ISA
International SSL Alliance

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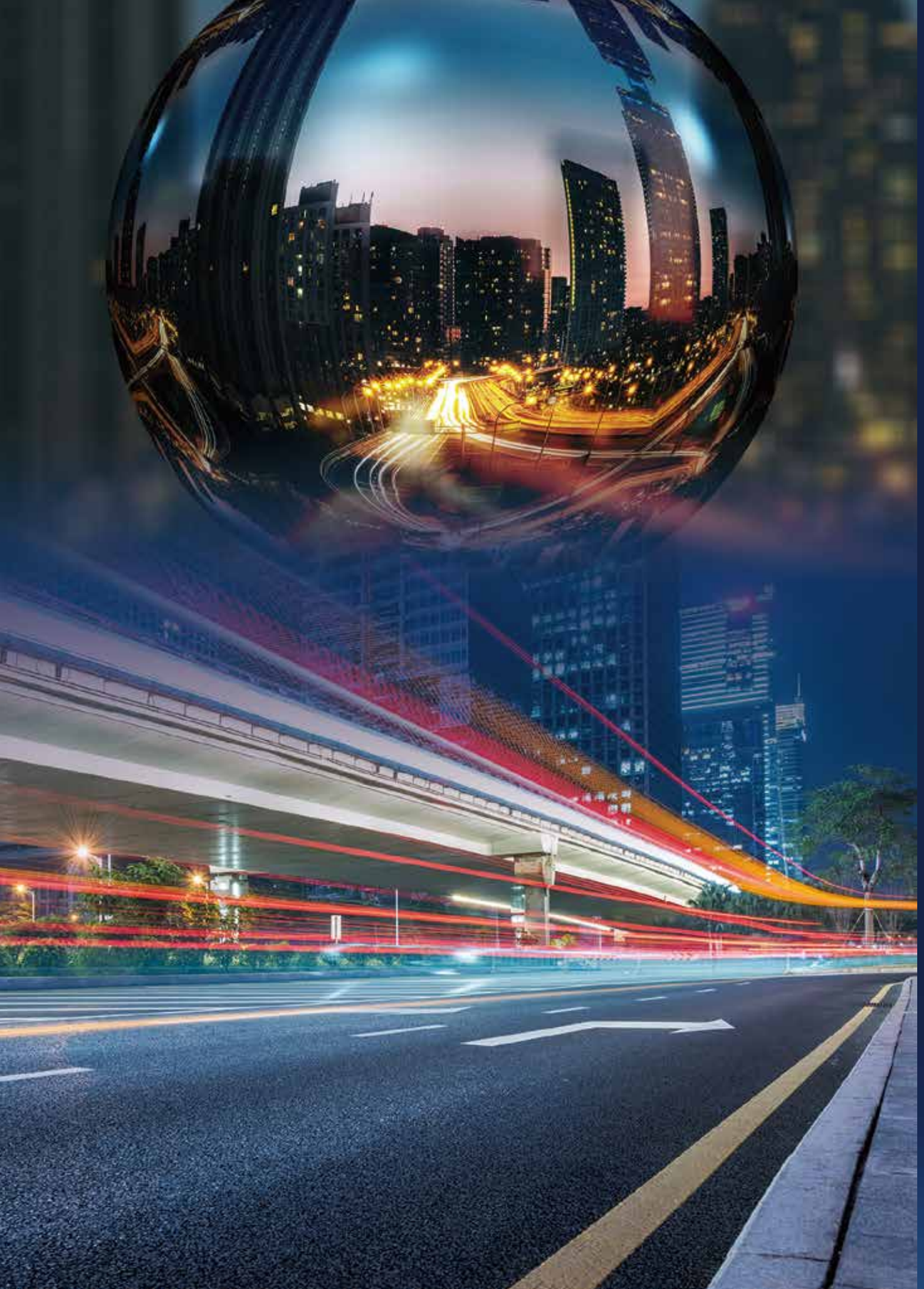


Solid state lighting (SSL) after 20 years' development has gradually reached a mature stage in terms of performence such as light quality, luminous efficiency, reliability and intelligent feature. SSL products, services and system solutions have been widely used in most parts of the world.

With the in-depth research and development and the continuous innovation of manufacturing technology, the SSL's non-visual functions are also being rapidly explored. Various innovations and applications of "beyond lighting" are entering many aspects of society and life. SSL has been showing its tremendous application potential and R&D depth in high value added application integration e.g. agriculture, health, communications, high-definition display, polymer curing, disease vector control etc. Integrated innovation and interdisciplinary innovations based on SSL technology have yielded a steady stream of achievements, marking a new stage of SSL development.

Innovation drives development, which in turn fosters innovation. From the advent of the first GaN-based blue LED in 1978 to the commercial manufacturing of the first high-brightness blue LED in 1993, and the commercial manufacturing of blue and green LEDs with InGaN quantum well (QW) structures, SSL has gone from laboratory to industrialization in merely decades as well as from manufacturers to thousands of households, all of that are the result of innovation.

The ISA twelfth Executive Member Meeting decided to establish the "Global SSL Award of Innovations Top 100", and start the selection from the year of 2021. The award aims to encourage and inspire the global SSL industry to persist the spirit of innovation in new era to make new discoveries, explore more unknown areas, and create more applications in the field of "beyond lighting", to benefit mankind with more SSL miracle. This is the intention and ultimate goal of this award.

Jianlin Cao

Jianlin Cao
President of ISA

International SSL Alliance

ISA Introduction

ISA is a non-for-profit international organization consists of regional alliances, association/society, leading companies and renowned universities in global Solid State Lighting (SSL) field.

The Business of ISA members have covered the whole SSL value chain of upstream, middle stream and downstream of global SSL industry such as epitaxy, packaging application, materials and equipment, design system integration and testing etc.

The currently ISA 82 members, representing more than 4000 individuals & organizations includes major players (such as Signify, Osram, Smsung, GE Lighting, Cree, Veeco, AIXTRON etc.). The output of which covers more than 70% that of global SSL industry.

The ISA Board of Advisers consists of leading experts and academic "Founder" level experts, such as the inventors of blue LED, yellow LED, Red LED, and OLED. Amongst Professor Shuji Nakamura, the Laureate of Nobel Prize in Physics in 2014, is the Co-Chair of ISA Board of Advisors (BOA) and Professor Hiroshi Amano, the Laureate of the Nobel Prize in Physics in 2014 is the member of ISA BOA.

The major works of ISA are: provide services to promote the development and application of global SSL, standardization, annually Global SSL Industry Report, annually SSL Awards, promote international, national and regional cooperation on SSL, etc.

The Mission of ISA

Cooperation with the global resources and efforts, ISA looks forward to fostering a more appropriate "eco-system" for the health development of the global SSL and its application. Echo the needs of the society with more added value services to ISA members. Strive to improve people's living and contribute a sustainable human society.

Global SSL Award of Innovations Top 100

Every year, according to the applications we received from all over the world, a certain number of SSL innovations projects will be selected as the winners of the "Global SSL Award of Innovations Top 100", which are judged by international authoritative experts. And medals, certificates and brochures will be given to encourage and praise.

Mission

To promote and stimulate the sustainable development of the global solid state lighting (SSL) industry, demonstrate the application and the innovation of the technology of SSL in the field of "beyond lighting", and push forward the global SSL into a new stage of development.

The Scope of the Application

The applications must be the technological innovation, product innovation or integration innovation etc. related to the SSL technology in the field of beyond lighting.

Include but not limited to the following areas:

1. Smart Lighting
2. Mini/Micro LED
3. Health Lighting
4. Visible Light Communication (LiFi)
5. Agriculture Lighting
6. UV LED Application
7. Others (Please specify)

Criteria for Selection

The application (s) should be innovative in the country, region or the world, and the technology (ies) or product (s) should reach a certain advanced level, and solve some key problems in practical application.

CONTENTS







Smart Lighting

01

A Smart Street Light with Freely Combinable Cubic Modules (named Infinite)

LongT Lighting Group, Inc.

Brief Introduction

Background

Street light is a common component of road and city lighting. The traditional street lights only has a lighting function. However, with the development of the city, many new urban functional needs appeared, such as advertising, video surveillance, environmental monitoring, car charging and so on. Although it is possible to add all these functions to street lights, the cost is too high if we need to customize separately because each project has different needs.

Our product Infinite includes a bottom module, a top module and a plurality of intermediate modules. The bottom module includes a bottom light pole and a bottom plate. The top module is connected to a light head through a connecting bracket. The intermediate module can be a billboard module, a video monitoring module, a temperature and humidity monitoring module, or many else types. All modules are secured in a fastened structure, easy to install, and can be freely combined.

We socket all the modules together in sequence and lock them with nuts and screws. According to the number and specifications of intermediate modules, we choose the appropriate positioning holes on the base plate and fix them to the horizontal sockets of the lower fixing plate with pins, so that we can fix several modules stably in the vertical direction. The number and type of intermediate modules may be different for each street light and may need to be replaced after a period of use, manual information acquisition is inconvenient, also carries the risk of human error. So the following automated acquisition scheme has been designed. It can run automatically and return statistical values when a module information collection command is issued.

Two intellectual property rights have been obtained, invention patent: ZL201811097448.4 A smart street light with freely combinable cubic modules.

Appearance Patent: ZL201930696841.4 Smart Multifunctional Garden Light (Turning the Tide)

Real Scenarios (Dalian Olympic Plaza Project)

Product Description

Industry-leading smart garden light: Infinite is a smart city IoT lighting solution with a modular design concept that can be flexibly assembled, interchanged and added, integrating IoT functions and smart lighting control. It supports a variety of communication methods, such as Wi-Fi, to interconnect devices in the municipal environment, ecology, firefighting, micro-meteorology and other urban areas, so as to realize multifunctional functions, such as traffic management, environmental monitoring, emergency help, intelligent charging and other functions. This will enhance the city's comprehensive management capabilities.

Innovative aesthetic design: We adhere to the concept of "less is more", using less material and space to form more geometric elements. This smart garden light is cut inward to form rich lines, utilizing the human illusion principle, resulting in a rotating and rising visual experience. At the same time, the different combinations of modules make light and shadow intertwined, full of technological fantasy.

The Innovation Points

We cut the pole into a twisting, rising appearance to create line interference. This design utilizes the principle of human illusion to vary the angle of illumination, while helping to reduce wind resistance. Fusion of pragmatism and technological fantasy.

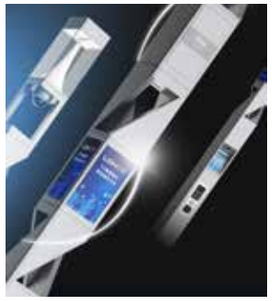
Modular structure, flexible and convenient: the product as a whole is composed of multiple module combinations, and a single module can be directly used as the smallest operating unit during installation or transportation. This provides a low-cost, high-quality solution to meet the diverse and individualized needs of urban construction.

Seal strip waterproof technology is effectively applied to the whole product, so the light pole outdoor waterproof performance is excellent, effectively protect the intelligent equipment inside the pole.

Low installation costs: Easily disassembly and installation, hidden equipment, simple physical structure, flexible transportation, and universal use in all scenarios. These improve construction safety and reduce project budget and time costs.

Wide range of application: Modular smart light poles can be compatible with lighting, video surveillance, environmental monitoring and other functions. According to the needs of users in different scenarios, we choose different deployment programs and make reasonable matching of different modules.

Low maintenance cost: Intelligent street light can meet the emergency command, environmental inspection, vehicle guidance, road traffic detection, multimedia information dissemination and other functions. Compared with the traditional street light, it can effectively reduce the repeated deployment cost and maintenance cost in the late stage of the project. In addition, all LED lights access to automatic energy-saving control, which is bound to improve the environmental impact of night lighting. Also new efficient lighting can save up to 50% of lighting energy costs as a result of increased energy efficiency.



Possible Economic and Social Benefits

Use of recyclable materials: The whole smart light pole is made of all aluminum alloy to ensure high standard of metal strength and toughness. Resources can be recovered and recycled, which is in line with the strategy of sustainable development. It is dustproof and waterproof, fearless of harsh natural environments, and durable enough to protect the smart devices inside the pole for a long time.

Maximize the use of resources: We use recyclable aluminum alloy to ensure environmental sustainability. Instead of a horizontal extension, we use an upright columnar structure that is hollowed out inwards. This saves material and does not take up visual space. Our Infinite can be equipped with a variety of amenities, such as flower baskets, seats and small garbage cans, to enhance the aesthetics of the streetscape and bring convenience to the public.

Intelligent traffic system reduces traffic congestion: Access to advanced intelligent traffic control system, equipped with high-definition camera and AI image recognition function, it can real-time monitor the pedestrian and traffic flow on the road and dynamically adjust the red light time to reduce traffic congestion. When pedestrians are still on the crosswalk, it can automatically predict the passage time and extend the red light time to reduce the traffic accident rate.

By building multi-functional intelligent street lights, the company not only reduces the construction cost of the government, but also relies on self-developed intelligent lighting products to greatly improve the construction efficiency in the post-construction, which provides a possibility for the large-scale popularization and application of intelligent street lights.

Smart Lighting

02

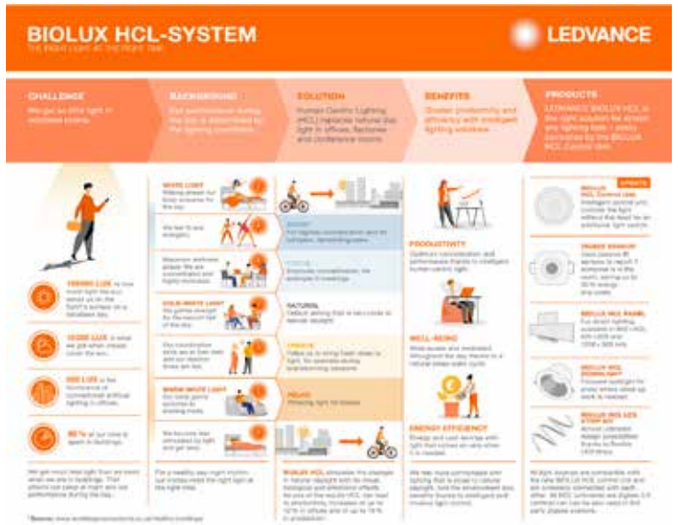
BIOLUX Human Centric Lighting System

LEDVANCE Operation & Management (Shenzhen) Co. Ltd.

Brief Introduction

The BIOLUX HCL Human-Centric Lighting Control System represents a significant leap forward based on the concept of Human-Centric Lighting (HCL). Through light source selection, luminaire system design, innovative intelligent control algorithms, and light scene creation, it effectively addresses users' requirements for indoor artificial lighting in terms of visual, biological, and emotional aspects.

In recent years, expectations regarding lighting have transcended mere brightness and color. The emergence of HCL emphasizes the biological effects of light, such as its impact on human circadian rhythms. The BIOLUX system fully integrates this concept, employing intelligent algorithms and advanced technology to not only simulate



the characteristics of natural light at different times, ensuring indoor lighting synchronizes closely with the body's internal clock, but also creatively developing various light scene modes. These modes can be adjusted in real-time based on the diverse needs of user groups to achieve optimal experiences and effects.

Foremost, the system's most significant technological breakthrough lies in its ability to accurately simulate the fluctuations of natural light, offering an experience indoors that mirrors the natural light outdoors. Leveraging geographical data and GIS information of the lighting system's location, the system meticulously considers the outdoor daylight environment's intensity, spectrum, and duration variations. This is achieved through highly innovative algorithms that generate real-time, dynamic simulations of natural light curves. This innovation not only enhances visual quality but also positively influences indicators such as work efficiency and fatigue.

Moreover, the system comprises five pre-designed dynamic light scene modes: Boost, Focus, Natural, Creative, and Relax. These modes, based on different light formulations, exert varying degrees of influence on physiological and psychological indicators. Responding to users' changing needs, they can switch light environment dynamic scenes at any time, optimizing the match for indoor usage purposes and promoting both visual and non-visual well-being.

The BIOLUX system is not merely a technological innovation but also a proactive response to everyday concerns. Its applications are widespread, particularly suitable for environments lacking natural light, such as conference rooms and offices. Through precise lighting mode adjustments, the system plays a positive role in enhancing employee focus, emotional management, and circadian rhythm alignment. Currently, this system is globally available and has been applied in various settings including retirement homes, classrooms, and offices across Europe.

The BIOLUX system has garnered extensive global recognition. It is not only the first HCL product to achieve Germany's VDE certification but has also received numerous prestigious international awards such as the German Innovation Award, Red Dot Award, and Taiwan's Golden Pin Design Award. It has been extensively covered by global media outlets and exhibitions.

The innovative nature of the BIOLUX system extends beyond its intelligent technology, encompassing its profound impact on human health and lifestyle. We firmly believe that this lighting innovation will lead the industry's development, establishing new benchmarks for future indoor lighting standards.

The Innovation Points

The BIOLUX HCL Human-Centric Lighting Control System demonstrates exceptional innovation through its technological breakthroughs, far-reaching applications, and tangible solutions to real-world issues.

As a revolutionary product rooted in the Human-Centric Lighting (HCL) concept, the BIOLUX system not only achieves a globally advanced technological standard but also leads the direction of lighting technology advancement through practical applications. Firstly, the advanced technology of BIOLUX is protected by US patents. It holds the distinction of being the first HCL product to receive Germany's VDE certification, and has also been honored with prestigious global awards such as the German Innovation Award, Red Dot Award, and Taiwan's Golden Pin Design Award. It has garnered significant media coverage and exhibition recognition worldwide. Additionally, it provides robust and reliable development foundations for the realization and timing of Human-Centric Lighting. Utilizing four technological approaches—light source selection, luminaire system design, innovative intelligent control algorithms, and light scene creation—the BIOLUX system integrates human visual, biological, and emotional needs into indoor lighting, creating an entirely new people-centric lighting experience that concretely translates academic HCL theory into practical application.

Technologically, the core innovation of the BIOLUX system lies in its ability to precisely simulate the characteristics of natural light at different times, achieving synchronization between indoor lighting and human circadian rhythms. Enabled by an intelligent control unit and innovative algorithms, the system accurately considers geographical location data and GIS information to dynamically model outdoor daylight environment's intensity, spectrum, and duration variations, generating real-time simulations of natural light curves. This technological breakthrough not only provides users with a more natural visual experience but also positively impacts key metrics such as work efficiency and fatigue. Furthermore, the system offers multiple dynamic light scene modes that influence users' physiological and psychological states through different light formulations, allowing users to switch scenes as needed to achieve optimal visual and non-visual effects.

The innovation of the BIOLUX system extends beyond technological advancements, profoundly impacting its application domains. Modern indoor environments often lack natural light, and the BIOLUX system is well-suited for scenarios such as conference rooms and offices that suffer from light deficiency. Through precise light adjustment, the system enhances employee focus, emotional management, and circadian rhythms, fostering positive effects for users.

The BIOLUX system effectively addresses the real-world problem of increased energy consumption due to HCL requirements. Its dynamically adjusted light curves, refined through algorithms, not only cater to visual and non-visual factors and emulate daylight variations, but also maintain lower energy consumption levels compared to traditional artificial lighting systems, with the aid of complex algorithms and precision sensors.

In conclusion, BIOLUX HCL Human-Centric Lighting Control System achieves revolutionary progress in the field of lighting through technological innovation and extensive application. By seamlessly combining the biological effects of light with modern lifestyle demands, it creates a more comfortable, efficient, and healthy indoor lighting environment for users, setting a new benchmark for the future development of lighting technology.

Possible Economic and Social Benefits

The BIOLUX system, as an advanced Human-Centric Lighting implementation, brings substantial economic and societal benefits to users and society at large.

Based on research conducted by authoritative third-party consulting firms, Human-Centric Lighting has the potential to enhance work performance by 12% in office environments, increase worker productivity by 18% in industrial settings, boost learning and academic performance by 14% in educational environments, and raise sales by 25% in commercial contexts. These positive effects are likely to translate to users of the BIOLUX system. Additionally, the advanced luminaire intelligent management and control system, driven by sophisticated algorithms and sensors, enables the BIOLUX system to demonstrate exceptional performance in energy efficiency and sustainability. Considering the advantages, it offers to businesses in terms of cost reduction and increased efficiency, deploying the BIOLUX system can shorten the payback period for product updates and replacements to within 6 months. This provides significant potential economic benefits to stakeholders. Moreover, it greatly contributes to the promotion of sustainable development within society and the enhancement of the well-being of human living environments.

Smart Lighting

03

Human Centric Lighting in Office Applications

Traxon Technologies Ltd.

Brief Introduction

General introduction

The Human Centric Lighting in Office Applications project aims to create a quality lighting environment for the office through the application of human lighting (HCL) technology. The goal of the project is to combine advanced lighting and intelligent control systems to meet the physical and psychological needs of employees and improve work efficiency and comfort. At the heart of the lighting unit is the e:cue SYMPHOLIGHT lighting management system, which together with various e:cue SYMPL components provides intuitive and user-friendly system operation. The dimming and color values for each individual luminaire or group of luminaires are calculated based on the time of day, brightness of natural daylight and 350 PIR luminance and presence sensor information sent to SYMPHOLIGHT via the DALI bus. As a global leader in indoor and outdoor lighting control technology, Traxon is committed to providing customers with innovative, high-performance and intelligent lighting solutions. In the design of the headquarters office in Shenzhen Science Park, Futian District, Traxon has implemented the concept of "people-oriented" lighting, creating a model of modern intelligent office environment for the office space.

Application scenario

Human Centric Lighting (HCL) technology is mainly used in office lighting design and management. Through the intelligent lighting control system of e:cue, sub-regional lighting design and management of office space can be realized, making full use of changes in natural light and achieving dynamic balance lighting. The solution provides a variety of lighting application protocol interface modules, which can easily create a lighting management system for indoor and outdoor lighting control according to different lighting needs, and has been applied in many places around the world. Osram Opto Semiconductor headquarters (Regensburg, Germany), FLUXUNIT office (Munich, Germany), Pain Treatment Center of Isar Hospital (Munich, Germany), Memory Center of St. Augustine Hospital (Neuss, Germany), etc.

Practical effect

Human Centric Lighting (HCL) technology brings multiple advantages to office Spaces. First of all, through the rhythm lighting effect that changes synchronously with the outdoor sunlight, it improves the comfort and work efficiency of employees, and creates a high-quality working lighting environment. Secondly, through multi-scene setting and precise control, the lighting needs under different work scenarios are met, and the office experience is improved. In addition, the solution saves energy, reduces the company's operating costs, and achieves the goal of energy conservation and consumption reduction.

To sum up, the application of Human Centric Lighting (HCL) technology solutions in the Shenzhen headquarters office has brought innovative technology empowerment to the office space, and achieved a new trend of intelligent, personalized and healthy and comfortable office life. The solution provides employees with a comfortable, efficient and convenient work experience through rhythmic lighting synchronized with natural light, multiple scene Settings and precise control, while saving energy and reducing operating costs. Human Centric Lighting (HCL) solutions show excellent practical results and market prospects in office Spaces, and have a positive role in promoting high-quality urban development.

The Innovation Points

Human Centric Lighting in Office Applications The project has the following innovations and technical advances:

1. Lighting design based on chronobiology and circadian clock regulation: The innovation of Human Centric Lighting (HCL) solutions is to apply the working principle of the biological clock to indoor lighting, adjusting the circadian rhythm of the human body by simulating the brightness and color temperature changes of natural light. The principles of chronobiology are integrated into lighting design to meet the biological effects of light on the human body. By adjusting the brightness, color and temperature spectrum of the light, as well as changing in sync with natural light, HCL provides a lighting solution that matches the human biological rhythm.

2. Personalized Lighting Settings: Human Centric Lighting (HCL) solutions achieve dynamically balanced lighting through subregional lighting design and management, combined with variations in natural light. HCL also innovates by providing a versatile setting for each individual office and meeting room. Through intelligent control and scene mode, the brightness and color temperature of the luminaries can be adjusted according to different work needs and environmental requirements. This personalized lighting setup increases employee alertness, focus and energy, which in turn improves work performance and productivity.

3. Adaptive Human Presence perception: Human Centric Lighting (HCL) solutions use sensor technology to achieve adaptive control of human presence perception. By sensing the presence and activity of the personnel, the system can automatically adjust the switch and brightness of the light to ensure that the light is automatically turned off when the personnel leave, thus achieving the goal of energy saving and environmental protection.

4. Programmable User interface: Human Centric Lighting (HCL) solutions provide a programmable user interface that allows users to control and manage lighting through schedule management, energy consumption dashboards, and more. This innovative technology allows users to freely adjust and customize lighting effects according to their needs and preferences for a personalized office experience.

5. Energy Savings and reduced operating costs: Human Centric Lighting (HCL) solutions not only provide efficient lighting, but also enable energy savings and reduced operating costs. Through intelligent control and sensor technology, the system can automatically adjust the light brightness and color temperature according to the actual lighting needs, minimizing energy consumption. At the same time, through the programmable user interface and the monitoring of energy consumption dashboard, users can understand and manage energy consumption in real time, further reducing operating costs.

The lighting solution solves hot, difficult and key problems in practical applications through the above innovation points:

1. Enhance office space comfort and productivity: Through dynamically balanced lighting design and adaptive human presence perception, the solution provides a comfortable, personalized lighting environment that enhances employee productivity and work experience.

2. Energy saving and environmental protection: Through intelligent control and energy consumption monitoring, the solution automatically adjusts the brightness and color temperature of the light to minimize energy consumption and achieve energy saving and environmental protection goals.

3. Flexible lighting control and management: With a programmable user interface and multi-scene Settings, the solution provides users with flexible and convenient lighting control and management to meet the lighting needs of different work scenarios.

4. Reduce operating costs: Through the monitoring and management of the energy consumption dashboard, users can understand and manage energy consumption in real time, and further reduce operating costs.

Through the above innovation points and technological advancement, the application of Human Centric Lighting in Office Applications in the headquarters office in Shenzhen has fully proved its practicality and demonstrated its excellent compatibility, reliability and energy saving during use. The project's innovative technologies and solutions effectively improve the quality and effectiveness of office lighting, providing employees with a more comfortable and healthy working environment, improving work efficiency and employee satisfaction.

Possible Economic and Social Benefits

Economic benefits:

1. Energy saving and cost reduction: The lighting solution uses intelligent control and sensor technology to achieve precise control and regulation of lights, minimizing energy consumption. This results in significant energy savings, reduced energy expenditure for businesses and individuals, and reduced lighting operating costs.

2. Efficient work environment: By providing a personalized, comfortable lighting environment, the solution enhances employee productivity and work experience. Adequate, soft lighting helps to reduce eye strain and improve concentration, which in turn increases employee productivity and creativity, further contributing to the economic growth of the business.

3. Market push for innovative technologies: As a leading provider of intelligent Lighting solutions, Human Centric Lighting (HCL) solutions has demonstrated its advanced technology and innovation capabilities in its Shenzhen headquarters office. This helps to enhance the company's reputation and competitiveness in the market, attract more customers and partners, and further promote the development and growth of the industry.

Social benefits:

1. Environmental protection and sustainability: By saving energy and reducing carbon emissions, the lighting solution plays a positive role in environmental protection and sustainability. Reducing energy consumption helps to reduce dependence on traditional energy sources, reduce environmental pollution and carbon footprint, and contribute to a cleaner and more sustainable future.

2. Health and well-being: Providing a comfortable, soft lighting environment helps to improve people's quality of life and work environment. The warmth and even distribution of light helps relieve stress, improve mood, and improve people's happiness and health. This is of great significance for enhancing the overall well-being and happiness of society.

In summary, the Human Centric Lighting in Office Applications project will bring significant economic and social benefits to the country, region or globally. From an economic point of view, the solution achieves energy savings and cost reductions, improves work efficiency and innovation, and drives the economic growth of the enterprise. From a social point of view, the solution promotes environmental protection and sustainable development, improves people's quality of life and happiness, and also shapes the image and sustainable development of the city.

Mini/Micro LED

04

New White Light Mini LED Display Application

Shineon Innovation Technology Co., Ltd.

Brief Introduction

In terms of new display technology, from PDP to LCD, and then to OLED, with the arrival of the intelligent world, more efficient and energy-saving new display technology will play an important role in it. The emergence of Mini/Micro LED display technology has been sought after by the global industry and academia. As a country with a deep layout in the LED and LCD industries and an absolute say in production capacity, China is an excellent opportunity for us to lead the world, and it is also closely related to China's information security and carbon neutrality. Samsung and LG from South Korea, Sony from Japan, and PlayNitride, AUO, and Ennostar from Taiwan have all released related products. Domestic upstream and downstream enterprises such as BOE, CSOT, Hisense, TCL, and San'an have successively laid out relevant technologies, and midstream module factories also need to follow up in a timely manner to help China achieve breakthroughs and lead the world in the historical opportunity period of new display technology crossing generations.

Due to environmental issues, high color gamut quantum dot materials contain heavy metal materials such as Ge, which have great pollution and harm to the environment. Therefore, it is extremely important and urgent to develop a white light solution with high efficiency, high color gamut and high cost performance. This project is a new type of white Mini LED backlight module without heavy metal based on AM driver.

It is mainly used as backlight source in LCD display products, including TV/MNT/NB/PAD/IPD and other display products.

Through this solution, higher black and white contrast, higher gray scale performance level, higher brightness and lower power consumption of LCD display products can be realized. And it also has high color gamut, lower cost. It helps to improve the penetration rate of Mini LED backlight in LCD display products, and makes up for the last short board in performance compared with OLED display. At the same time, due to the increase in the number of chips and the significant increase in display effect, with the increase in Mini LED penetration, the problem of overcapacity in the two major industries of LCD and LED will be effectively alleviated.

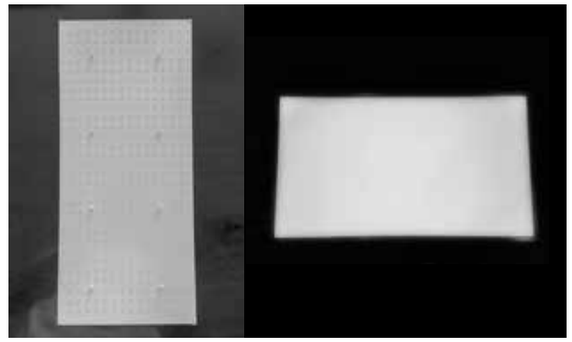
Product Performance:

1. White Mini LED backlight module solution, making the color more vivid, higher saturation, color gamut ≥ 90% NTSC;

2. White Mini LED lighting angle is greater than 170, Pitch/OD ≥ 1.5, fewer Mini LED chips, more cost effective, the cost will reach 1/2 of the existing Mini LED blue light solution, and it have the opportunity to improvement in the future;

3. The brightness of the display product reaches the typical value of 1000nits, the peak value is 2000nits, and the brightness uniformity is ≥ 90%; More details of the picture can be presented. The brightness of the highlighted part of the picture is bright enough and the dark part of the picture has details;

4. The solution is based on AM drive, the number of partitions ≥ 1152 zones, and the contrast ratio of the display product will be greater than 1000000:1, meeting the HDR1000 standard;



The White light Mini-COB PCB.

The lighted white light Mini-COB backlight module.

The Innovation Points

This white mini-COB solution for BLU was first proposed in China, and successfully realized productization, reaching the domestic leading position. The technology mainly revolves around the problems that bottlenecks of Mini LED in LCD backlight applications:

1. The reliability, environmental protection and mass production problems faced using quantum dot solutions in the Mini LED white lighting solutions. The white light mainly solves the potential environmental pollution problem existing in the existing QD film solution, and at the same time, the overall backlight module cost can be further reduced by white light. Due to the rules of light distribution of Mini LED blue chip, the optical lens size specification and position deviation requirements are extremely strict in the actual production process, which should be controlled within 200um, resulting in extremely low production yield and efficiency. At the same time, this solution is the first real white Mini COB solution in China. Currently, the existing white light solutions in the industry are all POB solutions, which means that the Mini LEDs still has a brackets or other intermediate structures to carry the Mini LED chips, instead of directly attaching the Mini LED chips on the PCBs, which is not a real Mini COB.

The FPGA for AM IC to drive white light Mini-COB backlight module.

The white light mini-cob backlight module with dynamic dimming.

2. Mini LED has low cost-effectiveness and low penetration rate. The main solution of optical design is that the existing Mini LED is used in too many quantities (Pitch/OD<1.5), resulting in high cost and inability to achieve industrialization and greater penetration rate. PM drive causes high energy consumption, poor display effect, and cannot support the problem of high refresh rate. AM driver mainly solves health and environmental protection related issues such as flicker and high energy consumption in existing PM driver solutions. The scanning method utilizes the residual effect of human vision to obtain image presentation, Therefore, there will be complex connections (X+Y connections are required), large parasitic resistance and capacitance will lead to low efficiency, short pixel luminous time (1 field/XY), which will lead to low effective brightness, easy crosstalk between pixels, high demand for scanning signal frequency, high requirements for circuit control, great difficulty, and inability to achieve a high refresh rate.

Through the implementation of this technical solution, the price of our COB Mini LED backlight products will be greatly reduced, from the super flagship product series that can only be applied in the display category to ordinary civilian products. At the same time, the image quality and effect of the display will reach a level comparable to that of OLED. At the same time, compared with the production and manufacture of OLED, it is environmentally friendly and healthy. At the same time, for China's two industries that both account for over 70% of the global market, they have exerted their respective advantages and formed a strong alliance, which has solved the problem of severe overcapacity caused by changes in international trade situation and economic conditions in the two industries. At the same time, it has also ensured China's leading position in the global market and industrial security in the display industry. This technical solution will effectively promote the large-scale implementation of Mini

LED backlight in LCD display products.

Innovation point:

1. The high color gamut white light Mini COB solution uses a high color gamut fluorescent powder solution to achieve white light conversion of Mini COB. By combining the Mini LED chip with KSF fluorescent powder to directly convert white light on PCB lamp boards, it solves the environmental pollution problem of the existing QD Film solution commonly used in the industry, reduces costs, and promotes the large-scale popularization of Mini LED products. At the same time, the light distribution of the entire light-emitting Mini LED unit is no longer a regular distribution after the Mini LED is whitewashing, and light is emitted in all directions. Therefore, in the matching process with the lens, there is no such thing as the blue light solution. Only by aligning each beam

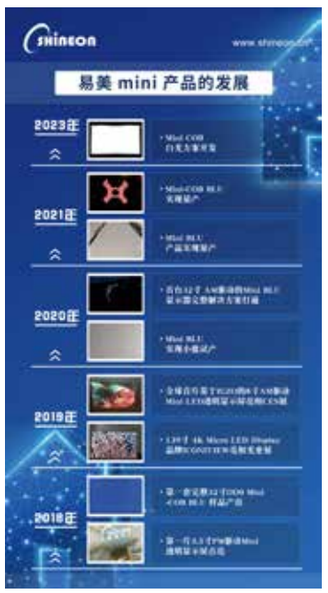
of light with the corresponding interface position of the lens can the light type after the overall light emission be consistent. The process window for matching the Mini LED light-emitting unit with the lens will be greatly reduced. The production yield and efficiency of the Mini COB backlight solution are greatly improved, thus greatly reducing the cost.

2. The use of integrated molding optical materials to solve the problem of Mini LED divergence angle is too small, through the use of molding silica gel through process adjustment to achieve the lens free-form surface controllable and adjustable. The light-emitting angle of the Mini LED is expanded to 170-180 degrees, so that a single Mini LED can obtain a larger light spot under the same chip, the same spacing and the same OD, thus greatly reducing the number of Mini LEDs used and reducing the number of Mini LEDs used by at least 2/3.

3. Through the development of AM drive solution, the independent control of backlight partition is realized, which solves the problems of existing Min LED smearing, caterpillar phenomenon, delay, flicker etc., and improves eye protection and health while obtaining high image quality.

Possible Economic and Social Benefits

As the first new technology with broad market prospects, it has the advantages of “thin film, miniaturization and array”, and will be gradually introduced into industrial applications. From the terminal application scenario, the application field of Mini LED can be divided into two scenarios: direct display and backlight. In 2020, the capital invested in the Mini LED field is close to 38 billion yuan, of which the investment of LED industry chain enterprises is about 28.8 billion yuan, and the capital invested by LED chip enterprises in the Mini LED field has exceeded 16.5 billion yuan, accounting for 43.42 of the investment scale in this field. Mini LED has a broad market prospect. With the increase of market demand for LED display screens in rental market, HDR market application, retail department stores and conference rooms, it is estimated that the market output value will reach 2.891 billion US dollars by 2025. Judging from the market size of Mini -LED, the application of large-size displays will become the mainstream. It is estimated that the output value of large-size displays will reach 1.98 billion US dollars by 2025, accounting for 68% of all applications.



It will form an annual production capacity of 150000 high-brightness LED devices, form a high-tech, large-scale LED device R & D and production base, become a leading enterprise in Beijing’s LED industry, and an important strategic supplier of Beijing's major industrial projects BOE. It belongs to the manufacture of photoelectric products, adopts automatic production equipment, advanced production process technology, belongs to clean production with low energy consumption, and there is no waste water and waste gas discharge in the production process.

The natural performance advantages of inorganic LED materials not only have the characteristics of high luminous efficiency, but more importantly, they are not affected by water vapor, oxygen or high temperature, so they have obvious advantages in stability, service life, working temperature, etc.

Mini/Micro LED

05

A Color Uniform Mini LED Module

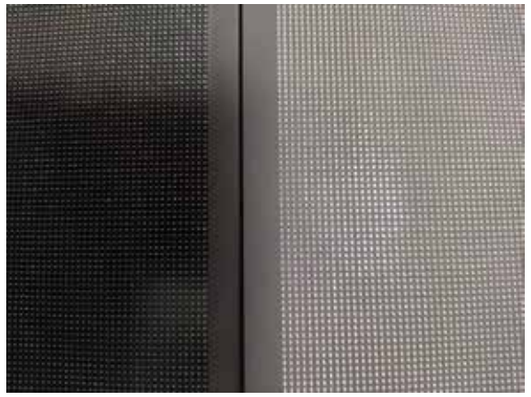
State Key Laboratory of Solid State Lighting
Xiamen Guo Zhao Technology Co., Ltd.
Wide Bandgap Semiconductor Technology (Shenzhen) Co., Ltd.

Brief Introduction

As a solid-state light source, Light Emitting Diodes (LEDs) are semiconductor devices that directly convert electrical energy into light energy without the need for other forms of energy conversion. LEDs do not contain harmful substances like mercury, have high luminous efficiency, and are easy to recycle after disposal, making them known as efficient and environmentally friendly light sources. They have long lifetimes, high reliability, and can operate for extended periods without frequent maintenance or replacement.

Mini LED, also known as sub-millimeter LED, typically has dimensions ranging from 80 μm to 200 μm. It is a new generation LED technology that inherits the characteristics of small-pitch LEDs, such as high efficiency, high reliability, high brightness, and fast response time. Compared to small-pitch LEDs, Mini LEDs consume less power and have lower costs. During the packaging process, Mini LEDs need to be soldered onto the Printed Circuit Board (PCB). The surface solder resist layer color may vary among different PCBs, and there may also be color differences in different areas of the same PCB's solder resist layer. These color differences can affect the optical performance and appearance of the final Mini LED module, resulting in significant variations.

In this method, after the Mini LEDs are chip bonded, a precision inkjet printing or precision dispensing process is used to cover the PCB surface with black ultraviolet-curable ink. The ink, when cured by UV light, forms a solder resist layer cover film, addressing the issue of unevenness on the PCB surface. The solder resist layer cover film is a solid material that can tightly bond with the PCB and silicone protective layer, improving the module's contrast and color uniformity while maintaining a consistent appearance. This method does not degrade the light flux output of the Mini LED module.



The Innovation Points

The technical solution used in this method is as follows:

A color-uniform Mini LED module, comprising a PCB board, multiple Mini LED chips, a silicone protective layer, and a solder resist layer cover film. The bottom of the Mini LED chips is fixed onto the PCB board through solder joints, and the solder resist layer cover film covers the surface of the PCB board. The thickness of the solder resist layer cover film is the sum of the height of the Mini LED chips and the solder joints, and the silicone protective layer covers the surface of the solder resist layer cover film and the Mini LED chips.

In this method, the thickness of the solder resist layer cover film is 50-150μm.

In a preferred embodiment, the height of the Mini LED chips is 100-200μm, and the height of the solder joints is 150-300μm.

In a specific embodiment, the solder resist layer cover film is the cured ultraviolet-curable ink, which comprises the following weight components: water-based polyurethane resin (65 parts), 2,4,6-trimethylbenzoyl diphenylphosphine oxide (8 parts), 2-methyl-1-[2-(4-morpholinyl) -1-oxopropyl]-2-n-methylol-1-propanone (5 parts), 1-hydroxy-cyclohexylphenylketone (2 parts), nanoscale copper-chromium black pigment (5 parts), water-based defoaming agent (5 parts), deionized water (10 parts).

The silicone protective layer in this method is preferably polydimethylsiloxane.

A method for producing a color-uniform Mini LED module in this method comprises the following steps:

I. Solder the Mini LED chips onto the corresponding solder pads on the PCB board to complete chip bonding.

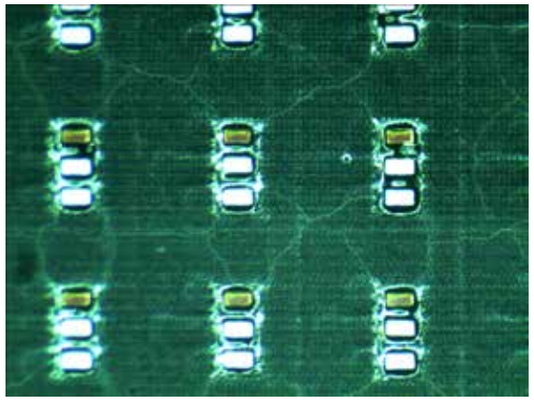
II. Cover the surface of the PCB board with black ultraviolet-curable ink through precision inkjet printing or precision dispensing.

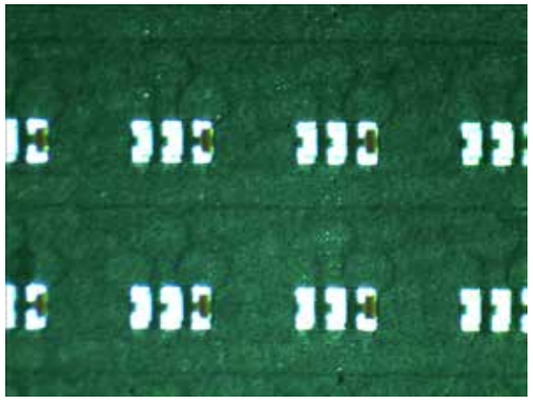
III. Use a deep ultraviolet light source with a peak wavelength of 350-400nm to irradiate the ultraviolet-curable ink in step II, causing it to cure and form a solder resist layer cover film.

IV. Use dispensing to drop silicone gel onto the solder resist layer cover film formed in step III, heat-cure it to form a silicone protective layer, and obtain the Mini LED module.

The beneficial effects of this method include:

After chip bonding, this method covers the surface of the PCB board with black ultraviolet-curable ink through precision inkjet printing or precision dispensing, forming a cured solder resist layer cover film. This solves the problem of surface unevenness on the PCB board. The solder resist layer cover film is a solid material that can tightly bond with the PCB board and the silicone protective layer, improving the module's contrast and color uniformity while maintaining a consistent appearance, without reducing the light output of the Mini LED module.





Possible Economic and Social Benefits

1. From an economic perspective, Mini LED has the following economic benefits:

Market growth and business opportunities: Mini LED, as an emerging technology, brings growth and business opportunities to the LED display and lighting markets. Its advantages, including higher brightness, higher contrast, and lower power consumption, make Mini LED displays have great potential in fields such as television, electronic devices, and automotive displays.

Cost-effectiveness: Mini LED technology utilizes tiny-sized LED chips. This means that when producing smaller-sized and higher-resolution displays, the cost is relatively lower, thus improving manufacturing efficiency and reducing production costs.

Innovation and competitiveness: The introduction of Mini LED technology stimulates innovation and competition in the display industry. Manufacturers need to continuously improve production processes and technologies to achieve smaller, brighter, and higher-quality Mini LED displays.

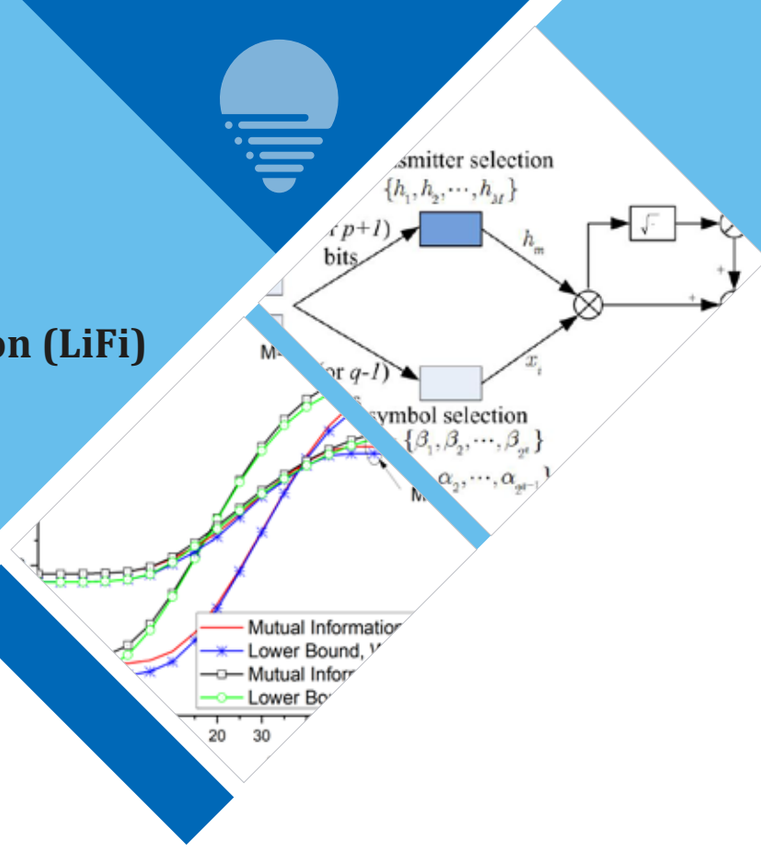
2. At the societal level, Mini LED technology also brings a range of social benefits:

Energy savings: Compared to traditional display technologies, Mini LED technology has lower energy consumption for the same brightness and resolution. Adopting Mini LED displays can reduce energy consumption, decrease carbon emissions, and have a positive impact on the environment.

Improved visual experience: Mini LED displays' high brightness and high contrast characteristics provide more delicate and realistic image and video display effects. This enhancement of the visual experience helps to improve user satisfaction and provide a better viewing experience.

Visible Light Communication (LiFi)

06



Bit Mapping Methods and Performance Evaluation Techniques for Optical Spatial Modulation Systems

Nanjing University of Posts and Telecommunications
(Jin-Yuan Wang, Sheng-Hong Lin, Min Lin, Jun-Bo Wang, Jianxin Dai, Jian-Xia Zhu, Hong Ge, Bo Huang)

Brief Introduction

Visible light communication (VLC), which combines illumination and communication, has the advantages of rich spectrum and no electromagnetic interference. By integrating spatial modulation and VLC, the constructed optical spatial modulation (OSM) system has attracted much attention, as shown in Fig. 1. The system employs multiple light-emitting diodes (LEDs) at the transmitter and multiple photodiodes (PDs) at the receiver. At each time instant, only an LED is activated to send message and the others are silent. Therefore, OSM technique can avoid inter-channel interference and synchronization problems in multi-input multi-output (MIMO).

In addition to signal constellations, OSM can also provide space constellations, i.e., the LED's index can be used to convey information. In existing studies, to guarantee the bit number mapped by the LED's index is an integer, the number of LEDs is often set to be a power of two. However, when deploying LEDs indoors, the number of LEDs may not necessarily be a power of two. In this case, existing bit mapping methods are inapplicable. To this end, we propose an adaptive bit mapping method for OSM when the number of LEDs is arbitrary, as shown in

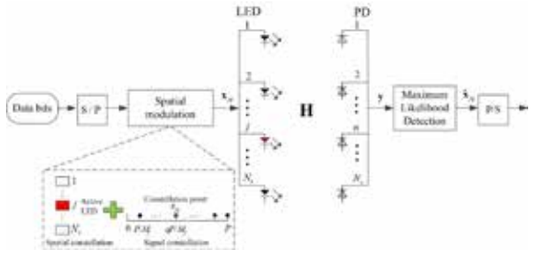


Fig. 1 Schematic diagram of OSM

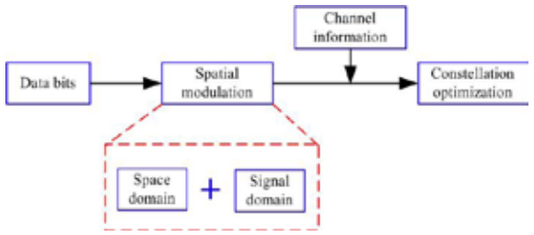


Fig. 2 Adaptive bit mapping method for OSM

Fig. 4 Published papers

Fig. 2. Such a method includes three steps: (i) Spatial domain bit mapping: Each LED's index carries a different information bit number; (ii) Signal-domain bit mapping: Bit number sent on each time instant is identical by using different pulse amplitude modulations; (iii) Channel state information (CSI)-based adaptive bit mapping: Based on the CSI, the optimal bit mapping with best system performance is obtained. Some contents have granted a patent ZL201710363164.4, while other contents have been published in IEEE Access and WCSP.

We propose performance analysis methods for OSM systems, and derive the closed-form expressions of key indicators such as mutual information, symbol error rate and secrecy rate. We also optimize the constellations, the precoding matrix, and the modulation order. The related results have been published in journals such as IEEE J. Sel. Areas Commun., IEEE Photon. Technol. Lett., IEEE Photon. J. and conferences such as IEEE GlobeCOM, as shown in Fig. 4.

The proposed bit mapping method in this application extends the application scenarios of OSM, so that the system is no longer limited by the number of LEDs. That is, regardless of the number of LEDs, adaptive bit mapping can be performed efficiently. The obtained performance analysis and parameter optimization results can provide theoretical support for evaluating and optimizing system performance, which have broad prospects in applications.

The Innovation Points

1. Innovation of the Application

(1) Adaptive Bit Mapping Method for OSM With Arbitrary Number of LEDs

When the number of LEDs is N_t (not a power of two), the bit mapping method includes three steps:

(i) Bit mapping in space domain

① Choose k∈¥⁺ such that ;

② Define $\Gamma = \{1, 2, \ldots, N_t\}$ be the LEDs' indexes set, and select the former 2^k elements from Γ into Ω set ; Divide set Ω into two sets Ψ and Ξ, where Ξ contains the former 2^{k+1}-N_t elements and Ψ contains the remainder N_t-2^k elements. Then, k bits are used to map these 2^k elements.

③ Define the remaining elements of Γ as the set Φ .

④ The bit mapping in set Φ is initially the same as that in set Ψ .

⑤ "0" and "1" are appended at the end of each bit mapping for sets Ψ and Φ, respectively.

⑥ A data bit is added at the end of each bit mapping for set Ξ , which is determined by the bit mapping in signal domain.

(ii) Bit mapping in signal domain

① Choose q∈¥⁺

② When the LEDs with the index in sets Ψ and Φ are activated, 2^q-ary PAM is employed;

③ When the LEDs with the index in set Ξ are activated, 2^{q+1}-ary PAM is employed.

(iii) CSI-based adaptive bit mapping

① Find all modulation combination D=$\{d_1, L, d_L\}$, where the i-th combination is $d_i = [M_1^i, M_2^i, L, M_{N_t}^i]$ denotes the modulation order of the -th LED in the -th combination.

② Select the best modulation combination from all combinations in set D.

③ The corresponding set of the LEDs' indexes is obtain according to d_{opt} .

Fig. 5 shows BER performance of the proposed CABM scheme and the MV-IGCH scheme. As can be seen, the BER of the proposed CABM scheme always lower than that of the MV-IGCH scheme, which verifies the superiority of the proposed scheme.

(2) Performance Evaluation and Optimization of OSM Systems

For an arbitrary number of LEDs, we derive the mutual information and its lower bound of the OSM system, which can be used for system performance evaluation. A precoding scheme is proposed to further improve performance. In Fig. 6, the gap between the mutual information and its lower bound is small, which verifies the accuracy of the theoretical derivations. The performance of the proposed precoding scheme is better than that of the scheme without precoding.

For OSM systems with eavesdroppers, the secrecy-rate bounds and asymptotic bounds are derived, which can be used to evaluate the physical-layer security of the system. To enhance secrecy rate, the selection of activated LEDs is optimized, and the channel adaptive selection (CAS) and greedy selection (GS) schemes are proposed. From Fig. 7, the derived secrecy rate bounds are tight, and the performance of the proposed two schemes is constantly better than traditional uniform selection (US) scheme.

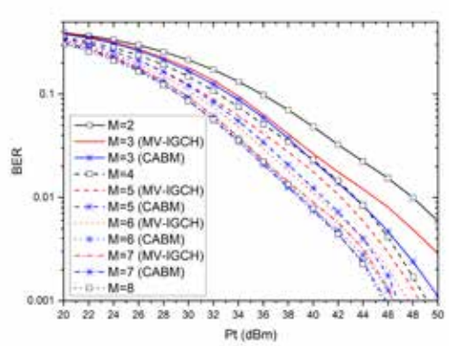


Fig. 5 BER comparisons between the proposed CABM scheme and the MV-IGCH scheme

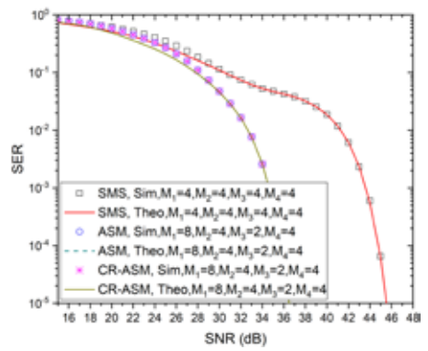
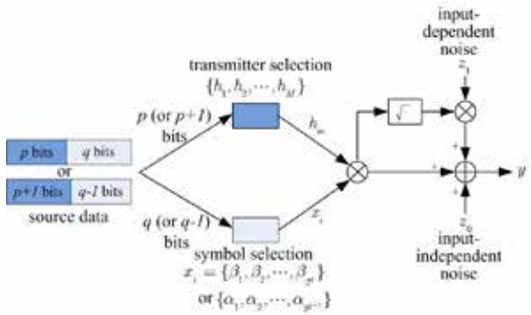
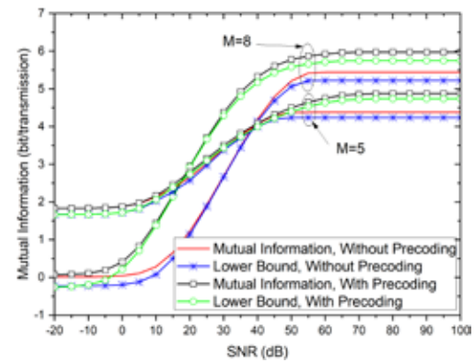


Fig. 8 Comparison of SER performance with different modulation order optimization strategies



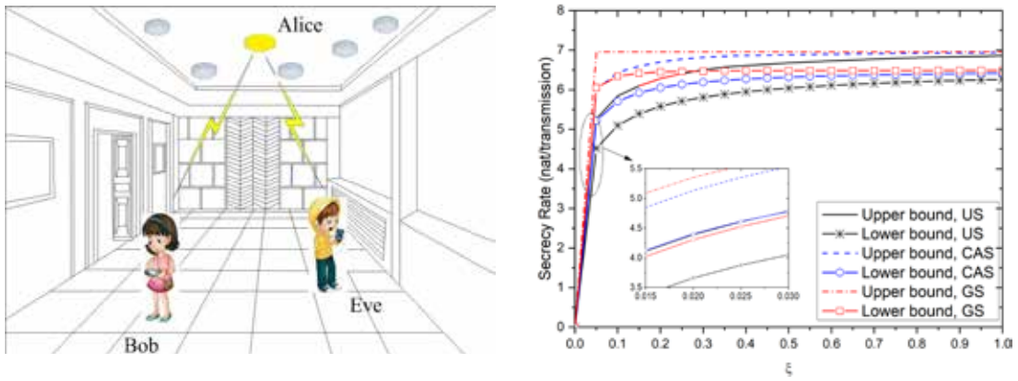
(a) System schematic diagram



(b) Performance Comparisons under different schemes

Fig. 6. OSM system with arbitrary number of LEDs

For the OSM system, the symbol error rate (SER) expression is derived, which can be used to evaluate system's error performance. To improve the reliability, the modulation order is optimized, and the adaptive spatial modulation (ASM) and candidate reduction ASM (CR-ASM) schemes are proposed. From Fig. 8, theoretical results match with the simulation results, which verifies the accuracy of the derived SER expression. Both the proposed ASM and CR-ASM schemes outperform the conventional SMS scheme.



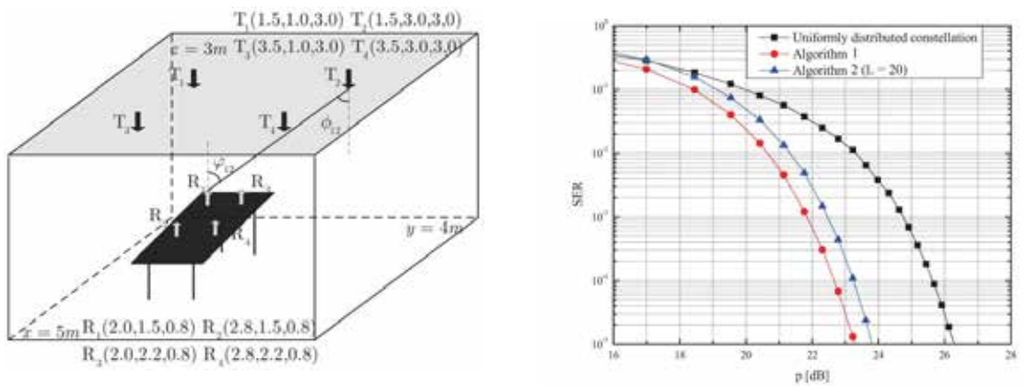
(a) System Diagram (b) Performance Comparisons under different schemes

Fig. 7. Physical layer security for OSM systems

For the OSM system, a multidimensional signal constellation is designed by maximizing the minimum Euclidean distance between the constellation points, and an interior point algorithm (Algorithm 1) and a low-complexity greedy algorithm (Algorithm 2) based on Jacobi's algorithm are proposed. As can be seen from Fig. 9, the performance of both proposed algorithms is better than the traditional uniformly distributed constellations, indicating the superiority of the proposed algorithms; the performance of the proposed Algorithm 2 is slightly worse than Algorithm 1, but the complexity is greatly reduced.

2. Regional or Global Level

It is predicted that more than 80% of data services will occur indoors in the future, and thus VLC will play an important role in 6G indoor wireless access. Although MIMO can achieve high-speed transmission, its performance depends on antenna's position, synchronization and the complexity of interference cancellation algorithms. The OSM can effectively overcome the drawbacks of MIMO while maintaining high spectrum utilization, which is a promising VLC technology. Although OSM has been widely studied, most works assume



(a) System deployment (b) SER comparisons for different algorithms

Fig. 9 Constellation optimization for OSM systems

that the number of LEDs is a power of two, which undoubtedly restricts the applications. Our proposed adaptive bit mapping method perfectly solves the problem and extends the application fields of OSM. We also analyze system performance of OSM and optimize key parameters, which provides the fundamental performance limit for theoretical research and technical support for system design. The research contents have reached a level of internationally advanced.

3. Key Problems Solved

The limitation that the number of LEDs in OSM system must be a power of 2 is overcome, and the bit mapping with arbitrary number of LEDs is realized, which extends the application fields of OSM.

The fundamental performance limits of OSM system (such as mutual information, SER and secrecy rate) are revealed, and key parameters are optimized, which provide theoretical guidance for practical system design.

Possible Economic and Social Benefits

By 2024, it is expected that tens of billions of LED lighting equipments will construct a huge VLC network. The global VLC market could reach 101.3 billion dollars, while China's VLC mark could reach 32.55 billion yuan. In this application, the proposed bit mapping method and the obtained fundamental performance limits for OSM are currently in the theoretical research stage and have not been applied to practical VLC systems. However, it can be imagined that introducing the proposed OSM technologies into VLC can significantly improve the system's spectrum utilization and reliability, and can assist in the rapid development of VLC. In the near future, after the realization of large-scale OSM systems, each LED can be used as a high-speed network hotspot, which can meet the wireless communication requirements at networks terminals, such as indoor networks, Internet of Things, Internet of vehicles, Industry 4.0, secure payment, smart city, national defense communications, weapons and equipment, electromagnetic sensitive areas. It can provide a new and affordable access method for "Internet +". In the coming decades, the amount of information transmission will exceed the carrying capacity of the existing radio frequency spectrum. Therefore, the OSM technology can effectively break through the dilemma of the serious shortage of radio frequency spectrum resources. The OSM technology is one of the next generation wireless communication technologies with broad application prospects, and can also form a strategic emerging industry with an annual output value of trillions.

Visible Light Communication (LiFi)

07

A Low-power Consumption Wearable Lightwave Sensing Communication and Positioning System

Zhejiang Zheneng Lanxi Electric Power Generation Co., Ltd.
Zhejiang Energy Digital Technology Co., Ltd.

Brief Introduction

In the context of ubiquitous sensing and interconnectedness, traditional wireless communication technologies face issues such as spectrum resource depletion, high energy consumption and unsuitability for radiation-sensitive environments. Visible Light Communication (VLC), as an emerging communication technology with abundant spectrum resources, green energy efficiency and no electromagnetic radiation interference, has been recognized as one of the key technologies for next-generation 6G spectrum communication. Utilizing the visible light spectrum for signal transmission and precise positioning of individuals, VLC is considered a practical approach to implement VLC on commercial devices, providing location services and intelligent visualization management in settings such as factories and large warehouses. Therefore, conducting research on low-power wearable optical wave sensing communication positioning systems and expediting their practical application not only enables the overcoming of current communication spectrum limitations but also holds the potential to usher in the next generation of green communication revolution.

This application presents a comprehensive positioning system solution that utilizes components such as visible

light positioning signal-emitting LED lights and low-power wearable VLC positioning receivers. The purpose of this application is to address three key technical challenges: (1) how to reduce power consumption and enhance battery life for positioning; (2) how to rapidly construct maps during system deployment to meet scene adaptation requirements and effectively coordinate with positioning algorithms to achieve high robustness

in positioning; (3) how to address the varying interference caused by different environmental backgrounds and positioning lights in different scenarios, which can result in significant positioning deviations after the deployment of the positioning system. To tackle these issues, this application employs various novel technologies, including low-power code-division multiplexing positioning technology, visible light fingerprint mapping technology, positioning error self-calibration technology, indoor visible light positioning algorithm based on ELM neural networks, and visible light fusion positioning technology based on Kalman filtering. These technologies enable accurate personnel positioning and provide intelligent visualization management.

By integrating the aforementioned innovative technologies into the existing VLC system, the LED light source can serve not only as an illumination device but also as a signal base station. The backend service system provides functions such as personnel positioning, target tracking, trajectory querying, behavior analysis, and violation warning. It also integrates live surveillance video display, facilitating video monitoring when querying personnel locations. To ensure continuous positioning functionality, the design incorporates the transceiver components with backup batteries and Bluetooth positioning, achieving dual protection. The purpose of this application is to reduce personnel safety risks, improve production efficiency, and lower operational costs, thereby enhancing security and efficiency in settings such as factories and warehouses. This further promotes the safety and stable operation of power plants.

The Innovation Points

Japan, Western countries, and Singapore have made earlier advancements in VLC research, but the existing VLC systems are still not well-suited for precise personnel positioning scenarios and have only a limited number of practical applications. Therefore, there is an urgent need for further research and industrialization to address the technical bottlenecks of VLC in practical personnel positioning scenarios. To tackle the actual issues of high-power consumption, poor scene adaptability, and low positioning accuracy in existing VLC systems, this application innovatively conducts in-depth research on key technologies to improve VLC performance. The focus is on addressing crucial issues related to VLC performance optimization in personnel positioning scenarios, enhancing the practicality of VLC in personnel positioning applications, providing effective solutions for reliable data transmission in personnel positioning scenarios, and contributing to the competitive advantage of optical communication technology in the field of next-generation communication networks.

The innovations in this application can be summarized as follows:

(1) To address the power consumption and battery life issues of the positioning system, a low-power code-division multiplexing positioning technology is adopted. By using code-division multiplexing modulation/demodulation for signal transmission and positioning, the energy consumption of the devices is successfully reduced, extending their lifespan.

(2) To achieve high-precision positioning and scene adaptation, a visible light fingerprint mapping technology is employed. By collecting visible light fingerprint information in the environment, a fingerprint database and matching algorithm are established, enabling rapid map construction and effective coordination with positioning algorithms, thus resolving the challenges of fast map construction and robust positioning.

(3) To improve the accuracy and stability of the positioning system, a positioning error self-calibration technology is introduced. By monitoring and correcting errors in the positioning system, adaptive and self-calibrating capabilities are achieved, mitigating error accumulation caused by environmental changes and device drift.

(4) To achieve precise positioning in indoor environments, an indoor visible light positioning algorithm based on ELM (Extreme Learning Machine) neural networks is utilized. Through learning and training by the neural network, the positioning signals in indoor environments are recognized and analyzed, enhancing the accuracy and reliability of the positioning system.

(5) To combine multiple sources of positioning information and improve positioning accuracy, a visible light fusion positioning technology based on Kalman filtering is employed. By fusing data from multiple positioning sources using state transition and measurement models, the accuracy and stability of the positioning system are enhanced.

The introduction of these five innovations aims to address three key technical challenges. Firstly, the use of low-power code-division multiplexing positioning technology reduces power consumption and enhances battery life. Secondly, the application of visible light fingerprint mapping technology enables rapid map construction and robust positioning. Lastly, the positioning error self-calibration technology is employed to tackle the issue of positioning accuracy deviations in different scenarios.

In summary, this application explores the international forefront and breaks through the technological bottlenecks of existing VLC systems. It enables the positioning system to better adapt to different environments and requirements in practical applications, surpassing the limitations of traditional positioning systems. As a result, it significantly enhances the security and efficiency of settings such as factories and warehouses, reduces personnel safety risks, improves production efficiency, and lowers operational costs.

Possible Economic and Social Benefits

The low-power wearable optical sensing positioning system provides indoor ultra-high-speed communication and offers advantages such as high positioning accuracy, low cost, simple deployment, strong confidentiality, no electromagnetic interference, and lighting integration. It aligns with the national energy-saving and emission reduction strategy. This project establishes a production safety monitoring and early warning platform based on the Internet of Things (IoT), indoor positioning, and AI technologies. By collecting data and maintaining the relationships between areas, tags, and personnel through basic configurations, it integrates tag position information and personnel relationship models. This enables applications such as personnel positioning, monitoring, trajectory playback, dynamic warnings, and area device monitoring. It truly achieves human-machine interaction, providing a double insurance for the safety and intelligent operation of power plants and laying the groundwork for the construction of smart power plants.

This project effectively enables secure positioning for production management in power plants, providing new technological support for the safety and intelligent operation of power plants. It reduces personnel safety risks, improves production efficiency, and lowers operational costs, thereby promoting the safe and economic production and stable operation of power plants. The implementation of the project can provide solutions for application scenarios in industrial fields such as power plants that require security controls such as "human defense, physical defense and technical defense." The project has broad application prospects and aligns with the future development trend of indoor positioning technology. Therefore, the project outcomes have significant economic and social benefits.

Other Type

08

High Power COB LED Module with Tunable Correlated Color Temperature

Changchun Cedar Electronics Technology Co., Ltd.

Brief Introduction

The tunable correlated color temperature high-power COB LED module is designed in this project, according to GB/T 35269-2017 《Road Lamps with Non-integrated LED Modules Required by LED Lighting Application and Interface》, and adopts integrated heat supconducting and dissipation to break through the bottleneck of COB light source heat dissipation, realize small volume and lightweight yet standard module size, higher power and power density, effectively reduce the wind resistance of lamps on roads, high poles, expressway tunnels and high-speed rail tunnels, greatly minimize product costs, and realize continuously adjustable light color of a single high-power light source to meet the wide application of "beyond lighting".the wide application of "beyond lighting".

Front view of tunable correlated color temperature high power COB LED module

According to the appraisal meeting of scientific and technological achievements organized by China Lighting Society, the module has overcome the integration problem of how to make a photoelectric thermal system with small volume and lightweight yet standard module size, higher power and power density, and developed ultra-high power density standardized high power COB LED module with tunable correlated color temperature, realizing the integration of superconducting heat cavity and heat dissipation structure; By using the self-developed tunable arrangement COB chip technology, the light distribution accuracy, light control ability, parameter consistency and accurate mass production have been realized. The achievements own independent intellectual property rights and have reached the international advanced level as a whole, among which COB superconducting phase change heat dissipation and high-power COB tunable correlated color temperature technology is advanced in the world's arena and is valuable for wide popularization and application.

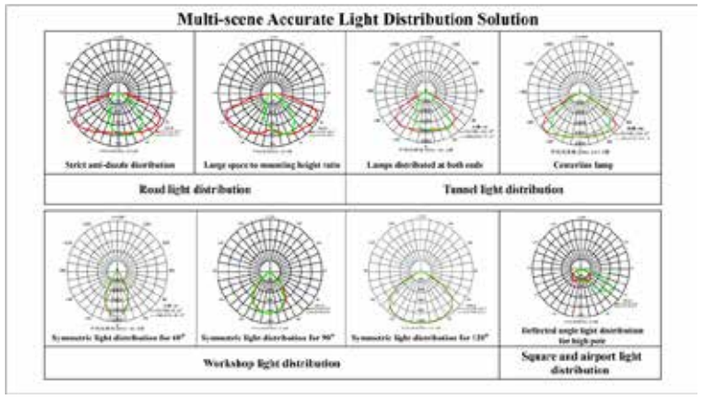
The research results can effectively replace the industry standard module, be compatible with the traditional high-pressure sodium lamp shell, and be used as the light source of large space and high-power lamps such as road lamps, tunnel lamps, high pole lamps and flood lamps with different optical systems and structural components. It can be widely used for urban roads, railways, expressway tunnels, factories, airports, docks, stadiums, museums, art galleries and other places, so as to enable a safe, healthy and energy-saving lighting environment, and promote the overall technical level of the industry and meeting the needs of major projects at home and abroad.

Verification meeting of tunable correlated color temperature high power COB LED module

Road lamps

Tunnel lamps

Flood lamps



Multi-scene accurate light distribution solution

The Innovation Points

Tunable correlated color temperature high-power COB LED module has obvious advantages in power, light source, lens material, light and color adjustment and weight compared with similar standard modules in China and the rest of the world.

For instance, a well-known international brand, its LED series modules adopt the traditional aluminum profile for heat conduction, and the size of a single module is 300mm*70mm*67mm, which can achieve the power of 50W-84W; Plenty of well-known lighting products in China also adopt standard modules, with the specification of 300mm*75mm*52mm owning the most market share, which can achieve the power of 40-60W; Another product category with large volume is ceramic pixel products, which adopt ceramic heat dissipation, and the power of a single ceramic pixel power is 3-5W, which is designed as a non-standard module. The size of 45W non-standard module is 135mm*180mm*40mm. Problems such as miscellaneous types, poor interchangeability and difficult maintenance in the later period frequently bother conventional LED lighting products both in China and the rest of the world. Modular LED lighting products have low power density due to the limitation of heat dissipation, and have problems such as multiple light sources, large volume, heavy weight, limited replacement of sodium lamps, high input cost, etc. Plastic optical fittings are easy to cause light attenuation due to electrostatic adsorption of dust, poor weather resistance and low light transmittance.

The key technology of tunable correlated color temperature high power COB LED module comes from Research on Key Technologies of LED Lamps with High Light Efficiency, High Reliability, Super Power, Small Volume and Lightweight, the third project of Research on Key Technologies of LED Lamps with High Efficiency and Reliability, which is the national key research and development plan of the 13th Five-Year Plan. The design and development of tunable correlated color temperature high-power COB LED phase change module has been carried out according to the market demand. The standard module size is 300mm*70mm*85mm, the tunable correlated color temperature is 2700K-6000K, the net weight of a single product is just 1kg, and it can realize the power of 150W. Compared with domestic and foreign products with the same power, its weight is reduced by 30%-50%, and the wind resistance area by nearly 2/3, forming product industrialization and application demonstration. And the whole product is produced in China and independently controllable. The products have independent intellectual property rights. After the scientific and technological achievements appraisal meeting organized by the Chinese Lighting Society, the self-developed tunable correlated color temperature high-power COB LED modules have been rated as the international advanced level. Especially, the technology of COB superconducting thermal phase change heat dissipation and high-power COB tunable correlated color temperature technology is advanced in the world's arena and is valuable for wide popularization and application.

Specific innovations are as follows:

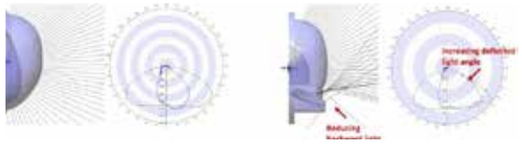
1. Enhanced working medium diversion circulation technology with omni-directional combined micro-groove

The enhanced working medium diversion circulation technology with omni-directional combined micro-groove has been adopted, which improves the heat conduction capacity of the heat dissipation module, and realizes the power of 150W for single module, which can effectively replace three industry standard (50W) modules. Compared with domestic and foreign products of the same power, the weight is reduced by 30%-50%, and the area of wind resistance by nearly 2/3, thus realizing high power, small volume and lightweight.

Technical performance of products	High-power COB LED module with tunable correlated color temperature	Traditional SMD LED Module	General COB LED module
Single module power	150~320W	40~60W	40~60W
Type of light source	High-power COB	SMD	COB
Tunable correlated color temperature	Adjustable, excellent light mixing	Mixed light difference	Adjustable, excellent light mixing
Lens material	Optical glass No yellowing, zero light attenuation	PMMA or PC Yellowing and light decay	Optical glass No yellowing, zero light attenuation
IK grade	IK09	IK06	IK09
Size/area for 150W Product	300mm*70mm / 21000m^{m}2	300mm*210mm / 63000m^{m}2	300mm*210mm / 63000m^{m}2
Weight for 150W Product	1050g±50g	1560g±50g	2130g±50g

Effective replacement of three universal 50W modules

Comparison in heat dissipation between traditional module (left) and omni-directional combined microgroove module (right)



Conventional lens design (left) v.s. compact multiple refractions and reflections integrated lens design (right)

2. Superconducting heat dissipation technology of multi-degree-of-freedom high heat flux module

Based on the omni-directional extension design of radiator, combined with the integrated technology of transverse and longitudinal multi-degree-of-freedom stretching technology and superconducting heat dissipation, it meets the heat dissipation requirements of multi-power segments and solves the problem of oneness in thermal design of traditional module radiator. Through any combination of omni-directional stretching profiles, the adaptation flexibility of module power has been improved, the balance between raw materials and power design has been achieved for sustainable development of products.

3. Compact multiple refractions and reflections integrated light distribution technology

The specially-shaped COB light source and multiple refractions and reflections integrated large space lighting lens light distribution technology has been adopted, which helps to solve the problem of low light utilization rate, improves the virtual shadow phenomenon existing in discrete light sources, and realizes accurate light distribution with different correlated color temperatures, stronger light control ability and greater lighting effect.

4. Efficient fabrication technology of standard COB module

Efforts have been made to innovatively put forward the composite technology of external pressure excess assembly and centrifugal vacuum and air direct pressure heat dissipation module, and develop on-line automatic vacuum sealing device, cavity sealing automatic detection device, high positioning precision double-speed chain assembly line and assembly carrier, which solved the technical problems of large vacuum degree difference and difficult sealing detection of phase change radiator, improved the parameter consistency and yield of product during production process, and realized rapid and accurate production in batches.

Possible Economic and Social Benefits

1. Economic benefits

The tunable correlated color temperature high-power COB LED module can effectively replace the existing industry standard module, is compatible with the structure and shell of traditional lamps and module lamps at home and abroad, and can be used as the light source of road lamps, tunnel lamps, high-pole lamps, flood lamps and other lamps with different lenses. It can be widely used for urban roads, railways, expressway tunnels, airports, stadiums, museums, art galleries and other places, supporting a safe, healthy and energy-saving outdoor lighting environment, promoting the overall technical level of the industry, meeting the needs of major project construction at home and abroad, and boasts broad market prospects. Through the promotion of wholesale, engineering and overseas channels, it is estimated that its market capacity and scale can reach more than 100 billion yuan.

2. Social benefits

The results of the project constitute a part of scientific and technological innovation of China’s 13th Five-Year Plan. By fully relying on domestic semiconductor optoelectronic technology and industrial advantages, it has realized scientific and technological innovation and upgrading, effectively increased jobs in domestic manufacturing industries, promoted the innovative development of technical professionals, cultivated and built industry leading enterprises. By absorbing international experience, efforts have been made to create excellent Chinese brands, strengthen made-in-China products and promote economic development. The products can effectively reduce the procurement cost of municipal roads, railway systems and landscape lighting, save government’s special funds for lighting construction, realize more construction projects, accelerate urban development and achieve greater benefits; The project can enable China to continue to maintain the leading level of optoelectronic industry in the world, and has very important and far-reaching significance for accelerating the transformation of China's high-tech industry represented by optoelectronic industry and promoting the transfer and transformation of China's major technological innovations and achievements. The results of the project can effectively promote the realization of the global sustainable development and China's carbon peaking and carbon neutrality goals.

TOP 100

Other Type

09

Application of UV LED in Indoor Air Purification and Disinfection

ZhongKe YUE Puritech (Shandong) New Materials Co., Ltd.

Brief Introduction

Through the COVID-19, people's attention to air health has been increasing, and the dynamic air disinfector with human-computer coexistence has received more and more attention. At the same time, conventional indoor air pollutants, such as formaldehyde, odor, etc., also need to be effectively removed by the same air purification equipment at the same time.

According to relevant data, in 2022, the market size of air disinfectors in China alone reached about 30 billion yuan, a year-on-year growth of over 10%.

It is expected that the market size of air purifiers in China will reach 100 billion yuan in 2023, with a compound annual growth rate of approximately 10.3%

The global air purifier market has exceeded $30 billion and is growing at an annual rate of 8%. In Asia, the market size of air purifiers is also constantly growing, and it is expected to reach $50 billion by 2025.

At present, air purifiers mainly use activated carbon adsorption to remove gas pollutants, which cannot inactivate bacteria and viruses and remove odors.

New semiconductor photocatalysis technology developed by the Chinese team completely based on independent intellectual property rights. It can efficiently decompose almost all organic matter VOCs and remove odor gas under normal temperature and pressure. The UVA LED photocatalysis unit has stable physical and chemical properties, corrosion resistance, intrinsic safety, explosion-proof, no pollution and the materials recyclable.

The UVALED photocatalytic unit is less affected by temperature and humidity and can directly replace the activated carbon that must be used in conventional air purifiers. It can also effectively decompose and remove odors, bacteria, and viruses that cannot be removed by activated carbon.

The Innovation Points

The newly developed UVA led light source for photocatalysis has the advantages of narrower wavelength UVA irradiance Uniform and strong, no harmful substance mercury in the raw materials, durability, no ozone generation, low energy consumption, high photoelectric efficiency, long life span》 eliminate the risk of easy damage, low photoelectric efficiency, short service life and secondary ozone pollution.

The TCSA 072-2021 standard《technical requirements for UVA LED module for photocatalysis》 issued by the CSA has been officially released, and has been approved by the ISA standard of the international semiconductor lighting and Industry Alliance《it is the first officially released UV LED application standard in the world》and The Zhong Guan Cun standard T/ZSA 82-2021 《technical specification for UVA LED module for photocatalysis》 is also released.

The photocatalysis unit based on UVA LED light source has been tested by a third-party laboratory, and the removal rate of sterilization and disinfection within one hour has exceeded 99.90%. The removal efficiency of formaldehyde, TVOCs, toluene, xylene, hydrogen sulfide, ammonia and sulfur dioxide can reach or exceed 90% within one hour in a sealed cabin, which is 5-40 times the efficiency of similar products at home and abroad.

The photocatalysis technology air disinfector can coexist man and machine, get CE certification. It has obtained the disinfection product certification of the China CDC.

Possible Economic and Social Benefits

1. UV LED has new opportunities to enter the new market, beyond UV irradiation sterilization, solidification, and biological lighting applications, dynamic air sterilization, decomposition, and removal of formaldehyde and odors under human-machine coexistence conditions, this is a new application, the market scale reaches 100 billion level.

2. In terms of photocatalytic application, UVA LED has completely replaced mercury UV light source, providing a new solution for the implementation of Minamata convention.

Global SSL Award of Innovations Top 100

Jury Panel 2023

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