonetheless, μPLS technology, with its self-emitting system, offers many advantages such as a wide color gamut and low power consumption. We are committed to continuing our internal research and development in this area.

"The key elements for all these Nichia solutions are the provision of high brightness and visibility."

In terms of in-car information displays, there are various applications including Laser Diodes. We plan to continue developing new applications to enhance the functionality and efficiency of these systems.

DVN: Following your points on interior displays, are you also considering their use for exterior applications?

As a potential application, we consider Car Body Lighting, but there are challenges including cost and reliability.

DVN: What do you think about LED competition with new entrants from China. How does Nichia imagine that it will compete with such companies and more intense price competition in the future?

We recognize there is potential for various situations that could arise based on OEM perspectives. Particularly for cars developed and sold in China, many parts might be used without our awareness. China is such a vast market, but for products that can be sourced domestically, we anticipate increasing challenges in selling our products there.

On the other hand, competition within China is intense, and there is a trend to adopt the latest technologies even faster than Europe or Japan. If we can provide products that Chinese LED manufacturers cannot, we believe there is room for us to capture the high-end market in China.

Besides China, large markets such as India and ASEAN, where Chinese LEDs will likely to be prevalent. However, outside of China, we believe our standard LEDs and production systems, particularly in terms of quality and reliability, have an advantage over Chinese new players. In markets outside of mainland China, while we may not be able to compete on price, we are confident in our ability to compete in terms of innovation with the quality and performance of our latest technology products as well as our standard mass-produced items.

5.1 COMPANY STRATEGIES, MISSION AND VISION

Nichia's Mission:

'Through continuous creation of innovative key materials and devices in the fields of light and energy, Nichia will add a new value to life and contribute to society.'

Nichia's corporate philosophy is built on the foundations of its mission to create the world's best products, leveraging the collective knowledge, talent and expertise of all its employees. The company continues to make a significant planet-friendly contribution to society by continuously researching and developing products that lead to a 'brighter world'.

Nichia Corporation's founder, Nobuo Ogawa, aimed to use limestone from Tokushima to produce pharmaceutical materials. Over time, Nichia has expanded from calcium compounds to a wide range of products, including phosphors, LEDs, laser diodes, battery materials, and magnetic materials. The company's enduring belief is that it can continue to create the finest products globally through determination and dedication, utilizing the collective technology and expertise of its employees.

The Nichia Way

Nichia employees have consistently embraced the vision and decisions of the company's founder and management team. To cultivate the brand effectively, the company has organized its foundational elements—spirit, history, core beliefs, and work ethic—into three key categories: Corporate Philosophy, Mission, and Work Principles. The Nichia Way encapsulates this approach, enhancing corporate culture and organizational capabilities by leveraging Nichia's distinctive strengths.

Success has been founded on principles of embracing continuous challenges, enhancing credibility and collaborating diligently with colleagues, teams in other business units and industry partners. This collective effort has shaped Nichia's identity.

This belief has driven Nichia to become a leader in lighting, clearly demonstrated by its innovation in high-brightness blue LEDs and white LEDs. The company continues to focus on studying and better understanding the fundamental nature of light and pursuing the ultimate quality in its products, with the overarching goal of contributing to a brighter future through continuous research and innovation.

5.2 LED INNOVATIONS AND COMMITMENT TO MONOTSUKURI

As stated earlier, Nichia operates under the philosophy of monotsukuri, a Japanese term that translates to the 'making of things' and represents the concept of manufacturing. It broadly encapsulates a blend of technological skill, practical knowledge, and the ethos of Japan's manufacturing traditions.

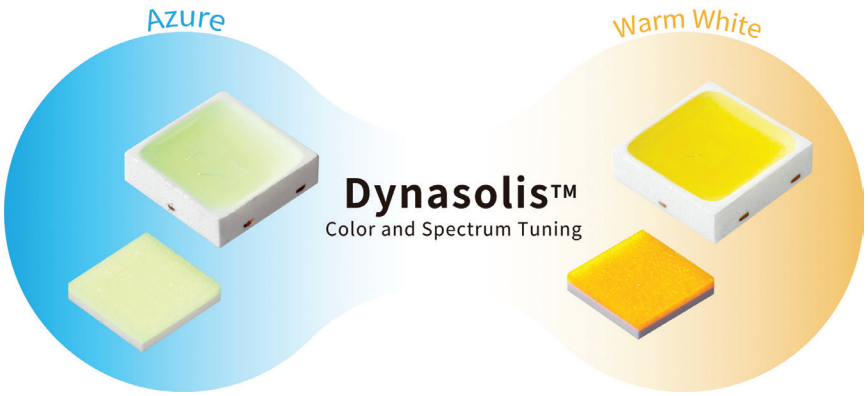
The commitment to monotsukuri has undoubtedly contributed to Nichia Corporation making so many remarkable advancements in LED technology, focusing on enhancing the quality and shaping of light beyond traditional metrics of brightness and efficiency.

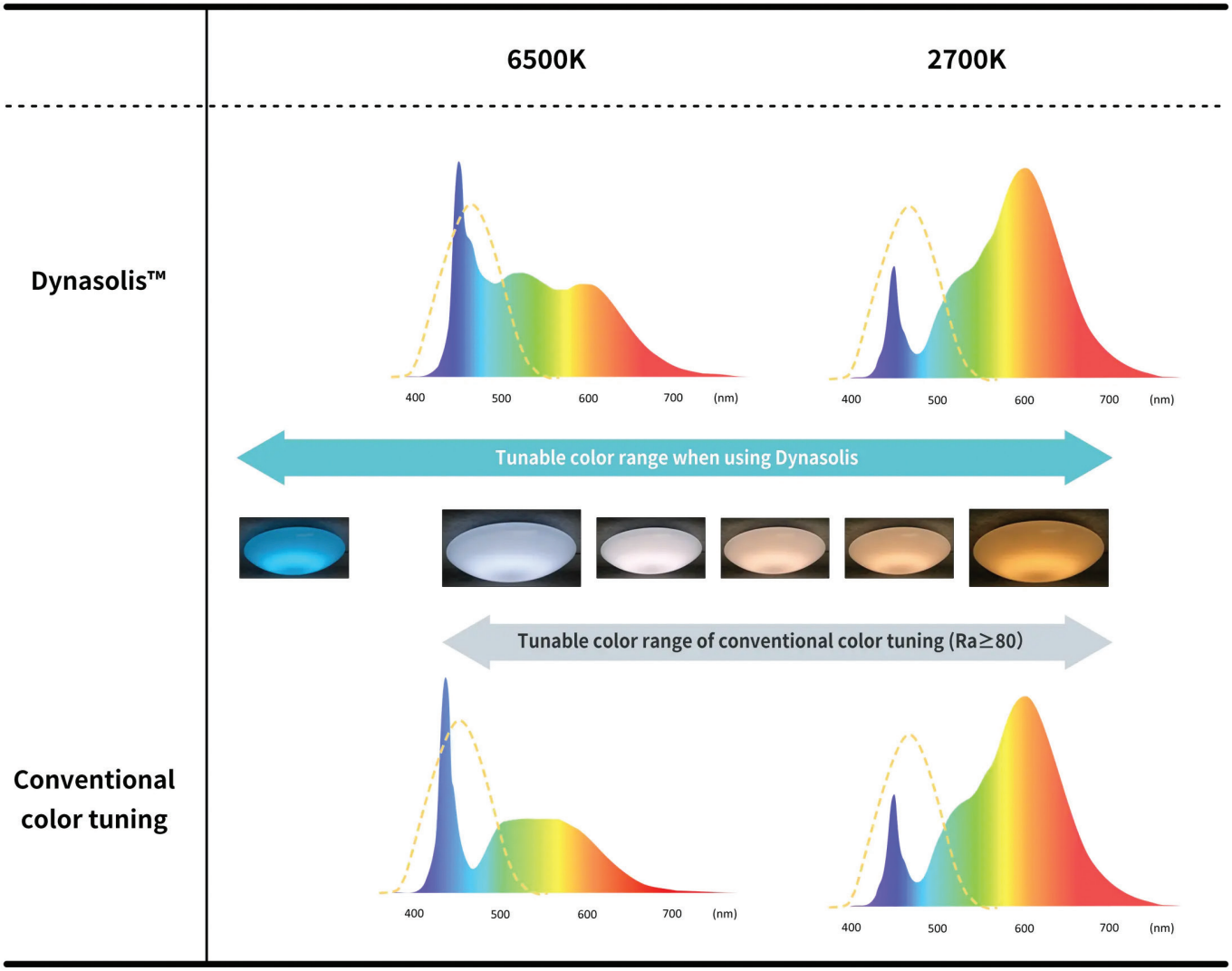
For example, Nichia has pioneered several cutting-edge technologies in automotive lighting, significantly impacting vehicle safety and aesthetics. One notable innovation is the high definition microLED matrix solution developed in collaboration with Infineon Technologies.

This system integrates over 16,000 microLEDs for adaptive driving beam applications, providing precise and efficient road illumination. Additionally, Nichia's contributions include laser diodes for adaptive headlights. More details on these innovations will be provided later in this report.

"The commitment to monotsukuri has undoubtedly contributed to Nichia Corporation making so many remarkable advancements in LED technology."

Beyond automotive applications, Nichia's expertise extends to general lighting, where they have introduced several groundbreaking products. The award-winning Optisolis™ LED series, for instance, offers a spectrum close to natural light, making it ideal for environments requiring high color accuracy, such as museums and art galleries. This innovation ensures high color rendering (Ra98-99) with minimal UV emission, thus protecting illuminated objects from UV degradation.





Nichia's Circadian Tune LED technology further exemplifies their focus on human-centric lighting. This Dynasolis™ technology combines phosphor-converted cyan LEDs and TriGain® technology* to enhance circadian rhythm management by optimizing light for both stimulating and calming effects. This approach improves workplace alertness during the day and promotes relaxation and sleep readiness at night. More information on this solution is available from the Nichia website: https://led-ld.nichia.co.jp/en/product/lighting_dynasolis.html

*TriGain® is a registered trademark of Current Lighting Solutions, LLC.

6.0 GENERAL INFORMATION

6.1 ADVANCED TECHNOLOGIES AND R&D INITIATIVES

Nichia Corporation is widely recognized for its unwavering commitment to innovation and excellence, particularly in the field of monotsukuri. This business philosophy is deeply embedded in Nichia's approach to research and development (R&D), where the company prioritizes long-term technological advancements over short-term profits. Nichia's corporate culture is built on continuous experimentation and a drive to push the boundaries of what is possible.

R&D is the cornerstone of Nichia's mission to achieve the highest standards. From basic research to the development of cutting-edge products, Nichia's team of expert researchers and engineers collaborates to leverage the company's extensive technological expertise. This approach has led to the creation of countless products and the acquisition of over 7,000 patents, establishing Nichia as a global leader in the lighting industry.

Nichia's commitment to R&D is further demonstrated by its significant financial investments in innovation. Over the past decade, Nichia has allocated more than ¥300 billion JPY (around $2 billion USD) to research and development, alongside over ¥600 billion JPY in capital investments. This level of investment underscores Nichia's dedication to advancing technology, delivering a meaningful impact on society, and maintaining its leadership in the lighting industry.

In the context of automotive lighting, Nichia's R&D initiatives have been particularly impactful. The company's pioneering work in LED technology has transformed automotive lighting, providing energy-efficient, durable, and highly reliable solutions that are essential for modern vehicle design. Nichia's ongoing research will meet the evolving demands of the automotive industry, ensuring that the company remains at the forefront of technological development in this vital industry sector.

In conclusion, Nichia's focus on advanced technologies and R&D is not merely a business strategy; it is a commitment to mastering the science and art of manufacturing. By fostering a culture of exploration, quality and excellence and by making substantial investments in R&D, Nichia not only sustains its competitive edge but also contributes significantly to the advancement of automotive lighting and other critical technologies on a global scale.

6.2 PRODUCT SEGMENTS OVERVIEW

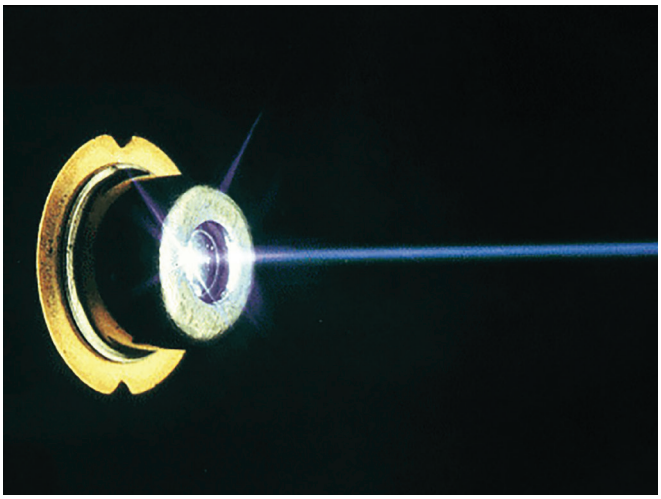
6.2.1 LED SOLUTIONS

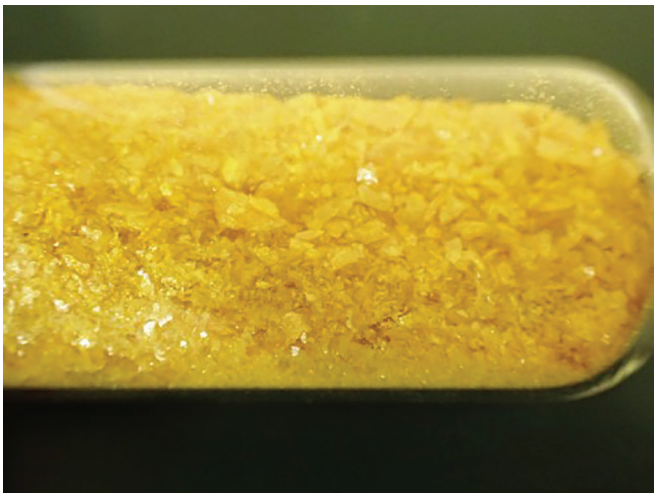
Nichia's automotive LEDs have set the benchmark for reliability, adhering to the stringent IATF16949 certification. These LEDs are integral to a variety of exterior automotive lighting applications, including headlights, daytime running lights (DRL), adaptive driving beams (ADB), and turn indicators. Additionally, the company's LEDs enhance interior automotive environments through applications in ambient lighting, instrument panels, LCD backlighting, switches, and heads-up displays (HUD). As the automotive industry advances towards electric and autonomous vehicles, Nichia remains committed to supporting this evolution with cutting-edge LED technologies.

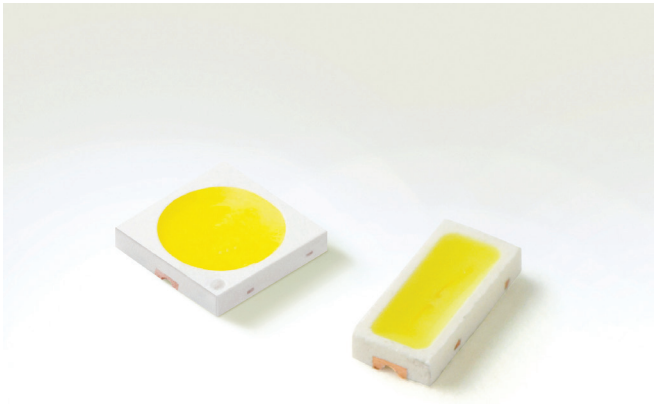
Beyond the automotive sector, Nichia's LEDs play a crucial role in several other applications. In LCD backlighting, the company's high-performance LEDs are essential for the latest TVs, smartphones, and laptops, ensuring superior image quality and efficiency. In general and specialty lighting, Nichia's LEDs are preferred for their luminous efficiency and long lifetime, covering a wide range of applications from indoor lighting to street and stadium illumination. Nichia also focuses on human-centric lighting solutions that optimize circadian rhythms. In the display sector, Nichia's innovations in high-brightness blue and pure green LEDs have revolutionized full-color displays, widely used in advertising, transportation information boards, concerts, and stadium scoreboards. Furthermore, Nichia's UV LEDs, known for their reliability and quality, are utilized in applications such as disinfection as well as currency detection, ink curing, and precision manufacturing, maintaining high standards through integrated management from wafer production to shipment.

6.2.2 LASER DIODES

In recent years, significant advancements have been made in GaN-based semiconductor lasers, particularly in diversifying the wavelength range and increasing optical output power. Consequently, their applications have expanded into projectors, industrial machinery, and medical sectors, including lithography equipment, 3D printing, and endoscopes. Laser diodes are penetrating additional markets, such as automotive headlights, head-mounted displays, and laser processing. With top-tier product quality, a diverse product portfolio, and reliable supply stability, Nichia is committed to continuing the production of laser diodes that cater to the wide array of requirements from customers.







6.2.3 PHOSPHORS AND SEMICONDUCTOR MATERIALS

Nichia is a global leader in phosphor production and phosphor recipe formulation. Phosphors are substances that convert energy from electron beams, electromagnetic waves, and ultraviolet light primarily into visible light. Nichia's phosphors are utilized in various applications, including LEDs for automotive lighting.

For compound semiconductors, such as substrates for LEDs and laser diodes, high-purity Gallium is used as a raw material. For example, Nichia's infrared LED epitaxial wafers are extensively employed in high-power and fast-response infrared LEDs across multiple sectors, including surveillance cameras, security system sensors, and high-speed photocouplers for various applications.

6.2.4 LITHIUM-ION BATTERY CATHODE MATERIALS

Nichia's cathode materials for Lithium-ion batteries are widely recognized for their application in secondary batteries used in consumer electronics such as smartphones, laptops, and power tools. Looking ahead, Lithium-ion batteries are poised to play a critical role in industrial applications, including electric vehicles and energy storage solutions. Nichia is strategically positioned to expand its market presence and reinforce its status as a premier global manufacturer of cathode materials.

6.2.5 MAGNETIC MATERIALS

Nichia specializes in the production of anisotropic SmFeN plastic compounds for injection molding. Utilizing a proprietary manufacturing technology, Nichia produces SmFeN powder with an ultra-fine particle diameter of 3 μm without the need for destructive fine milling processes. This results in a plastic compound with superior flowability, capable of being molded into intricate shapes and integrated designs. Furthermore, Nichia's advanced oxidation-resistant treatment enhances the material's resistance to heat and moisture, making it highly suitable for automotive applications.

6.2.6 OTHER PRODUCTS

Nichia also supplies high-purity Titanium, Zirconium, Nickel compounds, and more, produced through its proprietary techniques. These organometallic compounds are used in various applications, including catalysts for polymerization and organic synthesis, as well as raw materials for high-performance electronic materials.

Additionally, Nichia has leveraged its extensive experience in producing and applying inorganic ceramic powders, including phosphors, to develop a range of evaporation materials ideal for creating high-quality optical thin films for applications such as optical communications and media such as DVDs and projectors.

7.0 NICHIA COMPANY HISTORY AND EVOLUTION

7.1 KEY MILESTONES

NICHIA

Key Moments in our History

1956 — The story begins
Nobuo Ogawa establishes Nichia Kagaku Kogyo, K.K. to supply phosphors for industrial use.

1966 — No.1 phosphor manufacturer
Leading the world in calcium halophosphate phosphor production for fluorescent lamps.

1983 — Dawn of opto-semiconductors
Diversifies into opto-semiconductor business with GaAlAs epitaxial wafers for IR LEDs

1993 — Invention of the blue LED
World-first high luminous blue LED developed, revolutionizing LED technology.

1996 — The first white LED
Invention of the world´s first white LED, combining blue LED with yellow phosphor.

2009 — Cathode materials for EVs
Development of high-quality cathode materials for Lithium-ion batteries in electric vehicles (EVs).

2019 — UV LED expansion
Deep UV LEDs proven to inactivate bacteria/ viruses with applications in sterilization and more.

2024 — The future is bright
Nichia continues to pioneer world-class technological lighting solutions for many applications

7.2 ENVIRONMENTAL & SOCIAL RESPONSIBILITY

LEDs manufactured by Nichia have been playing a central role in carbon neutrality. LED lighting can reduce power consumption to less than half compared to conventional light sources such as incandescent and fluorescent bulbs. By the 2030s, LED lighting is expected to replace most of the world's lighting. If this happens, more than 1 billion tons of CO_2 emissions will be reduced compared to if conventional light sources had been used continuously. One billion tons per year is almost the same amount of CO_2 emitted by all of Japan in a year.

Notwithstanding the impact of LEDs, Nichia is deeply committed to corporate social responsibility (CSR), focusing on both environmental preservation and social contributions. Rooted in their principle of 'Respect the Environment', Nichia has undertaken numerous initiatives to protect and preserve natural resources and biodiversity. For example, the company established the Nichia Furusato Foundation in 2013 to support environmental conservation efforts in Tokushima, subsidizing activities to preserve biodiversity, support reforestation and combat global warming.

"LEDs manufactured by Nichia have been playing a central role in carbon neutrality."

In terms of social responsibility, Nichia places a strong emphasis on supporting educational and research institutions. The company has made significant donations to educational facilities and scholarships. For example, the business has funded many research grants and donated to the construction of new buildings at Tokushima University and also helped to establish a course about photon information technology at the University of Tokyo. Nichia also actively contributes to local communities through donations for public infrastructure improvements, participating in local festivals, and engaging in volunteer clean-up activities.

"These initiatives demonstrate Nichia's commitment to maintaining positive sustainability and social impact, integrating business operations with comprehensive environmental and social objectives."

7.3 INDUSTRY AND ACADEMIC COLLABORATIONS

Nichia places a strong emphasis on collaboration with academic institutions to advance research and innovation. By engaging with universities and research organizations worldwide such as Tokushima International Science Institute, the company seeks to break new ground in LED development and semiconductor engineering. These partnerships enable the exchange of knowledge and resources, fostering an environment that fosters a greater potential for technological breakthroughs to materialize.

Nichia collaborates on a wide array of joint research projects, from material science to applied physics. These efforts are not only pivotal for the company's innovation pipeline but also contribute significantly to the broader scientific community. Nichia's commitment to academic collaboration underscores its dedication to leading-edge research and its role as a global innovator in the field of lighting and semiconductor technologies.

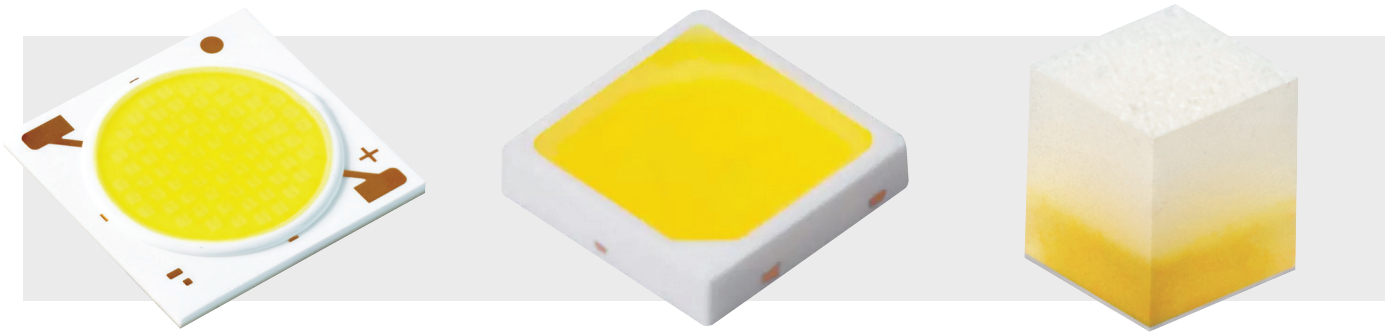
8.0 NICHIA MILESTONES IN LIGHTING TECHNOLOGY

8.1 LED PERFORMANCE DEVELOPMENT TIMELINE

LEDs have evolved significantly in the past decade, with advancements leading to the production of LEDs in various colors and configurations, enhancing their efficiency and reliability across multiple applications. For example, automotive lighting is expected to grow to over US $30 billion by 2030, according to Markets and Markets.

Initially, white LEDs, which combine blue GaN-based LEDs with phosphors, were less efficient than incandescent and fluorescent lamps. However, improvements in chip, phosphor, and packaging technologies by 2013 had allowed white LEDs to surpass fluorescent lamps in luminous efficiency, making them viable for general lighting. By 2022, the efficiency of white LEDs has exceeded 200 lm/W, marking a major leap in their application for energy-efficient lighting.

White LEDs have also seen major improvements in color rendering and long lifespan. The average color rendering index (Ra) for indoor lighting LEDs has improved from 80 to Ra⩾90 without compromising efficiency, thanks to advancements in phosphor and packaging technology. Additionally, the lifespan of white LEDs has been extended significantly, with newer materials like silicone resin and inorganic components replacing older ones, increasing their operational life beyond 50,000 hours under optimal conditions.



The development of LEDs has resulted in various types, each designed for specific applications. Mid-power LEDs, used in general lighting, offer moderate power and are suited for applications like ceiling lights. High-power LEDs, which provide higher luminance, are used in focused lighting applications like road and spotlighting. Other notable types include COB (Chip-On-Board) LEDs, used in high-grade lighting due to their seamless light-emitting surface, and CSP (Chip Scale Package) LEDs, which offer high luminance and compact design. Recent LED innovations have gone beyond just improving efficiency and focus on health benefits too. For example, circadian rhythm LEDs adjust their light to match our natural biological cycles, helping us stay alert during the day and relax at night. Another advancement is white LEDs supporting sterilization which emit light at 405nm. This specific wavelength can safely kill bacteria over long periods, making these LEDs perfect for places that need high levels of hygiene.

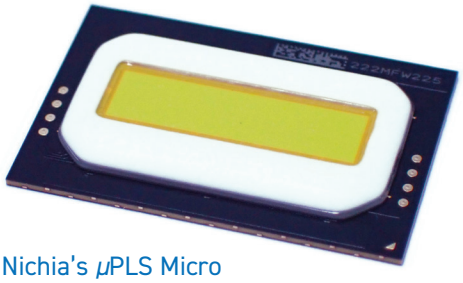
In summary, the advancements in LED technology over the past decade have greatly enhanced their efficiency, color rendering, and lifespan, making them the preferred choice for general and specialized lighting applications including automotive lighting. The future of white LEDs lies in expanding their functionality to include health benefits and other innovative uses, driving further developments in lighting technology.

9.0 AUTOMOTIVE LIGHTING

9.1 MICROLED SOLUTIONS FOR FRONT LIGHTING

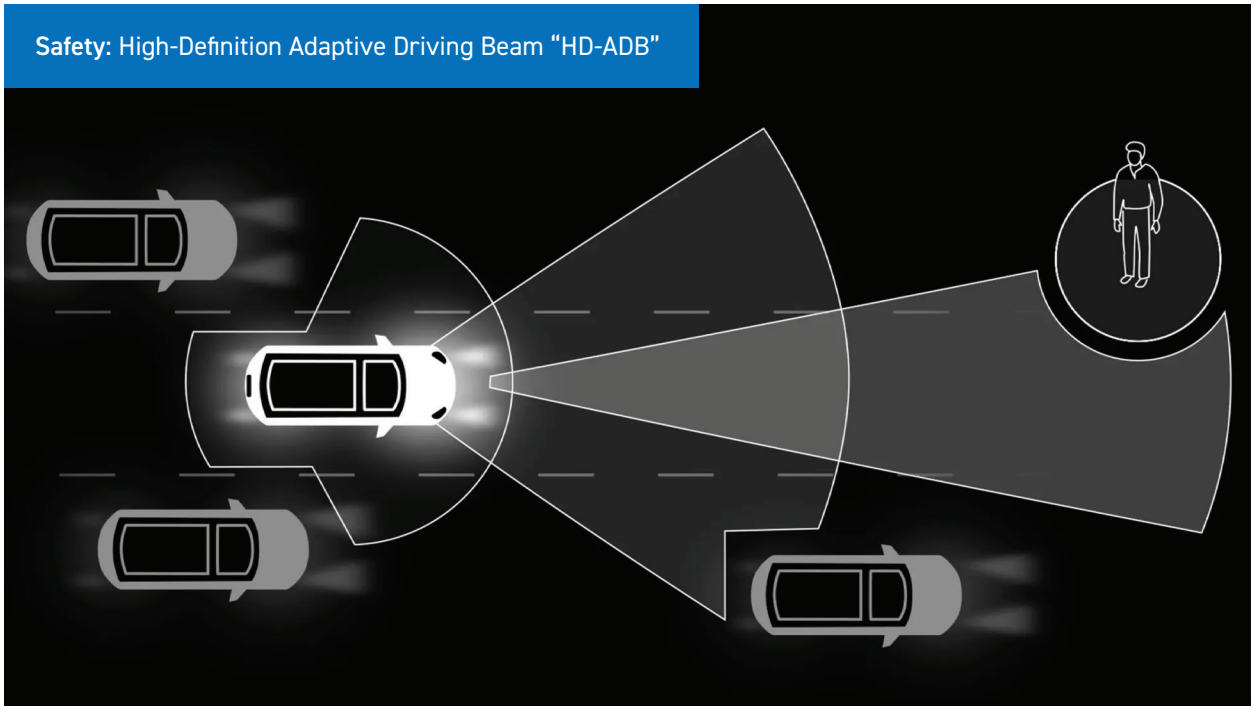
Nichia's μPLS (Micro Pixelated Light Source) perfectly illustrates the transformative potential of microLED technology in automotive applications that can significantly enhance road safety by offering precise light distribution and minimizing glare for oncoming vehicles. The revolutionary μPLS light engine, designed for high-definition adaptive driving beams, offers exceptional brightness, pixel density, efficiency, and versatile connectivity for seamless integration into modern automobile designs.

The μPLS light engine is fitted in uses Nichia's unique in-house LED chip and microLED technology and an integrated LED driver IC from Infineon that can drive over 16,000 microLEDs individually using pulse-width modulation (PWM) control. In contrast, the ADB (Adaptive Driving Beam) systems currently installed in commercial vehicle headlights typically control LED light sources with 10 to 100 pixels.



Nichia's μPLS Micro Pixelated Light Source

Safety: High-Definition Adaptive Driving Beam "HD-ADB"



Light Distribution Tuning: Consideration of Regulations and Axis Balance by Software

With the ADB system, glare is suppressed when driving with high beams, preventing dazzling effects on preceding and oncoming vehicles while maintaining good visibility. The *μ*PLS for headlights activates only the LEDs necessary for the illumination pattern. This allows for even more precise control of glare on other vehicles and also enables display functions through road surface projections, expanding its applications to driving support and communication.

Besides adaptive headlights, microLEDs offer exceptional visual performance for applications like heads-up displays (HUDs) and dashboard displays, which require high visibility and clarity under various lighting conditions. Their superior visual capabilities ensure that drivers receive clear and precise information, thereby enhancing safety and the overall driving experience.

9.2 TRENDS CONVERGING BETWEEN AUTOMOTIVE & GENERAL LIGHTING

While the complexities and technical differences between automotive and general lighting present significant challenges, they also offer a unique opportunity for knowledge exchange and invention.

The convergence of general and automotive lighting trends, particularly through LEDs, is unmistakable. LEDs have proven that lighting is not merely a functional element; it is an integral component in crafting an experience, controlling an atmosphere, and even enhancing safety and comfort.

Inside cars, human-centric lighting involves using high Color Rendering Index (CRI) lights for reading lamps and ambient lighting. This allows the true colors of a vehicle's interior to be more easily perceived, improving the chance to notice and appreciate the craftsmanship and seamless fusion of refined materials chosen to signify premium car brands.

For example, Optisolis™ technology, ultra-high color rendering index LED emitters developed by Nichia, provides a spectrum to match natural light. With a CRI higher than 98, this innovative solution provides an accurate representation of different hues in fabrics used within door panels, seating, dashboard, and center console.

This high CRI is a vital characteristic in the concept of the 'cockpit of the future', where the quality of light will contribute to the overall experience in a space that functions as a 'mobile living room'. With the advent of autonomous driving, passengers will spend more time reading, eating, sleeping, viewing entertainment, and communicating inside cars, necessitating a lighting environment that can adapt to these activities and more.

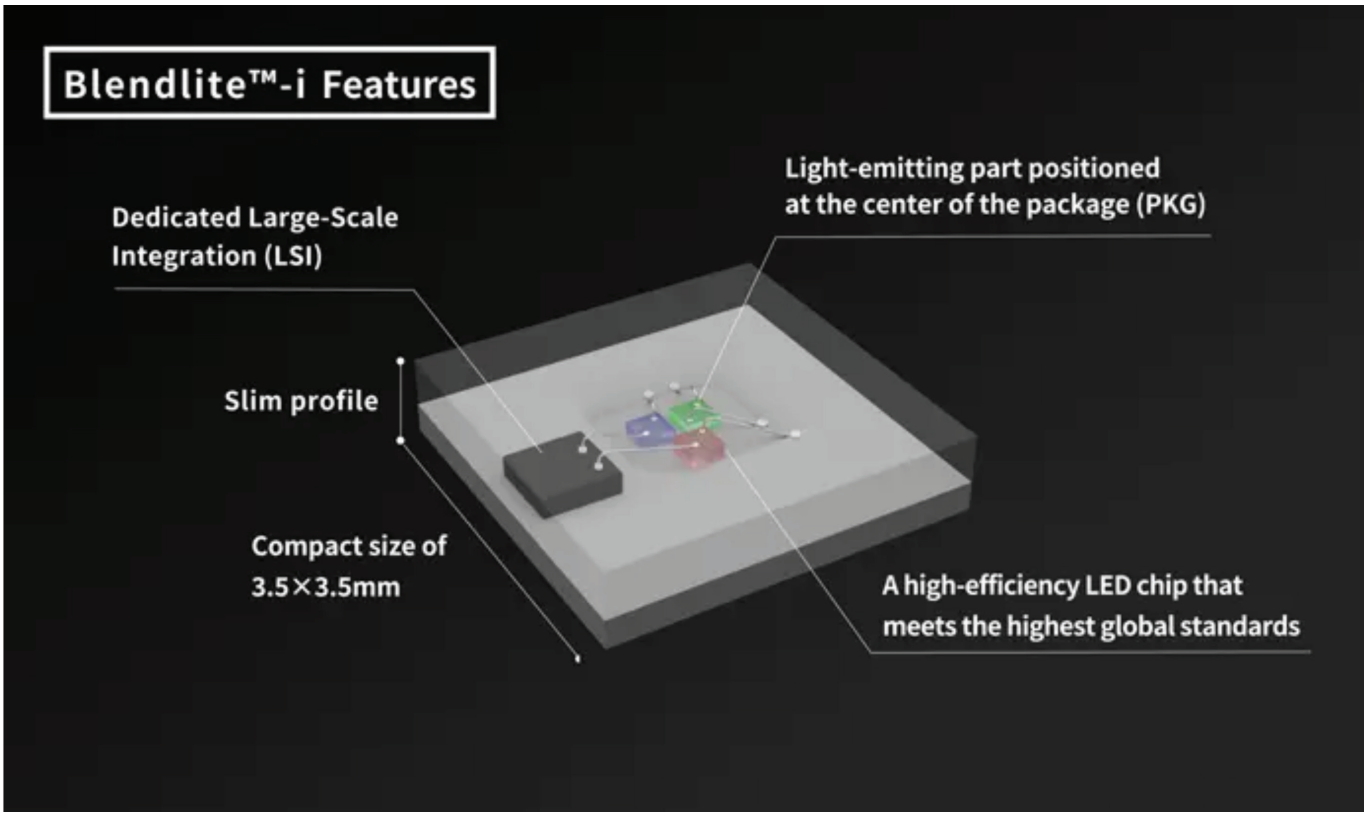
Occupants in cars may also benefit from Vitasolis™ and Dynasolis™ from Nichia. Dynasolis™ is designed to optimize circadian rhythms by adjusting both melanopic illuminance and color temperature. It uses a combination of azure-colored LEDs to provide energizing blue light around 480 nm and warm white LEDs for a calming effect. In contrast, Vitasolis™ emits a natural white color with a high content of blue-green energy, specifically designed to stimulate alertness and reduce eye strain. It is primarily used to improve circadian rhythms, productivity, and intense study.

"This high CRI is a vital characteristic in the concept of the 'cockpit of the future', where the quality of light will contribute to the overall experience in a space that functions as a 'mobile living room'."

Both technologies can enhance the driver and passenger experience respectively, keeping the driver alert and reducing fatigue during long drives during day and night while keeping rear passengers more calm and comfortable with ambient lighting to suit the time of day.

9.3 LATEST AUTOMOTIVE LIGHTING SOLUTIONS FROM NICHIA

Currently in development, a new solution called Blendlite™-i is an advanced RGB LED that integrates a specially designed driver IC, tailored specifically for automotive interior lighting. It features a high-efficiency LED chip that meets the highest global standards, ensuring exceptional performance. The low-power, high-performance LSI (RGB driver IC) is designed for easy integration and fits within a compact square package. Its open protocol offers broad compatibility with existing controllers, making it user-friendly. Blendlite™-i also excels in achieving high color reproducibility by minimizing color variation. Additionally, it is on track to receive AEC-Q102 qualification. By offering high color quality, simple circuit design, and low power consumption, Blendlite™-i is poised to contribute to more comfortable and safer automotive interiors, meeting the growing demands of the industry.



Nichia's Near Field Projection light solution is a cutting-edge innovation in automotive lighting, offering unmatched design flexibility. It leverages transmissive lenses and a compact chip-scale package to deliver powerful illumination, exceeding 400 lux from a small light-emitting surface at a distance of 1.2 meters. Despite its compact size, the near field projection solution provides precise, high-intensity lighting, allowing automotive designers to create sleek, space-efficient lighting systems without sacrificing performance. This technology is ideal for modern vehicles that demand both high-performance lighting and streamlined design.

While we are not selling modules for near field projection, Nichia's LEDs are ideally suited to support such trends, enabling modern vehicles to achieve both high-performance lighting and streamlined design.

"Blendlite™-i is poised to contribute to more comfortable and safer automotive interiors, meeting the growing demands of the industry."

Nichia's Thin Design Headlight sets a new standard in automotive headlamp design with its sleek lens height of less than 15 mm, achieving the perfect balance between aesthetics and functionality without compromising performance. This slim yet powerful headlight delivers the required luminous flux for low, high, and adaptive beams, ensuring optimal visibility while maintaining high optical efficiency. The minimalistic design not only enhances vehicle styling but also meets stringent aerodynamic requirements.

While we are not selling modules for thin design headlamps, Nichia's LEDs are ideally positioned to support such trends, enabling car makers to integrate sophisticated lighting solutions that deliver top-tier performance in a refined, elegant package.

"This slim yet powerful headlight delivers the required luminous flux for low, high, and adaptive beams, ensuring optimal visibility while maintaining high optical efficiency."

Additionally, GigaWhite™ is Nichia's latest ultra-bright SMD white laser diode created by combining a blue laser diode and phosphor. It was developed for automotive headlights, special lighting, and industrial lighting. Nichia's unique technology has realized uniform light with less color irregularity. Taking advantage of the characteristics of its ultra-high luminance, it enables compact headlight designs that can only be realized with laser diodes. In addition, the built-in sensor enables the electrical detection of failures which may cause laser light leakage, thereby ensuring a safe design. GigaWhite™ is capable of outputting ultra-bright white light that is approximately 10 times brighter than that of ordinary LEDs. Nichia expects that GigaWhite™ will enable ultra-compact headlights in the future that can allow for dramatic changes in car design.

Indeed, ultra-compact headlights that take advantage of the high luminance of laser diodes. The extremely high luminance of LD light sources enables a low-profile design with a lens height of less than 10 mm, while still meeting ECE R112 Class-B Regulation requirements This allows a much greater degree of freedom in design, enabling styling and creativity while achieving the ability to have the shape of the headlight be nearly undetectable.

10.0 GENERAL LIGHTING

10.1 QUALITY OF LIGHT

Nichia has proven to be a pioneer in delivering several groundbreaking products that significantly improve light quality and impact the shape of light, especially in general lighting. For instance, the Nichia Cube Direct Mountable Chip marks a significant advancement in LED technology by employing horizontal light distribution to create a softer, less glaring light (more details in the next section).

10.2 CUBE DIRECT MOUNTABLE CHIP AND NICHIA LIGHT CLUSTER™ TYPE L

Nichia's Cube Direct Mountable Chip technology delivers an ultra-wide light distribution and allows for the creation of smaller, more efficient luminaires that boost flexibility, reduce materials, and enhance building safety.

Additionally, Nichia Light Cluster™ Type L is a cutting-edge LED module that offers significant reductions of at least 60% in luminaire thickness and 30% in fixture weight compared to conventional modules, while maintaining even light distribution. While conventional modules illuminate strongly straight up, the light of these products spreads diagonally upward and sideways, illuminating the entire space.

"Nichia Light Cluster™ Type L provides 'perfectly soft diffusion' and 'amazing glare-free characteristics' according to lighting fixture design experts."

10.3 H6 SERIES

The industry-leading H6 Series delivers exceptional lumen efficacy while ensuring high-fidelity color reproduction, making it ideal for indoor environments where lighting quality is crucial. The LED industry has long faced the challenge of balancing high efficacy with maintaining a high Color Rendering Index (CRI) and TM-30 values. Nichia's H6 Series successfully addresses this issue, drawing on over 50 years of expertise in phosphors and LED technology, along with the advanced TriGain® technology.* This series offers the highest combined boost in color quality and efficacy in the industry. The H6 Series portfolio includes Mid Power to COB solutions suitable for a variety of applications, including retail spaces, offices, homes, and healthcare facilities.

*TriGain® is a registered trademark of Current Lighting Solutions, LLC.

10.4 1800K LED: The ultimate HPS Upgrade

Nichia's advanced 1800K LED portfolio, including the 757, Direct Mountable Chip, and 19 Series, serves as an ideal replacement for High-Pressure Sodium (HPS) lighting. These products replicate the warm glow of HPS lamps, delivering exceptional color matching and more vivid illumination to enhance safety and comfort in outdoor settings such as street lighting, tunnel illumination, parks, and residential areas.

With high efficacy (up to 15% more lm/W than HPS technology with Ra ⩾70) and an extended lifespan, these HPS color LEDs offer significant energy savings and reduced maintenance costs.

"Compliant with Dark Sky standards, they highlight our dedication to minimizing light pollution. Additionally, the light attracts fewer insects, helping to preserve local ecosystems and maintain cleaner, lower-maintenance lighting fixtures."

11.0 NICHIA AUTOMOTIVE INNOVATION CENTER

Nichia Automotive Innovation Center, located in Aachen, Germany, is a state-of-the-art facility and a major milestone demonstrating Nichia's commitment to rapidly accelerate advancements in automotive lighting, ensuring the company will meet the evolving needs of its customers with cutting-edge solutions.

"The Nichia Automotive Innovation Center highlights the company's vision for a more advanced and sustainable future in automotive lighting. With a legacy of innovation, Nichia continues to lead the way in enhancing lighting technology in cars, reinforcing its pioneering status in the LED industry."

Nichia Automotive Innovation Center aims to create safer, more efficient, and visually appealing lighting solutions for vehicles. By combining Nichia's latest technologies with the expertise of global partners and the dedicated R&D team in Japan, the company will bring new products to market faster and more efficiently. Equally important, the overall quality of interior and exterior car lighting will be boosted.

The Center is equipped with advanced tools for testing and prototyping and is staffed by top specialists in the field. Through teamwork with industry partners and academic institutions, Nichia is poised to accelerate innovation in automotive lighting.

The Nichia Automotive Innovation Center highlights the company's vision for a more advanced and sustainable future in automotive lighting. With a legacy of innovation, Nichia continues to lead the way in enhancing lighting technology in cars, reinforcing its pioneering status in the LED industry.

12.0 FUTURE OUTLOOK AND AUTHOR'S CONCLUDING THOUGHTS

Nichia is an industrial powerhouse that has demonstrated its pioneering role in innovations, being the first on the market for both white LEDs and microLED sources for HD lighting.

In the words of their president, Hiroyoshi Ogawa, Nichia believes that the potential for future groundbreaking solutions arises from a better understanding of the fundamental nature of light and its luminous/optical mechanisms. "Light behaves as a particle and as a wave at the same time". With this belief at its core, Nichia has already begun developing and selling new LEDs which strive to deliver the ultimate quality of light. Nichia's mission is to continue contributing to society always remembering the spirit that brought the company to where it is today: "Ever researching for a brighter world."

Looking ahead, we expect Nichia to continue improving its LEDs, enhancing both the lumen-per-watt ratio (even as the limit of 270 lm/W is approached) and the overall quality of light, which is especially important for interior lighting.

For main lighting and particularly for HD lighting, Nichia will likely advance in two main directions that the industry is eagerly awaiting: cost reduction and increased resolution.

Although no formal announcements have been made, cost reduction could be achieved by decreasing the number of LEDs from the current 16,384 μLEDs to around 4,000 LEDs. Additionally, to target higher-range automotive models, an increase in resolution, potentially reaching around 100,000 LEDs, seems a clear goal for Nichia, as it is the case for some of their competitors.

Nichia faces strong competition, including long-established players Lumileds and OSRAM as well as newer Chinese and other South Asia LEDs makers. Nichia does not aim to compete in every market, especially in low-cost markets. Instead, it focuses on high-quality and demanding market applications, where its strengths lie.

"With this belief at its core, Nichia has already begun developing and selling new LEDs which strive to deliver the ultimate quality of light."

With its expertise and resources, Nichia is well-positioned to continue succeeding in this approach.

13.0 DVN – SERVICES AND COMMUNITY

List of the 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 MunichWS
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 Laserlight 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 Profile
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 profile
Test houses
Shanghai DVN event summary

Reports to be launched in 2025

Lighting Market analysis Mexico
Lighting Market analysis China
Welding technology
Tooling status for lighting Techology
Condensation
Semiconductors
Test houses
Shanghai DVN event summary

DVN ECOSYSTEM AND SCIENTIFIC COMMUNITY

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

Car Makers

Audi
Bentley
BMW
Ferrari
Ford
General Motors
Genesis
Honda
Hyundai
Jaguar-Land Rover
Kia
Lotus cars
Lucid Motors
Lynk & Co
Mazda
Mercedes-Benz
Mitsubishi Motors
Nio
Nissan
Renault
Rivian
Shanghai-VW
Seat
Stellantis
Subaru
Toyota
SAIC Volkswagen
Volvo Cars
Zoox (Amazon subsidiary)

System Suppliers and Tier 1s

Adient
Anrui
Appotronics
Aspöck Systems
Chongqing Rebo
Creat
Diode Dynamics
Elba
F2J Industry
Feka
Flex-N-gate
Forvia
GHSP
Grupo Antolin
Hascovision
Ichikoh
J.W. Speaker
Keboda
Koito
Lighting Consultants Ltd
Lightworks
Lumax
Luxit
Magna
Marelli AL
Mind
Mobileye
Mobis
Nordic Lights
Odelo
OPmobility
Panasonic
Prettl
SL Corporation
SMR Automotive
Stanley
Toyota Boshoku
Valeo
Varroc
Xingyu
Zanini
ZKW
Zodiac

Light Source Suppliers

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

Univ., labs, Consultants

Bluebinaries
Capgemini
CEA Leti
Darmstadt university
DEKRA laboratory
FEP, Franhaufer
Fudan university
Fraunhofer IMS
Hannover Leibniz. (HOT)
Institut d'Optique
IHS Markit
Karlsruhe Lighting Institute
LAB
Nuremberg university Pacific Insight
Parma university
Pforzheim
Rensselaer university Sapphire
The Lighting Consultants
UMTRI
University of California
YoungNam University

Tier 2s

A2Mac1
Ascorium
AML Systems
Ansys
ASAP
ASYST Technologies
Auer Lighting
BASF
Braslux
Brightek
Cepton
Ceres Holographics
CLM Search
Coindu
Continental
Covestro
Dajac
DBM Reflex
Delo
Die haptiker GmbH
Docter Optics
Dow
EcoGlass
Edag
Elmos
Ennostar
Euro Moulders
EV Group
Focuslight
Grewus
Hitachi
HJ Optics
Huawei
Idemitsu
Infineon
Inova Semiconductors
Instrument Systems
Integrity
Joysonquin
Leonhard Kurz
Less
Liteon Technology
LMT
Luminus
Marquardt
Mektec
Microvision
Maxell Frontier
MD Group
Melexis
Microchip
Microrelleus
Mitsui Chemicals
Mocom
Muth Mirror Systems
Nalux
Novem
NBHX Trim
Oerlikon
ON Semiconductor
Polycontact
Polyrise
Preh
Ray Group
Rehau
Sabic
Seaborough
Seoyoneh-Ewha
Shihu
Sunny Automotive Optech
Synopsys
TechnoTeam
Toshiba lighting
TQ Technology
Vangest SA
Ventura
Weidplas CH
W.L. Gore & Associates
WLOPT
X2F
Xunchi
Zollner

DVN Lighting

DVN wishes thanks to Nichia for their inputs into this report.
For more information, visit: **DrivingVisionNews.com**