MicroLED Association

White paper:

Driving Innovation: The Transformative Potential of MicroLEDs in Automotive Displays

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Driving Innovation:
The Transformative Potential of MicroLEDs in Automotive Displays

By the MicroLED Industry Association (MIA)

MicroLED Association

MicroLED technology enables high quality displays, with many advantages over current LCDs and OLEDs – including higher brightness, longer lifetime, higher efficiency, a wider operating temperature range, and more. These traits make microLED displays highly suitable for demanding automotive applications. In this white paper, we will discuss the current and future automotive display market, discuss the potential of microLEDs, and discuss current industry challenges and ways to overcome them on the road towards microLED domination of the automotive industry.

The Automotive Industry

The automotive industry is a large one, with about 60-90 million cars sold each year, globally. A typical modern car is likely to have around 3-5 displays, which can be any combination of the below automotive display types:

* Digital instrument clusters (also referred to as Driver Information Displays), these displays are located behind the steering wheel to show key vehicle information to the driver
* Main multimedia displays, also called Center Stack Displays, sit between the driver and the front passenger, and usually show various car controls, media, navigation, and camera feeds.
* Rear seat displays, also referred to as Rear-Seat Entertainment displays
* HVAC controls
* Digital rear view mirrors (side mirrors, or main driver mirror)
* Head-Up Displays, or HUDs, that project information directly onto the windshield or a separate screen in the driver's line of sight
* Additional display types, like displays embedded in car windows to show external information such as keypad for opening the door, displays embedded in knobs, assistive small displays as part of an analog instrument cluster, and more.

Modern cars often contain a large number of displays. Some car makers, for example Tesla, opt for a very large main display (the Multimedia display) while other car makers prefer several smaller displays. Car makers are adopting new technologies, such as flexible displays and higher quality and higher-efficiency displays in premium car models, but high-end displays are also making inroads into mid-range car models.

The industry today is dominated by LCD displays, but car makers are starting to adopt OLED-based displays as the new technology of choice that offers higher image quality, potentially lower power consumption, and new design capabilities in the case of flexible displays.

Here are some examples of recent car models that adopt OLED displays

The Nio EC7 with its 12.8" multimedia AMOLED display

The Mini Cooper 2025, with a 9.4" round AMOLED display (produced by Samsung Display)

The Buick Electra E5, with its 30" 6K OLED, composed of several smaller AMOLED panels

The 2023 Cadillac Lyriq EV, with a wide 33-inch OLED display (composed of several smaller panels)

The 2022 Mercedes EQE EV, with the 56"
MBUX OLED Hyperscreen (3 OLED panels under a 56-inch glass, produced by LG Display)

The Automotive Industry – Display Requirements and Sought-after Properties

Unlike the consumer electronics industry, the automotive industry imposes stringent demands on component suppliers. Automotive displays are required to have:

- **A wide operating temperature range:** The operating temperature range for automotive displays is typically between -30°C to 85°C (-22°F to 185°F). Some car models even require stricter ranges, for cars built to operate reliably in more extreme conditions. This is a much wider range than the one required for consumer electronics
- **A long lifetime:** Automotive displays are usually required to last at least 5 years, and sometimes up to 10 years. This is much longer than the standard smartphone or wearable display, which is usually required to last up to about 3 years.

In addition to these exacting requirements, automotive manufacturers are looking for high end displays, that could increase the enjoyment of drivers and passengers, or increase the car's efficiency and safety:

- **Sunlight visibility:** The ability to easily read the car's displays, especially in direct sunlight.
- **Image quality:** High image quality is important, especially the display's contrast, resolution and color depth
- **Design freedom:** As car surfaces are not flat, displays that enable more design freedom, such as flexible, foldable and rollable displays are sought after
- **Display weight and power consumption:** Especially true for electric cars, automotive car makers increasingly seek higher efficiency displays, and lower weight ones (even though the display's power consumption is insignificant compared to that of its engine)
- **Display as a sensor platform:** Displays that can contain sensors behind them, such as cameras, or fingerprint sensors, are likely to be interesting for the industry
- **Transparency:** Transparent displays are interesting to the industry, as these can be invisible when not in use (to show the surface behind them), or embedded in windows or windshields
- **Privacy:** Displays that can control the viewing angle are interesting in this industry, as car makers would like to have displays that can be viewed from specific angles for example, only by the driver, or obstructed from the driver, etc.)

Displays are becoming increasingly important for automotive makers, and this trend is expected to continue. It is likely that the adoption of new innovative displays solutions will accelerate, which opens up opportunities for next-generation display makers.

The Challenges of OLEDs in the Automotive Industry

Since AMOLEDs entered mass production around 2007, we have seen increased adoption of OLED displays, across almost all display market segments, including in smartphones, wearables, laptops, tablets, VR headsets, and TVs.

The automotive market, however, has proven to be a challenge for OLED makers, mainly because of the inherently short lifetimes of OLED materials, and the limited operating temperatures.

OLED makers have developed technologies to address this market, and adoption of AMOLED displays in cars has been on the rise in the last few years. Such technologies include a tandem emitting stack, for example, that offers increased lifetimes. Other technologies include new OLED stack materials and higher light extraction materials.

Automotive Displays: An Opportunity for MicroLED Developers

We believe that the automotive industry poses an interesting opportunity for microLED developers. MicroLED displays are highly suitable for automotive applications, especially when compared to OLEDs:

* In-organic LEDs offer much higher lifetime, and an improved operating temperature range
* The image quality of microLEDs is as good as OLEDs'
* The efficiency of microLEDs can be higher than that of OLED displays
* Novel production technologies and processes could prove to enable even higher degrees of freedom for automotive applications
* MicroLEDs enable a much higher degree of transparency
* MicroLED displays could also offer increased ability to embed sensors behind the display.

In addition, the use of simple automotive displays in HVAC applications or small displays within analog instrument clusters, could offer another entry point for microLED displays.

The main problem, of course, is the still immature microLED industry, which is not in a position to start supplying displays in volume for any application.

We believe that the automotive market poses a unique opportunity for microLED developers, a market that has a real need for increased performance compared to current display options. This situation, however, may not last for a long time, as OLED display makers keep increasing the performance of OLED displays.

We also believe that unique microLED production processes could lead to enhanced customization that could bring another advantage for automotive makers – the ability to produce unique custom-shaped displays in low volume at an acceptable price, and such a strategy could make sense for microLED developers.

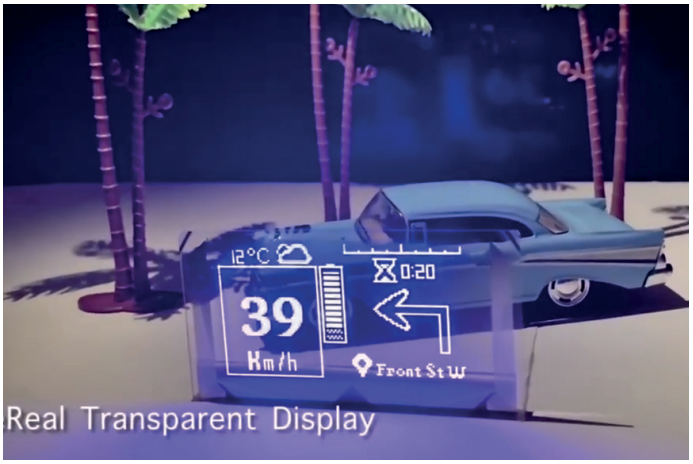
Automotive microLED prototypes

In this section we will detail some microLED prototypes, recently demonstrated:

Continental's 10" semi-transparent 'CrystalCenter' microLED prototype, developed in collaboration with Swarovski

Innolux's CarUX Pixiu 3 Premium complete cockpit system based on microLED displays

A 1" true-circle automotive microLED display prototype, with an embedded fingerprint sensor (AUO)



A custom transparent microLED automotive display, now in limited volume production (VueReal)

Transparent microLED panel integrated into vehicle side windows (AUO)

Member Directory

#Lasers, #production equipment, #Mass transfer, #inspection & repair

3D-Micromac

Laser equipment for µLED forward transfer, lift-off and repair process steps - ready for high volume production

Germany-based 3D-Micromac AG is the industry leader in laser micromachining and roll-to-roll laser systems. The company develops and manufactures processes and laser systems delivering powerful, user-friendly and leading-edge processes with superior production efficiency.

3D-Micromac systems and services have been successfully implemented in various high-tech industries worldwide. This includes semiconductor, photovoltaic, glass and display industry, electronics, as well as medical device technology.

For microLED display manufacturing, 3D-Micromac offers industrial laser solutions for mass production:

- Laser-Induced Forward Transfer (LIFT) which enables the transfer of hundreds of millions of microLEDs without having to apply mechanical forces
- Laser Lift-Off (LLO) which guarantees a highly uniform, force-free lift-off of different layers on wafer and panel substrates
- REPAIR: Single die repair process at every step of the microLED production process

https://3d-micromac.com/

#materials & technologies

3M

Produces a wide range of products including electrical and electronic connecting and insulating materials, and optical films.

The 3M Company, based in the US, operates in the fields of industry, worker safety, U.S. health care, and consumer goods. The company produces a wide range of products (over 60,000, in fact) including adhesives, abrasives, laminates, passive fire protection, protection films, dental and orthodontic products, electrical and electronic connecting and insulating materials, and optical films.

3M's Display Materials and solutions Division (DMSD) is offering several products for the industry – transparent adhesives (OCAs), micro/nanoreplication technologies, printable optical materials, and multilayered optical films.

https://www.3m.com

#microdisplays, #LED epiwafers

ALEDIA

Aledia is a start-up company established in 2021 in the Grenoble area (France) to develop GaN nanostructure-based LEDs for Display applications. It has 220 people (30% PhDs), has more than 250 patent families granted or in application, and has raised €270M in four financing rounds.

Aledia has two nanowire LED platforms, one based on blue GaN nanowires on 8-inch wafers, and the second that utilizes RGB LEDs. The company targets a wide range of markets, from AR microdisplays to TVs and videowalls.

Aledia has built a factory near Grenoble (France) for high volume epitaxial growth and low volume LED processing manufacturing; high-volume manufacturing capacity is being implemented in different countries including in Asia, closer to the market.

https://www.aledia.com/

#materials & technologies, #LED epiwafers

ALLOS Semiconductors

GaN on Silicon IP licensing and technology

ALLOS Semiconductors is an IP licensing and technology company that focuses on GaN-on-Si technology.

For the micro-LED market, ALLOS offers a turn-key technology transfer to establish a super-uniform CMOS-compatible large (200 mm) epiwafer process at customers within only 12 weeks.

https://www.allos-semiconductors.com

#LED epiwafers

ams-OSRAM

In an increasingly connected world, sensing is taking a crucial role by closing the gap between the physical and the digital. Using the full spectrum of light we allow humans and machines to capture and understand the world around us. Combining sensors, software and emitters, we bring the information that our environment holds to light by capturing, analyzing and visualizing it. We sense the world and make sense of it.

https://ams-osram.com

#MicroLED research

CEA Leti

One of the world's largest microelectronics and nanotechnology organizations

CEA-Leti is a non-profit research institute based in Grenoble, France. CEA-Leti is one of the world's largest microelectronics and nanotechnology organizations.

Leti is developing micro LED displays, with a focus on high-performance microdisplays. Leti has implemented this LED technology to manufacture high-brightness uLED arrays hybridized on silicon circuit with a 10-um pixel pitch and the institute manufactures blue and green arrays offering a brightness of 107 cd/m².

http://www.cea.fr/english

#Lasers, #production equipment, #mass transfer

Coherent

Laser-based solutions for the microLED industry: from a single laser source up to LLO, LIFT and repair systems

Coherent makes the amazing possible using the power of light. Performance, quality, and a global expert network support our customers in scientific, medical, electronics, and manufacturing markets.

MicroLEDs represents an exciting opportunity, potentially lowering the costs for very large area displays as well as some small area display applications. High energy, ultraviolet lasers are the key to success to cut production costs, increase throughput, and improve quality. Coherent provides several solutions from a single laser source, optical systems up to an integrated system for the three vital processes in MicroLED fabrication: Laser Lift-Off (LLO), Laser-Induced Forward Transfer (LIFT), and Repair/Trimming. Coherent also covers more process steps of the entire MicroLED production chain from laser cutting by ultrashort pulse lasers to Laser Assisted Bonding (LAB) by diode lasers.

http://www.coherent.com/

#materials & technologies, #LED epiwafers

Comptek Solutions

Develops quantum technology that boosts the performance of devices such as microLEDs and lasers

Founded in 2017 as a spin-off from the university of Turku, Finland, Comptek Solutions develops quantum technology (branded as Kontrox) that boosts the performance of devices such as microLEDs and lasers and makes their manufacturing process easier by solving the problem of aggressive oxidation of compound semiconductor materials.

Kontrox results in a high-quality passivation layer with substantially reduced defect densities that help to greatly decrease the surface recombination phenomena which is a predominant mechanism for such small devices.

Comptek says that MicroLED efficiencies increase significantly with Kontrox, the company has demonstrated up to 250% EQE (external quantum efficiency) improvements.

http://www.comptek-solutions.com

#materials & technologies

DELO

DELO is a leading manufacturer of high-tech adhesives and other multifunctional materials as well as corresponding dispensing and curing equipment. Their products are mainly used in the automotive, consumer electronics and semiconductor industries. They can be found in almost every mobile phone and half the cars worldwide, for example in cameras, loudspeakers, electric motors, or sensors. Customers include Bosch, Daimler, Huawei, Osram, Siemens, and Sony. The company has 1,000 employees and achieved revenues of €204 million in fiscal 2023.

Additionally, adhesives facilitate miniaturization, increase performance, and improve device functionality and reliability, from tiniest SMD component like miniLED and microLED to large size edge sealing.

https://www.delo-adhesives.com

#mass transfer

eLux

Massively parallel fluidic assembly of microLED displays

eLux Inc. was established in 2016 in the USA as a spin-out from Sharp Labs of America. eLux expertise and intellectual property development focus on the massively parallel assembly processes that enable low cost manufacturing of microLED displays.

https://www.eluxdisplay.com/

#Mass transfer

Ennostar

The holding company of Lextar, Epistar, Unikorn and Yenrich

Taiwan-based Ennostar was established in early 2021 as a joint venture between Epistar and Lextar. Ennostar is the holding company that owns both Epistar and Lextar, and together the two companies hold about 12.5% of the global LED chip market. Ennostar also holds Unikorn and Yenrich.

Ennostar official goal is to become a multinational investment platform for the compound semiconductor industries. Specifically the focus is on mini LEDs and microLEDs products and technologies.

https://www.ennostar.com/

#LED epiwafers

Epistar

One of the world's leading LED producer

Epistar Corp, based in Taiwan and established in 1996, is one of the world's leading LED producers. The company specializes in high-brightness LED devices for general lighting and consumer electronics.

Epistar is developing Micro LED chips and technologies. In 2021 Epistar merged with Lextar to form Ennostar.

http://www.epistar.com.tw/index_en.php

#materials & technologies, #microdisplays, #MicroLED Research

Fraunhofer FEP

Electron beam technologies, vacuum thin film deposition techniques and technologies for organic electronics, microdisplay technology and sensorics.

The Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP is one out of 76 institutes and research units of the Fraunhofer-Gesellschaft e. V., the largest European institution for applied research. The core competences of Fraunhofer FEP are electron beam technologies, vacuum thin film deposition techniques and technologies for organic electronics, microdisplay technology and sensorics. Main activities target development and adaption of the thin film deposition technologies to a wide range of industrial applications. Fraunhofer FEP runs multiple pilot scale vacuum coating systems.

Furthermore, Fraunhofer FEP has a unique position in designing microelectronic circuits and components with application- and customer-specific adaptations of silicon circuit foundries' CMOS processes that allow these finished wafers to be subsequently processed with OLED coatings, for example. This subsequent processing is used in particular for augmenting silicon CMOS wafer functionality with optical and photonic components, such as for high-resolution OLED microdisplays.

https://www.fep.fraunhofer.de/en.html

#materials & technologies, #MicroLED Research

Fraunhofer IZM

One of the world's leading institutes for applied research and the development and system integration of robust and reliable electronics

For 30 years, more than 440 employees have been finding technological solutions in cooperation with partners from industry and academia. Emerging challenges are addressed in branches such as automotive and industrial electronics, medical engineering, ICT and semiconductor technology.

Our technologies connect the individual components, protect components and devices from vibration and moisture, and reliably dissipate heat. Fraunhofer IZM thus ensures that electronic devices continue to function reliably in even the harshest conditions. Modern packaging technologies make developing smaller and smaller products possible. We process ICs thinner than a sheet of paper. The institute, founded in 1993, disposes of a lab area of over 8,000 sqm. About 80 percent of our turnover in 2021 was earned through contract research.

https://www.izm.fraunhofer.de/en.html

#color conversion

General Electric

For more than 125 years, GE has invented the future of industry. Today, GE is best known for its work in the Power, Renewable Energy, Aviation and Healthcare industries.

GE's Licensing team provides access to GE's patent portfolio and technical and intellectual resources. Licensees receive world-leading technology paired with advice and guidance to accelerate their technology development and achieve market differentiation.

The GE LED Phosphors team has world class chemistry and physics expertise as well characterization capabilities that have resulted in commercial successes in both lighting and LCD display technologies. Multimillion-dollar yearly revenue, multiple awards, hundreds of patents, over 20 licensees of our patents, along with various publications and invited conference presentations show that this team is on the cutting edge of luminescent material development and can advance from concept to invention to commercialization.

https://www.ge.com

#inspection & repair

InZiv

Testing and inspection tools for the microLED industry.

InZiv provides testing and inspection tools for the microLED industry. InZiv's technology offers one comprehensive platform for both full wafer mapping and individual chip testing and characterization at the highest resolution. Automated PL and EL provide today's most critical measurements, including EQE and angular measurements, and Nano-PL and Nano-EL enable the user to zoom in on individual chips and sub-pixel features and defects with 100nm resolution.

InZiv integrates multiple inspection modalities in one system, and provides a comprehensive analysis of both the whole wafer and its sub-pixel features. This unique combination empowers microLED developers and manufacturers with the ability to better understand the relationship between light, color, current, and structure – directly addressing today's most critical challenges in microLED.

https://inziv.com/

#inspection & repair

Instrument Systems

Develops and produces high-end light measurement technology, (AR/VR) displays, mLED wafers, VCSEL/laser systems, automotive lighting and LED/SSL modules.

Instrument Systems GmbH, founded in Munich in 1986, develops and produces high-end light measurement technology that is indispensable for the manufacturers of consumer electronics, (AR/VR) displays, mLED wafers, VCSEL/ laser systems, automotive lighting and LED/SSL modules. All solutions benefit from our CAS series of high-precision spectroradiometers that are recognized and in use all over the world. In combination with 2D imaging colorimeters, integrating spheres and goniometer systems, they enable high-precision and accurate measurements in the entire range from UV to IR, traceable to PTB or NIST.

Today, Instrument Systems is one of the world's leading manufacturers of light measurement technology. At its Berlin facility, the "Optronik Line" of products is developed and marketed for the automotive industry and traffic technology. Our subsidiary in Korea supplements the product portfolio with the "Kimsoptec Line" for the Korean light & display market.

Instrument Systems has been a wholly-owned subsidiary of the Konica MinoIta Group since 2012.

https://www.instrumentsystems.com/en/

#mass transfer

Kulicke & Soffa

Advanced microLED placement solutions

Kulicke & Soffa (NASDAQ: KLIC) is a leading provider of semiconductor, LED and electronic assembly solutions serving the global automotive, consumer, communications, computing and industrial markets. Founded in 1951, K&S prides itself on establishing foundations for technological advancement – creating pioneering interconnect solutions that enable performance improvements, power efficiency, form-factor reductions and assembly excellence of current and next-generation semiconductor devices.

The Company further extends its mini and micro LED technology and solutions through strategic acquisition of Uniqarta in 2021.

https://www.kns.com/

#LED epiwafers

Lextar

LED developer and microLED chip maker

Established in 2008 in Taiwan as a subsidiary of AU Optronics, Lextar Electronics Corporation is a leading global LED developer. Lextar produces LED chips, LCD backlights, automotive LEDs, lumiaires and other lighting solutions.

In 2018 Lextar introduced its first micro-LED chips – both RGB ones and color conversion ones, both suitable for mass transfer processes.

Lextar is now a part of Ennostar, following a merger with Epistar.

http://www.lextar.com/

#microLED displays

LG Electronics

The LG Business Solutions Company is a trusted partner offering innovative products and solutions for diverse industries worldwide.

With a portfolio of unique offerings, such as industry-leading OLED signage, LED signage and commercial TVs, LG is a respected name among customers around the world.
For more on LG's Business Solutions, visit www.LG.com/b2b

https://www.lg.com/global/business

#color conversion

Mitsui Kinzoku

Produces functional engineered materials and electronic materials, nonferrous metal smelting.

Japan-based Mitsui Mining & Smelting (also known as Mitsui Kinzoku) produces functional engineered materials and electronic materials, nonferrous metal smelting, minerals resource development, precious metal recycling, raw material related businesses, manufacturing and sale of automotive parts/components, etc.

For the MicroLED Industry, Mitsui Kinzoku developed a sulfide phosphor for color conversion. The material is highly durable and does not contain any hazardous material. As of 2023, the company is sampling the material for microLED developers.

https://www.mitsui-kinzoku.co.jp/mlab/en/

#Materials & Technologies

Mojo Vision

Developing RGB Micro-LED displays

The Future of Micro-LED Technology is Here

Mojo Vision is focused on developing and commercializing world-class micro-LED technology for consumer, enterprise, and government applications. Developed as a critical component of Mojo Lens and first announced in 2019, the Mojo Vision Micro-LED Display is the smallest, densest dynamic display ever made, and the Micro-LED technology platform underlying it is powerful and flexible enough to serve a wide range of applications from next generation wearables all the way up to future televisions and video walls. We believe Micro-LED will disrupt the entire $160B display industry and our unique technology puts us at the forefront of this disruption.

https://www.mojo.vision/

#display drivers

nsc innovation

Monolithically integrating GaN LEDs with silicon CMOS to enable microdisplay solutions

nsc is a groundbreaking integrated circuit design company based out of Singapore. Our chips are the first to effectively integrate silicon CMOS with GaN LEDs monolithically and at full wafer scale, while maintaining compatibility with traditional CMOS manufacturing. By doing so, nsc offers the functionality and manufacturability needed to enable widespread adoption of microdisplays. These highly efficient and cost-effective LED pixelated light engine (PLE™) chips can serve as the backbone for displays that will change the form factor of wearables, increase battery life, decrease cost, and make possible game-changing new product innovations. Our integrated chips are produced by co-opting existing manufacturing equipment and processes in order to deliver them at commercial scale.

https://www.nscinnovation.com

#Materials & Technologies

Pixelligent

Create and manufacture advanced tunable, high refractive index (RI) nanocrystal formulations and dispersions, Extended Reality (XR) devices, and sensor applications.

Pixelligent is a developer of industry-leading PixJet®, PixNIL®, PixCor™, and PixClear® Designer Compounds®. We create and manufacture advanced tunable, high refractive index (RI) nanocrystal formulations and dispersions that deliver the highest refractive index, most robust mechanical properties, and near-perfect transparency for next-generation displays, Extended Reality (XR) devices, and sensor applications.

Pixelligent has nearly 100 issued and pending patents, raised $100M in funding, been awarded over $15M in federal grant programs, and is ISO 9001 certified. Our 20,000 square-foot, state-of-the-art manufacturing and laboratory facility is located in Baltimore, Maryland and is supported by sales offices in the Republic of Korea and Taiwan and distributors throughout Asia.

https://pixelligent.com

#LED epiwafers

Q-Pixel

Overhauling Decades of microLED Display Technology by Replacing Century-old Monochromatic LED.

Q-Pixel is an innovator of polychromatic RGB microLED which is a revolutionary device to solve several key issues with decade-old microLED display technology. Problems, such as achieving ultra-high density pixels, high-yield mass transfer, etc., can be solved with a single full-color pixel.

https://www.quantum-pixel.com

#Color conversion

QNA Technology

Quantum dots for the display industry, based on unique surface engineering and QD inks

Poland-based QNA Technology, established in 2016, develops and produces quantum dots for the display industry.
The company optimizes its QDs for two applications: electroluminescence display devices (QD-EL) and for microLED displays devices based on UV microLEDs.

QNA developed QD surface engineering to enable the delivery of its materials in various solvents, such as polar, non-polar, monomers, powders, and more. The company is also developing QD inks for ink-jet printing and for UV-curable inks.

https://qnatechnology.com/en/

#Color conversion

Qustomdot

Cadmium-free quantum dots technology for microLED displays

Belgium-based QustomDot brings unmatched colors through quantum dot (QD) color conversion to microLED applications. The team combines QD synthesis, surface engineering and ink/photoresist formulation into patterned color conversion layers for microLED displays. QustomDot's patented technology is cadmium free and can withstand high light intensities.

https://www.qustomdot.com

#Materials & Technologies

Radiant Vision Systems

Automated inspection systems for microLED displays

US-based based Radiant Vision Systems, a Konica Minolta company, provides advanced imaging systems to critically evaluate light, color, manufacturing integrity, and surface quality of illuminated displays and device assemblies.

Radiant offers fully customized and automated inspection systems for microLED development and production.

https://www.radiantvisionsystems.com

#Materials & Technologies

Smartkem

Seeking to reshape the world of electronics with a revolutionary semiconductor platform that enables the next generation of low-cost displays and sensors.

SmartKem's patented TRUFLEX® inks are solution deposited at a low temperature, on low-cost substrates to make organic thin-film transistor (OTFT) circuits. The company's semiconductor platform can be used in a number of applications including mini- and micro-LED displays, AMOLED displays, AR and VR headsets, fingerprint sensors and integrated logic circuits. SmartKem develops its materials at its research and development facility in Manchester, UK, and its semiconductor manufacturing processes at the Centre for Process Innovation (CPI) at Sedgefield, UK. The company has an extensive IP portfolio including over 124 issued patents across 19 patent families.

https://www.smartkem.com

#MicroLED research, #LED epiwafers

Solid State Lighting & Energy Electronics Center

Researchers to advance solid-state lighting and energy efficient power switching using wide-bandgap semiconductors.

The Solid State Lighting & Energy Electronics Center (SSLEEC) at UC Santa Barbara is a collaborative center, which partners key industry leaders and UCSB researchers to advance solid-state lighting and energy efficient power switching using wide-bandgap semiconductors.

SSLEEC is focused on new semiconductor based technologies for disinfection, advanced mobile displays, energy efficient lighting, and power electronics. The objective of the SSLEEC is to provide a forum for its members – key industry partners and the faculty and student researchers at the University of California, Santa Barbara – to work in collaboration and across scientific disciplines to address the most challenging problems in these important and timely areas of research.

https://ssleec.ucsb.edu

#microLED displays

STRATACACHE

Digital signage systems developer, microLED display producer

STRATACACHE is a digital signage, merchandising and customer engagement systems developer, targeting the retail, restaurants, banking and financing, gaming, events and education markets.

STRATACACHE is constructing the first US-based complete display production facility in Eugene, Oregon, the future MicroLED E4 fab.

https://www.stratacache.com/en/

#production equipment

Tokyo Electron (TEL)

Global semiconductors production equipment maker

Tokyo Electron Limited (TEL) is a Japanese electronics and semiconductor company headquartered Tokyo, established in 1963. TEL supplies equipment to fabricate ICs, photovoltaic cells and flat panel displays. TEL is considered to be the world's largest manufacturer of IC and FPD production equipment.

https://www.tel.com

#Mass transfer, #materials & technologies

Terecircuits corporation

Photo-polymer mass transfer system for microLED production

Terecircuits develops technologies and manufacturing processes for microassembly based on a new class of photo-chemical polymers.

The company focuses on the development of a microLED photo-chemical mass transfer process.

http://terecircuits.com/

#Services

Unikorn

Professional III-V compound semiconductor foundry

Unikorn, spun-off Epistar and now part of Ennostar, is a professional III-V compound semiconductor foundry located in Hsinchu Science Park, Taiwan. Unikorn focuses on epitaxy and wafer/chip processing.

https://www.unikornsemi.com/?lang=en

#microLED displays, #mass transfer, #microdisplays

Vuereal

Micro-LED display technologies and display production

Canada-based VueReal is a startup company that develops Micro-LED display technologies. VueReal developed a cartridge-based microLED printing process that can produce high density displays at high production yields.

In addition to microLED technologies, VueReal also produces microLED displays, and offers custom display production done at its pilot production line in Waterloo, Canada.

https://www.vuereal.com

#inspection & repair

WEVE

World-class inspection of Epi Wafers, Micro LED CoWs, and OLED

WEVE is a South Korea-based company with industry-leading expertise in Epi wafer and CoW inspections. We are trusted by world-leading display and wafer manufacturers in South Korea and Taiwan. Our contactless and nondestructive technology performs AOI, PL, and Color Difference (xyY, WD) analysis in a single run. Conducting such a complex analysis is meaningless if inspection time greatly exceeds the realities of mass production. We provide crucial data set under acceptable time 6-inch CoW – under 10 minutes, 6-inch Epi Wafer – under 12 minutes. Being involved in big-scale productions we have accumulated great experience that helps our technology to be extremely useful in real environments. WEVE is among the very few in the world in terms of the total number of wafers inspected. We are always open to partnerships and new business development.

https://en.theweve.com

#MicroLED Microdisplays

XPANCEO

XPANCEO is a deep tech company developing the next generation of computing via an invisible and weightless smart contact lens

The XPANCEO smart lens reinvents the whole concept of human-technology interaction and redefines the way we experience both real and digital worlds, including social media, content consumption, and gaming.

https://www.xpanceo.com/

#MicroLED displays

Yenrich

miniLED and microLED direct view displays

Yenrich, spun-off from Epistar and now part of the Ennostar group, develops mini-LED and micro-LED packaging. The company is focused on direct-view displays, both miniLED based and microLED based.

https://yenrichtech.com/en/