HEPTAGON

Heptagon Wafer-Level Offerings for Emerging Applications

2025-03

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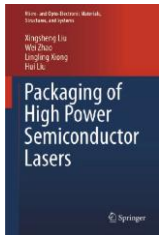
Focuslight Overview

- Founded in 2007 by Dr. Victor X. Liu, headquartered in Xi’an, China.
- A fast-growing company that develops and manufactures:
  - **High-power diode laser components and materials** (Photon Generation)
  - **Laser optics components** (Photon Control)
  - **Photonics module and system solutions** (Application Solutions) focusing on optical communication, automotive, pan-semiconductor, and medical and health applications.
- A **global photonics foundry** offering process development and manufacturing services to the global photonics community.
- Publicly listed in the Shanghai Stock Exchange (Ticker Symbol: 688167).

Milestones

2007

Founding of Focuslight



2013

World's first monograph on packaging of HPDL published

2017

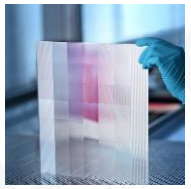
Technology breakthrough of gold-tin film deposition

2018

UV-L750 Ultraviolet Line Laser System won Prism Award

2019

Automotive LiDAR transmitter project awarded from international Tier 1



2019

Production of micro-optics on world's largest glass wafer (300 x 300 mm²)

2023

Line Beam LiDAR Transmitter Module awarded nomination from European Tier 1

2017

Acquisition of LIMO;

Started providing photon control and photonics application solutions

2018

Dongguan delivery and high-volume manufacturing center officially in operation

2019

Global branding identity upgrade

IPO

2021

Successful IPO at Shanghai Stock Market

2024

Acquisition of SUSS MicroOptics

2024

Acquisition of ams OSRAM's optical component assets;

Adopt Heptagon brand for global photonics foundry services

Products and Businesses

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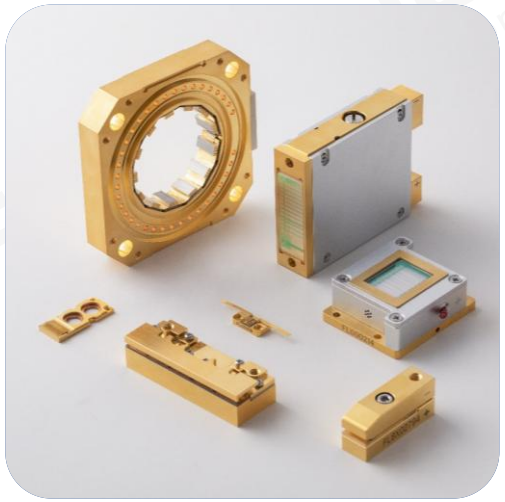
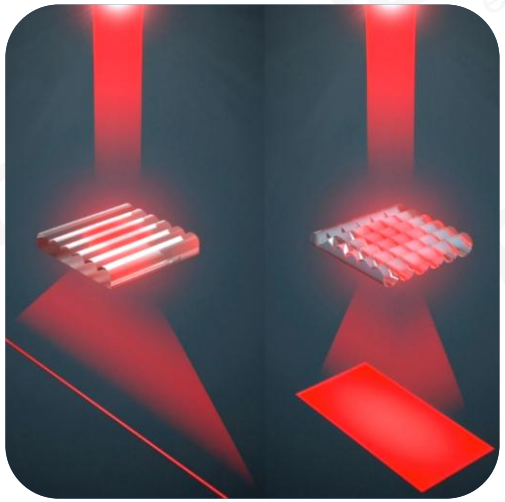


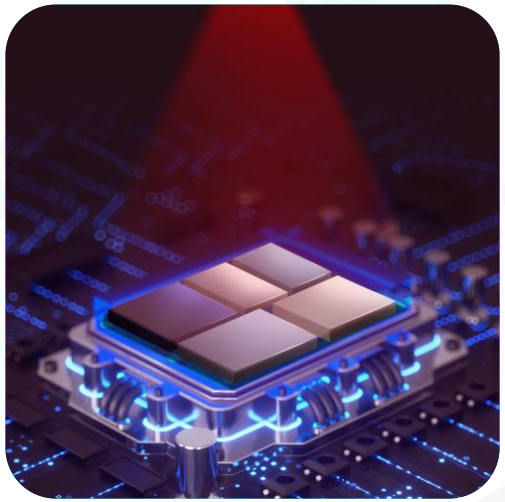
Photon Generation

+



Photon Control

+



Photonics Application Solutions

+

Global Photonics Foundry

Markets

Be the global trusted photonics solution provider

through innovation, manufacturing excellence and fast response

Focuslight Global Operations System

HEPTAGON

Leverage the strengths and capabilities of each location to **cater to specific customer demands** and **optimize operational efficiency**.

Through centralized decision-making, integrated operations, and lean management, a **high-efficiency, low-cost global operations system** is established.

Neuchâtel, Switzerland
Operation Center

Dortmund, Germany
Operation Center

Xi'an, China
Focuslight HQ, Operation Center

Haining, China

Hefei, China
Operation Center
(being constructed)

Silicon Valley, USA
Innovation Lab

Zurich, Switzerland
R&D Office

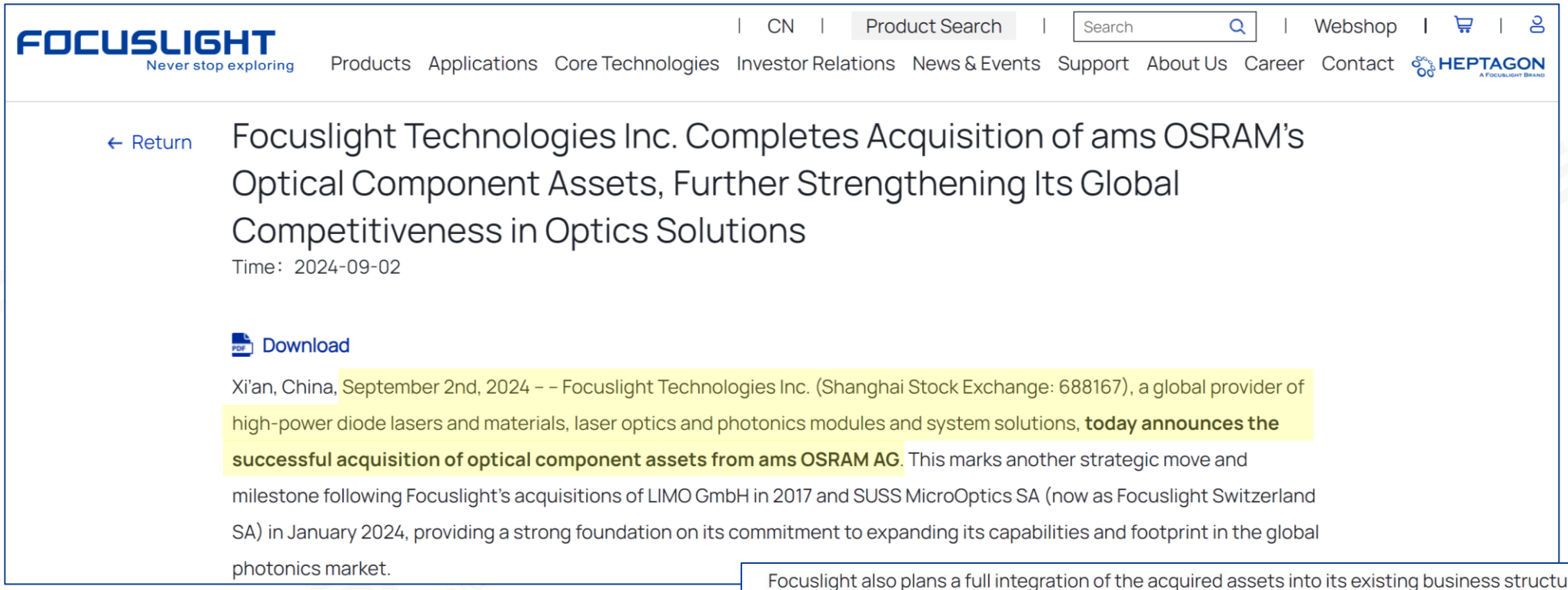
Ang Mo Kio (AMK), Singapore
Operation Center
Business Center

Other Southeast Asian regions (to be decided)
Photonics Foundry

Shaoguan, China
Operation Center

Dongguan, China
Operation Center

Heptagon is Back as a Focuslight Brand



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Focuslight Technologies Inc. Completes Acquisition of ams OSRAM's Optical Component Assets, Further Strengthening Its Global Competitiveness in Optics Solutions

Time: 2024-09-02

Download

Xi'an, China, September 2nd, 2024 – – Focuslight Technologies Inc. (Shanghai Stock Exchange: 688167), a global provider of high-power diode lasers and materials, laser optics and photonics modules and system solutions, **today announces the successful acquisition of optical component assets from ams OSRAM AG**. This marks another strategic move and milestone following Focuslight's acquisitions of LIMO GmbH in 2017 and SUSS MicroOptics SA (now as Focuslight Switzerland SA) in January 2024, providing a strong foundation on its commitment to expanding its capabilities and footprint in the global photonics market.

Focuslight also plans a full integration of the acquired assets into its existing business structure. The company will reorganize and integrate certain assets into its Automotive Business Unit to strengthen its capabilities in serving global automotive customers. A **Strategic Growth Division** will be established to house the R&D teams and equipment related to consumer electronics, disposable medical solutions, and other emerging applications. All products associated with these assets will be unified under the **Focuslight** brand.

Meanwhile, **a Global Photonics Foundry Business Unit** will be established serving as a global center for photonics industry process development and manufacturing services under the historic **Heptagon** brand, which was originally founded in 1993 and will now continue its legacy of innovation, quality, and high-volume manufacturing under Focuslight's global operations, transforming its customer's ideas and designs into industry-powering photonics solutions.

News source: https://focuslight.com/news-events/newslist/focuslight-technologies-inc-completes-acquisition-of-ams-osrams-optical-component-assets-further-strengthening-its-global-competitiveness-in-optics-solutions/

Story of Heptagon

Initially founded in 1993, Heptagon was a prominent brand in the micro-optics industry, known for its advanced optical packaging and wafer-level micro-optical modules, as well as high-volume manufacturing powering consumer electronics applications.

Now, under the frame of Focuslight global operations, Heptagon will continue to be the official brand name of your Global Photonics Foundry Services.

Visit www.hptg.com for more information

- **2024** The Heptagon brand is restored after acquisition by Focuslight for its global photonics foundry services
- **2017** Acquired by ams
- **2016** 2 billion units shipped
- **2015** Entry into 3D and IoT
- **2014** Entry into wearables
- **2013** 1 billion (1,000,000,000) units shipped
- **2010** First light WLO solution for leading smartphone OEM
- **2007** Imaging WLO high-volume manufacturing in Singapore
- **2006** First wafer-level CMOS micro-optics solution to leading handset OEM
- **2002** First wafer-level micro-optics solution
- **1993** The company Heptagon was founded

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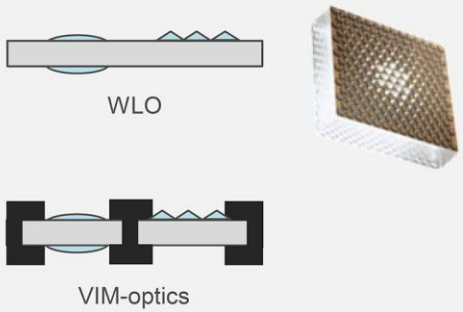
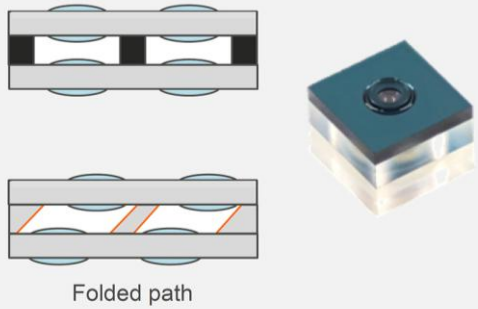
Global Photonics Foundry Services



Wafer Level Optics

Imprinted optics from mm to nm scale

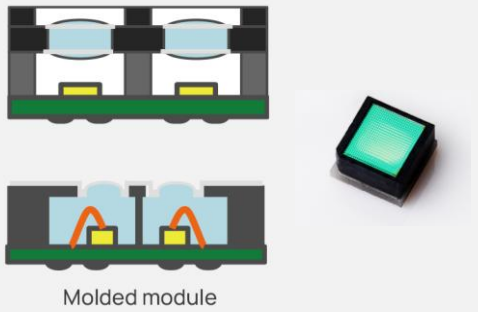
- Diffractive and refractive optics
- Micro lens arrays (MLAs)
- Diffusers



Wafer Level Stacking

From imprinted optics from mm to nm scale

- Imaging lenses
- Projector lenses



Wafer Level Integration

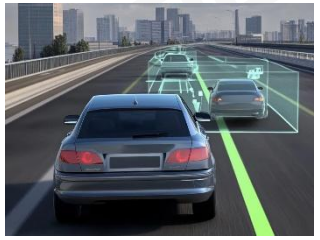
From imprinted optics from mm to nm scale

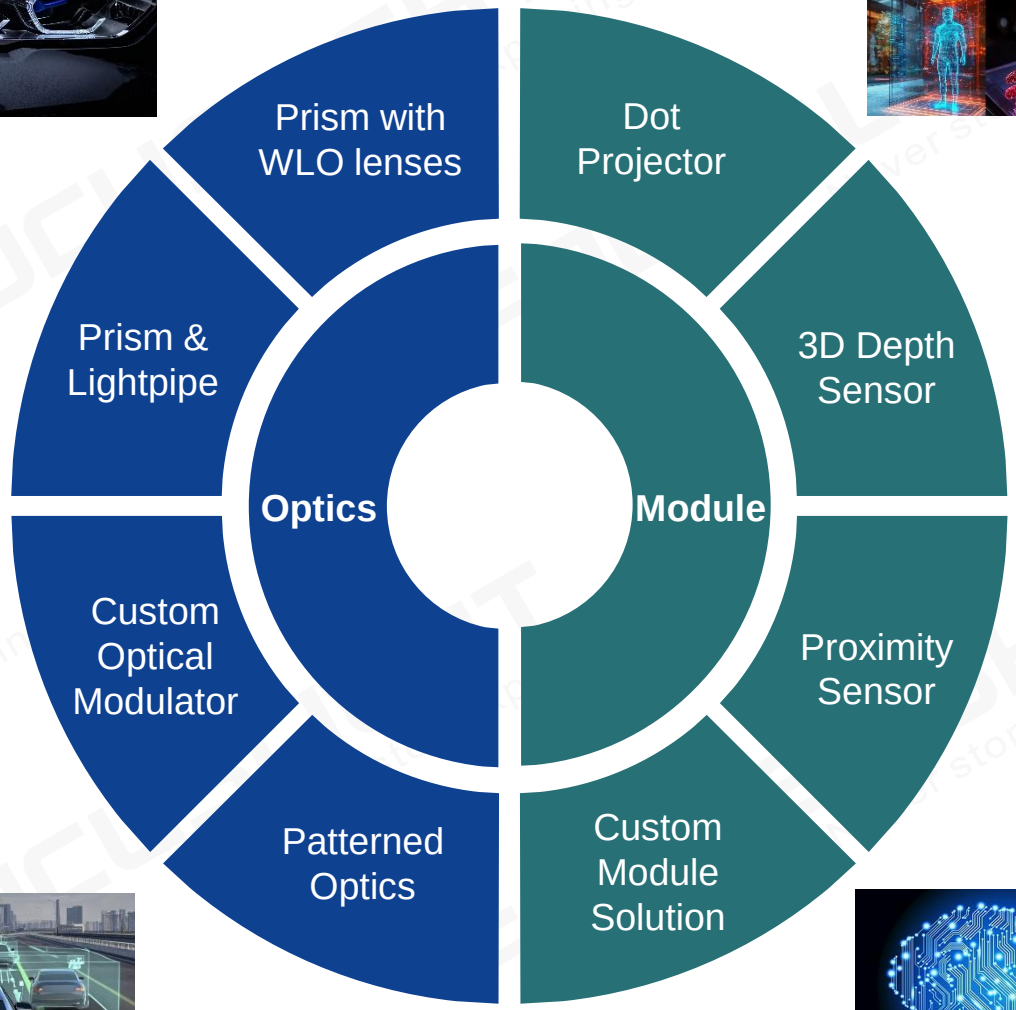
- Optical sensor and illumination modules

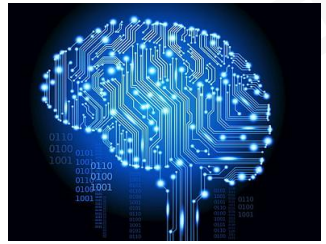
With the Heptagon legacy of know-how in wafer-level technologies, excellent design, development, and mass production capabilities of micro-optics based solutions, the foundry will be a global hub for photonics process development and manufacturing to the global photonics community, offering manufacturing facilities worldwide based on customer needs.

Wide Application Spectrum of Solutions

HEPTAGON



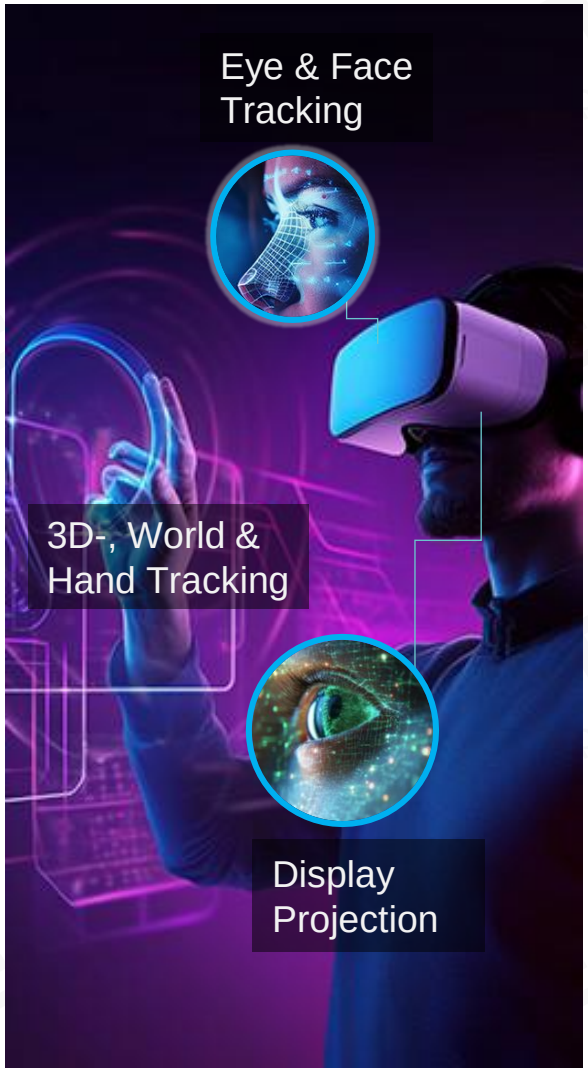




Typical Application and Products

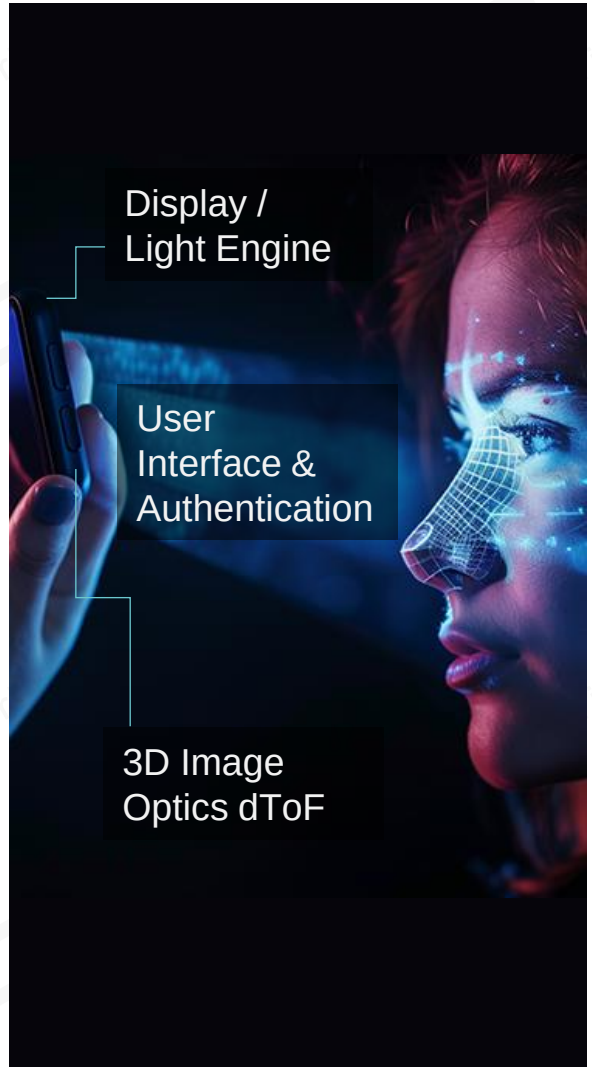
HEPTAGON

Consumer Electronics



Optical Sensing, Empowering AR/VR and AI to See

Multi-aperture wafer-level optical lens for AR-Light Engine	Face ID, Under-Display Face ID
Micro-optics Modules for Vis & NiR solutions with multiple FoV options	Complex Micro Dot Projectors Optics
Wafer level stacking that is fully reflowable and thus mass manufacturable	Multi-Zone 3D sensor solutions, including dToF, Proximity sensor optics
Leading thermal performance, ensuring simple thermal design	Leading thermal performance, ensuring simple thermal design

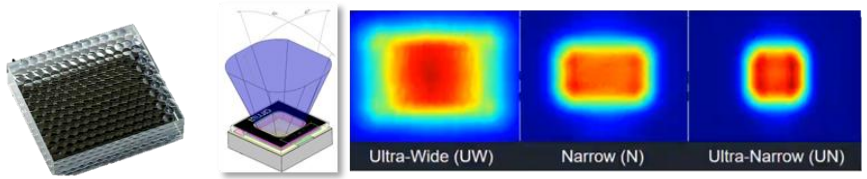


Typical Application and Products

HEPTAGON

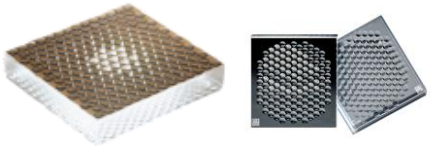
Automotive, Robotics, Medical

Tailored Diffusor Micro-Optics

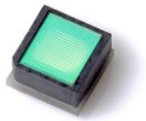


Irregular Micro Lens Arrays for flood illuminators with various FOIs

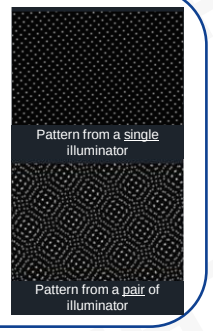
Pattern-Generating Micro-Optics



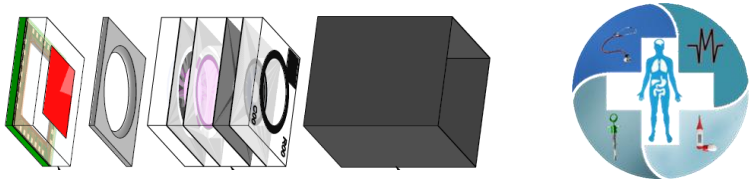
MLA-based Projected Lighting System



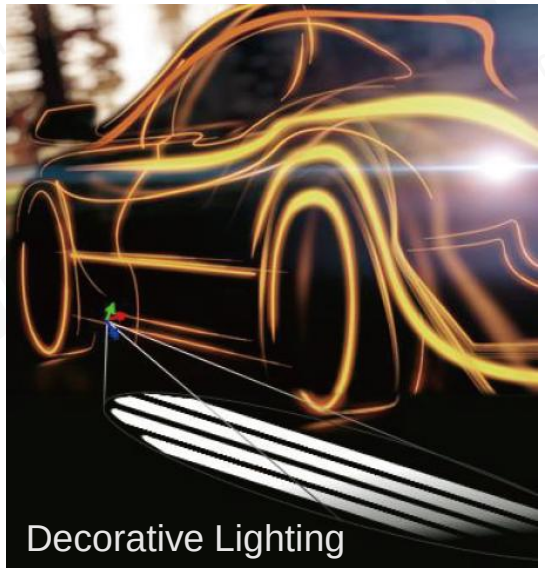
MLA-based molded module



Imaging and Projection Micro-Optics



WLO lens & camera integration for chip-on-tip medical endoscopes



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Wafer Level Optics – Common Technology Base

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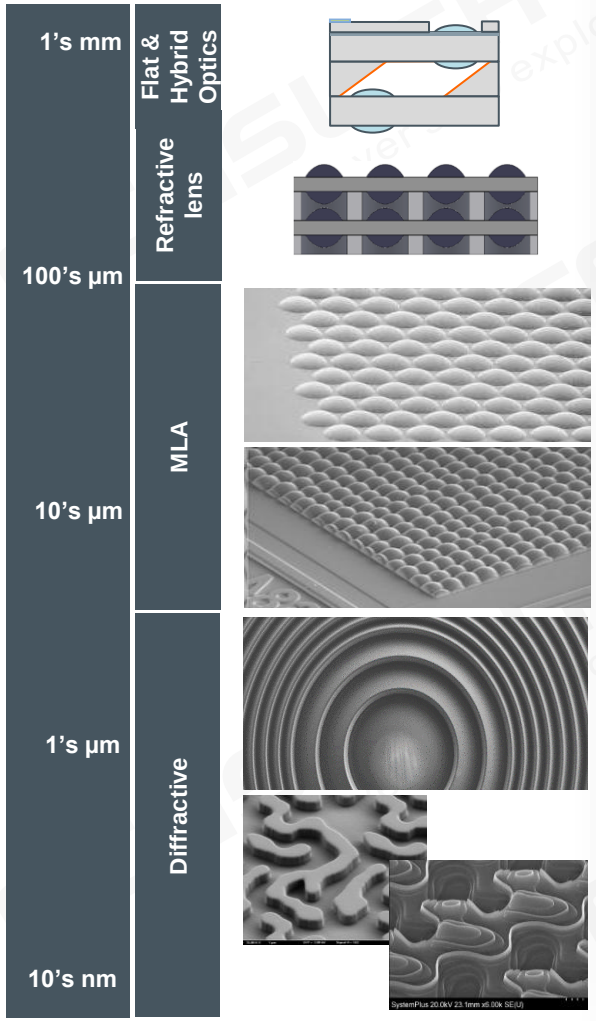
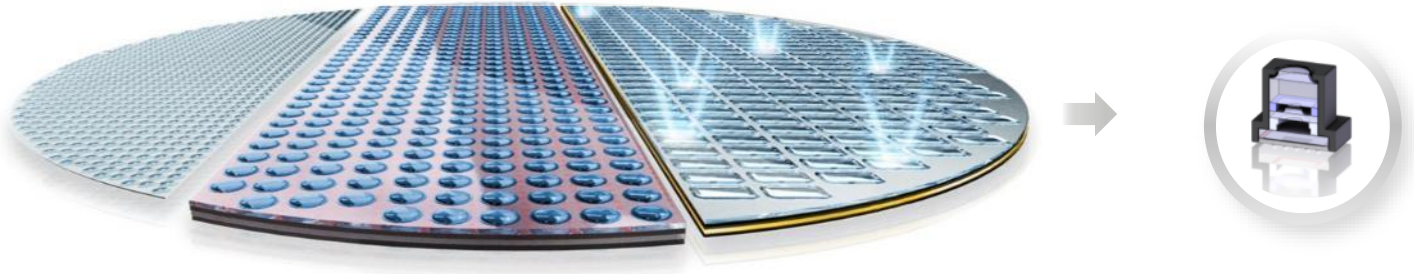
Design for Manufacturing by In-House Wafer Level Optics & Stacking Technology



Wafer-Level Optics, Electronics, Packaging, Integration, Testing and Processing



Wafer-level imprinted optics from mm down to nm-scale

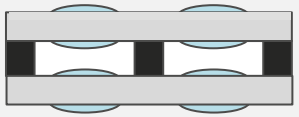
WLO
(Wafer Level Optics)

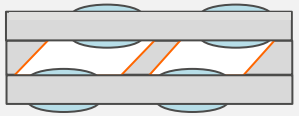
WLO

VIM-optics

Diffractive & refractive optics, MLAs, diffusers

WLS
(Wafer Level Stacking)

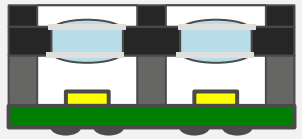


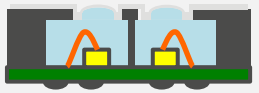


Folded path

Imaging lenses, projector lenses

WLI
(Wafer Level Integration)

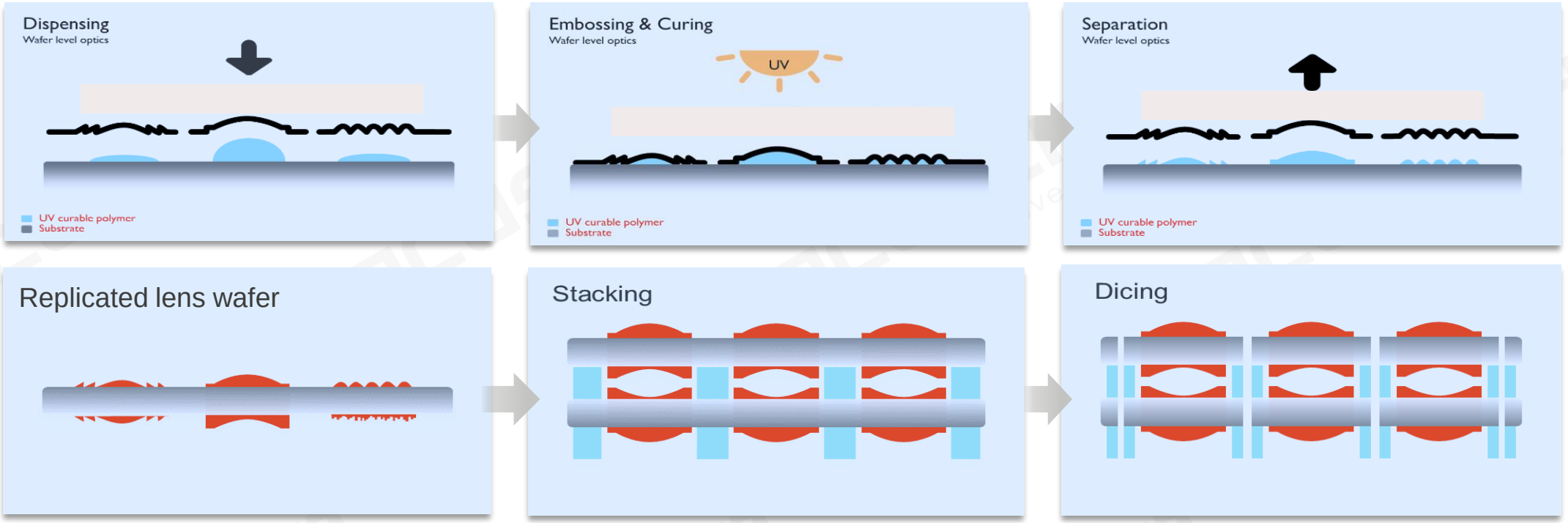




Molded module

Optical sensor & illumination modules

Wafer Level Optics – Basic Manufacturing Process



WLO Competitive Advantages:

- Full wafer-scale process for high volume mass production
- UV curing, Low temperature, low pressure process
- Conformal, microfluidic filling for micro/nano structures
- Conformal reproduction of features less the 1µm
- Reflowable optical material with high thermal performance

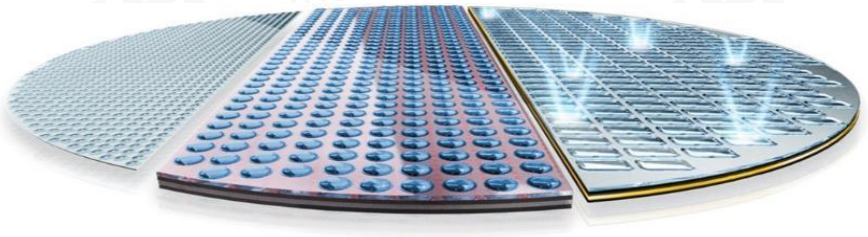
Unique Advantages for High Performance u-Camera:

- Full Solution reflowability, no Compromise of Function, Fit, Cosmetics
- No barrels, mounts, highly compact, highly integrated optical solutions
- Miniaturization (mm^2) flexibility, advanced capabilities, performance
- Concepts to ensure quality mass production volume solutions
- Active Alignment to sensor delivering µWLO+Image Sensor Modules

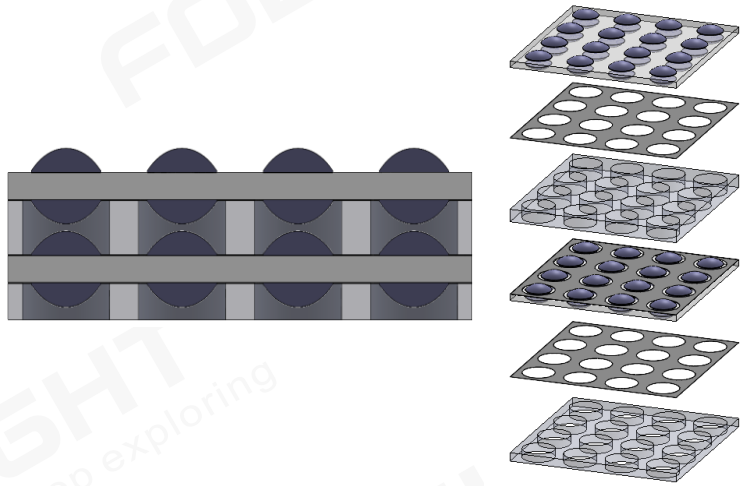
Reflowable WLO-lens systems enable smallest footprint for µcamera devices and integration

Benefits – Wafer-Level Optics and Stacking

- **Wafer-Level Optics (WLO)** is an extremely high-precise fabrication technology for micro-optics at large volume
  - ✓ Wafer-scale process rapidly scalable for mass production
  - ✓ Tends to be profitable at high volume (MP >100 wafers per production) due to relatively high master & tooling cost



- **Wafer-Level Stacking (WLS)** enables high-performance and highly integrated micro-optical system products
  - ✓ Micron-level precision stacking of multiple optics wafers using leading-edge mask aligners
  - ✓ Wafer-scale bonding using rigid spacers and materials with excellent thermal and mechanical stability
  - ✓ Economic wafer-scale integration of added functions such as apertures, coatings, spectral filters, a.o.



- WLO & WLS benefits can be leveraged best in high-volume markets such as Consumer Electronics, AR/VR & Automotive
- Committed to providing reliable, high-performance WLO products and superior development services to our customers

How WLO Technology Enables Your Applications

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Developing Customized Wafer-Level Optics Solutions for our Customers

Customer Concepts, Requirements…
Target Application Spec Sharing

Smart Phone
FaceID
dToF
µCam (Vis/NIR)

Medical
Disposable
Endoscopy

Automotive
MLA/DOEs
µProjectors
µCam (NIR)

Smart Watch / Smart Audio
dToF
µCam NIR
MLA Lenses
µLED Projectors

AR/VR/MR
Tracking µCam (Eye/Face/Gesture/World)
LED/Laser Projectors
Imaging µCam (Visible/NIR/Slam)
MicroDisplay
3D/dToF
Micro-Projector
ALS/Prox

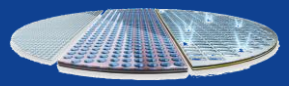
Many More…

Optical Component
System Level Solutions

Optics Solution Provider

"From concept idea to mass production solution"

Feasibility Study,
Product Design,
POC-Sampling
Validation,
Product Development,
Qualification,
Mass Production



Delivering the Optic or Module to Customer,
Semicon or indeed ISP partner

Final Solutions
Module or Application Level

Illuminators	µMLA, Lenses
Optical 3D-Sensors	Optical 3D-Projectors
µCamera Optic/Module	µCamera Sensing
AR-Display Engines	Micro-Projectors

USP for WLO, WLS, WLI

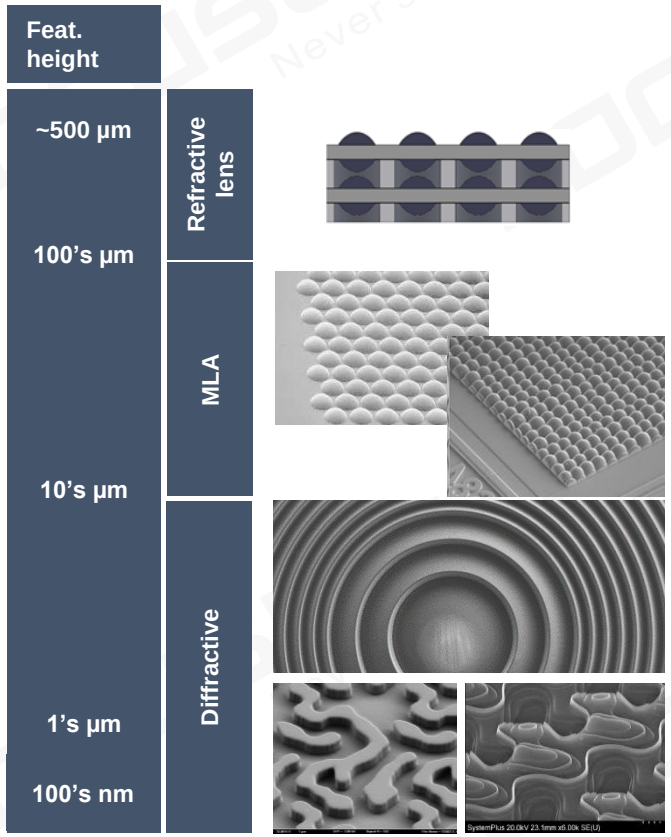
- Outstanding Performance
- Micro Size
- Reflowability
- High Volume Manufacturing

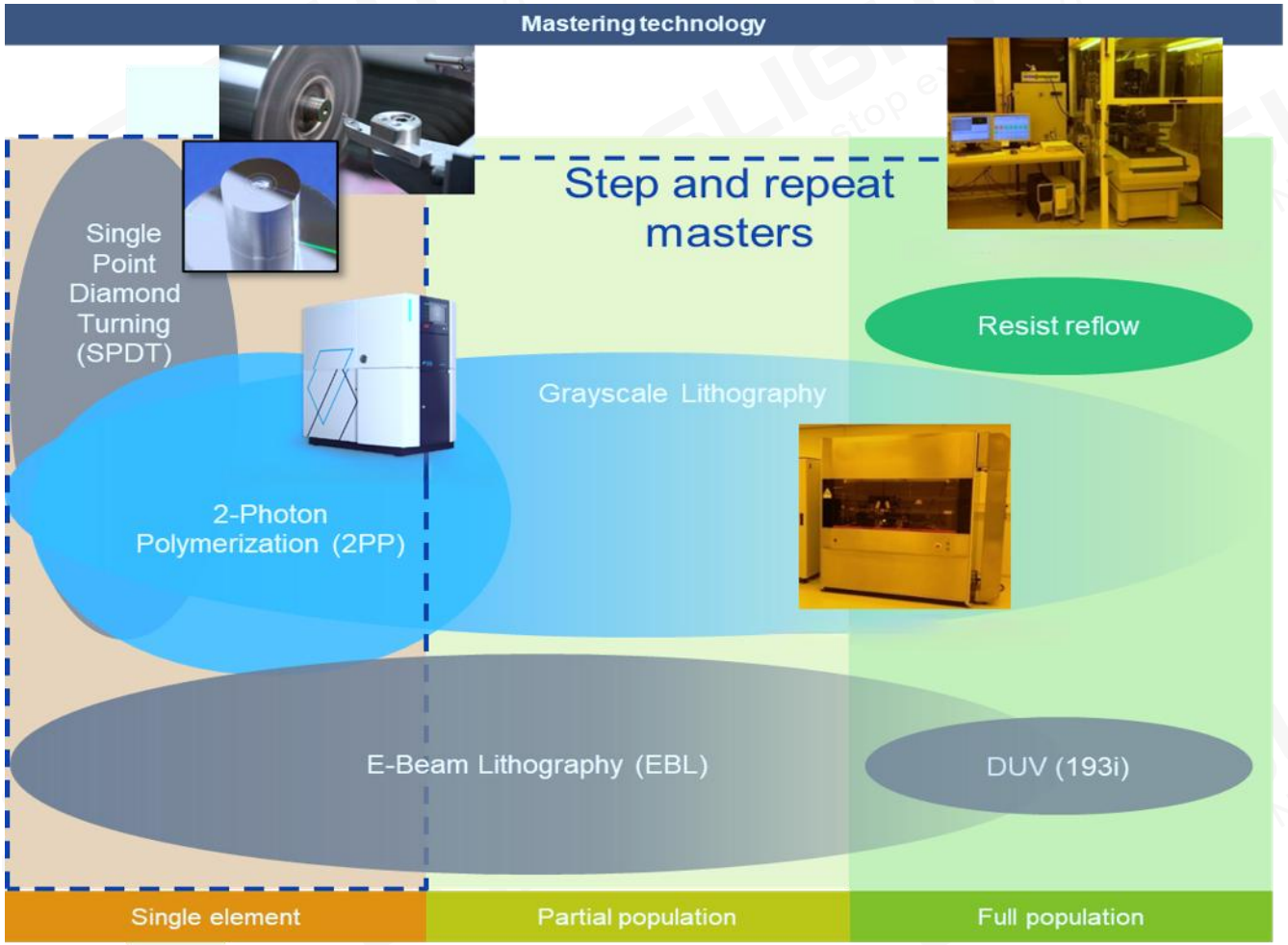
Wafer-Level Optics solutions are generally **customer and application specific,** due to specific targets as well as specific semiconductor light source, µ-display and light detector components

Our Mastering Capabilities – All Starts from Here

HEPTAGON

Our R&D Lab and Equipment





Ensuring the Optical Performance of Products

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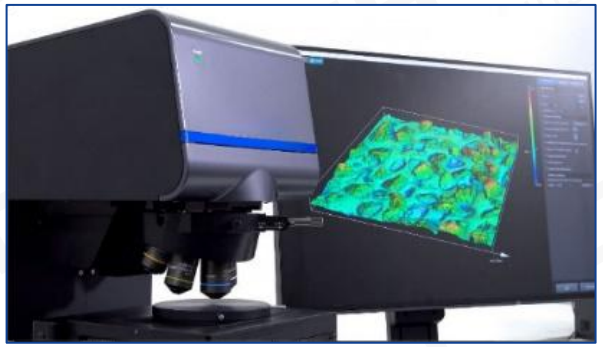
Metrology Capabilities

Coordinate Measuring Machine

Contour Measuring Instrument

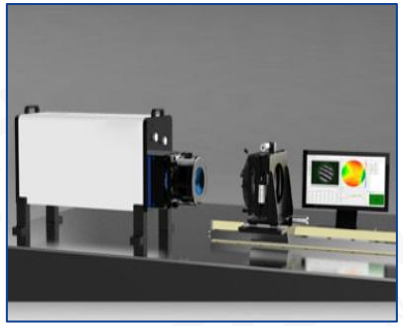
White Light Interferometer



Confocal Microscope

SEM

Precision Goniometer



Large-diameter horizontal planar & cylindrical interferometer

Full Size Measuring Instrument

Off-Center Measuring Instrument

Ion-miller

3D Optical Profiler

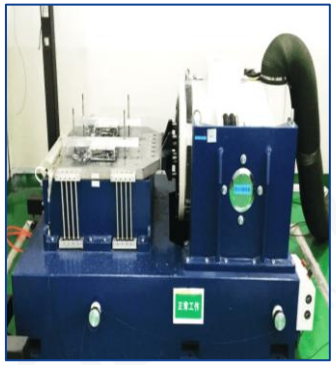
Ensuring the Product Reliability

Temperature Shock Chamber x3
Temp. range: -55~150℃
Thermal shock (Switching time≤1min) : <30s

Thermal Cycling Chamber x3
Temp. range: -55~150℃
Heating/freezing rate: ≤15℃/min

High / Low Temperature & High Humidity Chamber x5
Temp. range: -55~150℃
R.H. range: 20~98% RH

High-pressure boiling testing chamber x1
Temp. range: 100~132℃
R.H. range: 100% R.H.
Pressure: <5atm



Vibration table x1
10000kgf max force; 2~2500Hz frequency, 2m/s max speed

Salt Spray Test device x1
According to ISO 9227:2017

Xenon lamp aging tester x1
According to DIN 75220

Reflow Oven x1

Work with Us – From Concept to Mass Production

HEPTAGON

Value Chain for Customer-Specific Micro-Optics Solutions

Specification Requirements

(ERS, RFI, sharing)

Design Feasibility Study

Outcome: Concept & prelim. design (fulfilling requirements, dimensions, est. cost),

DFM* Stage

Outcome: Full-fleshed design for WLO-technology, manufacturability and risk analysis

*DFM: Design For Manufacturing

Design Verification / POC Stage

Outcome: 1st gen working samples manufactured, testing data results for e.g. yield analysis

Product Validation & Qualification

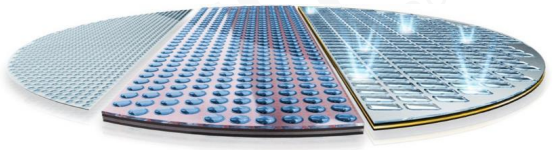
Outcome: 2nd or xth gen working samples, creation of product documentation (e.g. delivery req. specifications, drawings, technical datasheets etc.), cost analysis

Ramp-Up

Mass Production

WLO components fully compliant according to product requirements and test specs

Wafer Level Optics (WLO)

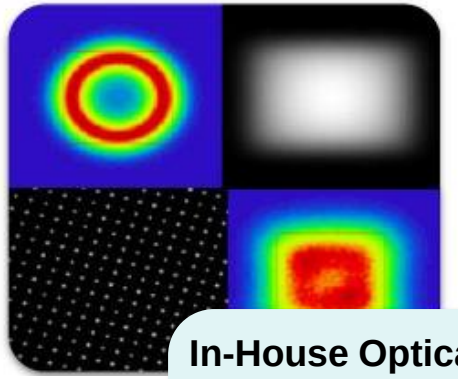


In-House Skills and Capabilities, Delivering Concepts, Design using DFM Development Cycle and Testing
Ensuring high volume manufacturing, with reliability delivering proven Quality

Work with Us – From Concept to Mass Production

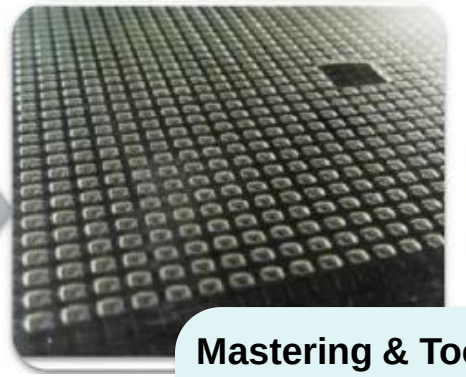
HEPTAGON

Full-Scale Capabilities for the Whole Process



In-House Optical & Mechanical Design

- Location: Switzerland
- Ray trace and wave optics
- Full CAD capacity
- Physics simulation
- Single-Element to Full System Designs



Mastering & Tooling

- Master in-house and 3rd party
- Tooling: in-house
- Locations: Singapore and Switzerland
- Wide range of micro- and nano-structures possible

In-House Wafer Rep., Stacking and BE Process

- Location: Singapore
- Epoxy on glass, multiple materials options available
- Capacity for high volume production of micro-optics

In-House Optical & Final Testing

- Location: Singapore
- High UPH
- Wafer level, unit level, and module level testing with standard and customized systems

In-House Vertically Integrated Capability: Design, Development, Manufacturing, Reliability and Optical Test

Business Models

1

Based on the available technical capabilities, we provide our **product portfolio** (standard, customizable) or pure custom **Heptagon designs**.

The customer can then integrate these **Heptagon products** into their application solutions.

2

Based on the available technical capabilities, we cooperate with the customer, provide our **foundry service** to convert **customer's designs** into mass produced products.

These products will then be the **customer's own products**.

Both business models (products and foundry service) share the same technology base, yet they power the customer's business in different ways.

Summary

- 30+ Years of Optical Design & Simulation + Volume Production Expertise
- Advanced & Unique Wafer-level-Technologies to Provide Various Optical Solutions
- Reliable, Stable Quality + High Precision Products for Various Applications
- Fast Response + Customized Service Available

Your committed and reliable long-term partner in photonics application solutions

THANK YOU

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