DELO

HIGH PERFORMANCE FUNCTIONAL ADHESIVES TO STIMULATE PHOTONICS INDUSTRY

TOMMY ZHANG DELO

DELO

HOW

ADHESIVES ENABLE INNOVATION

DELO

FAMILY-OWNED

€ 205 M. REVENUES

1,000 EMPLOYEES

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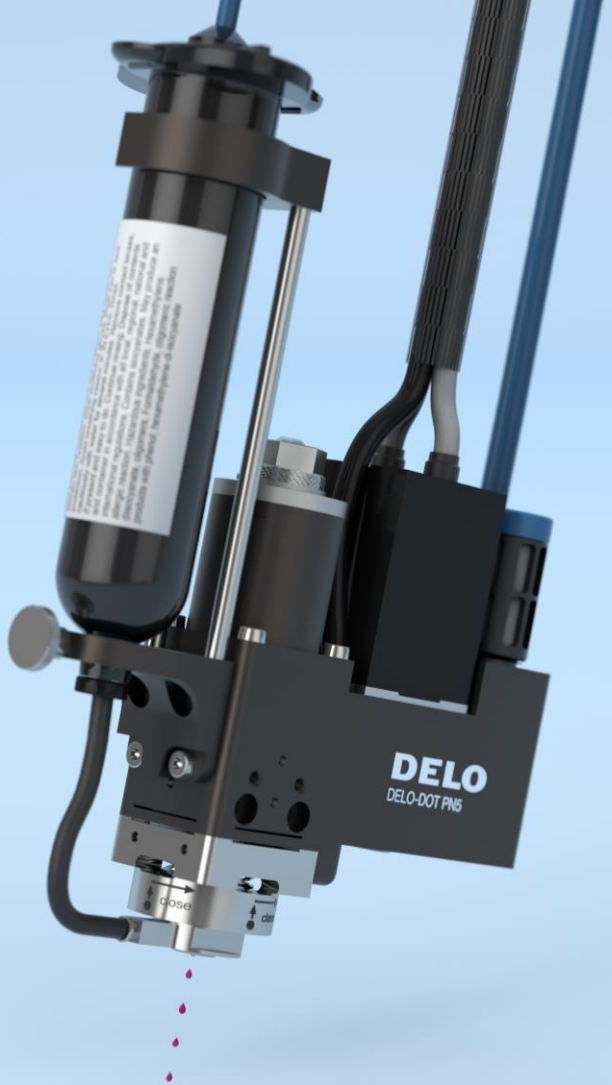
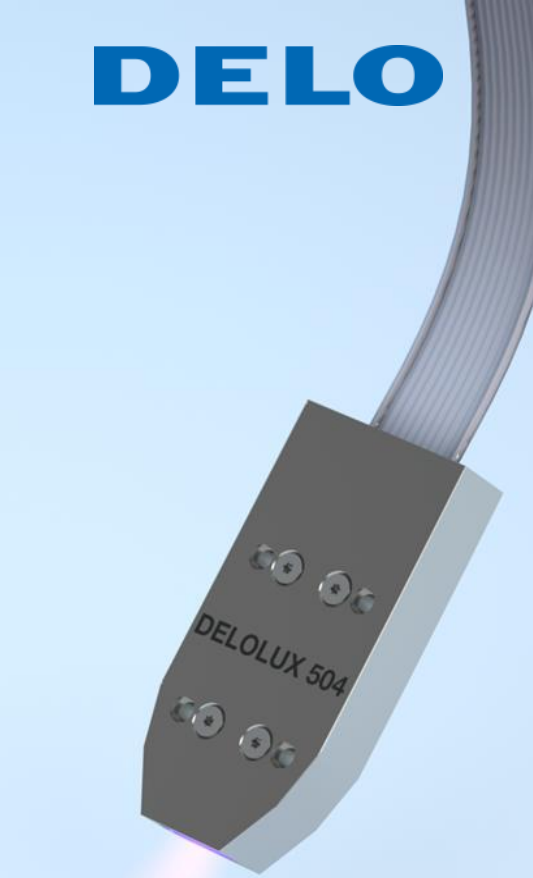
Adhesives / Polymers



Dispensing Equipment



Curing Equipment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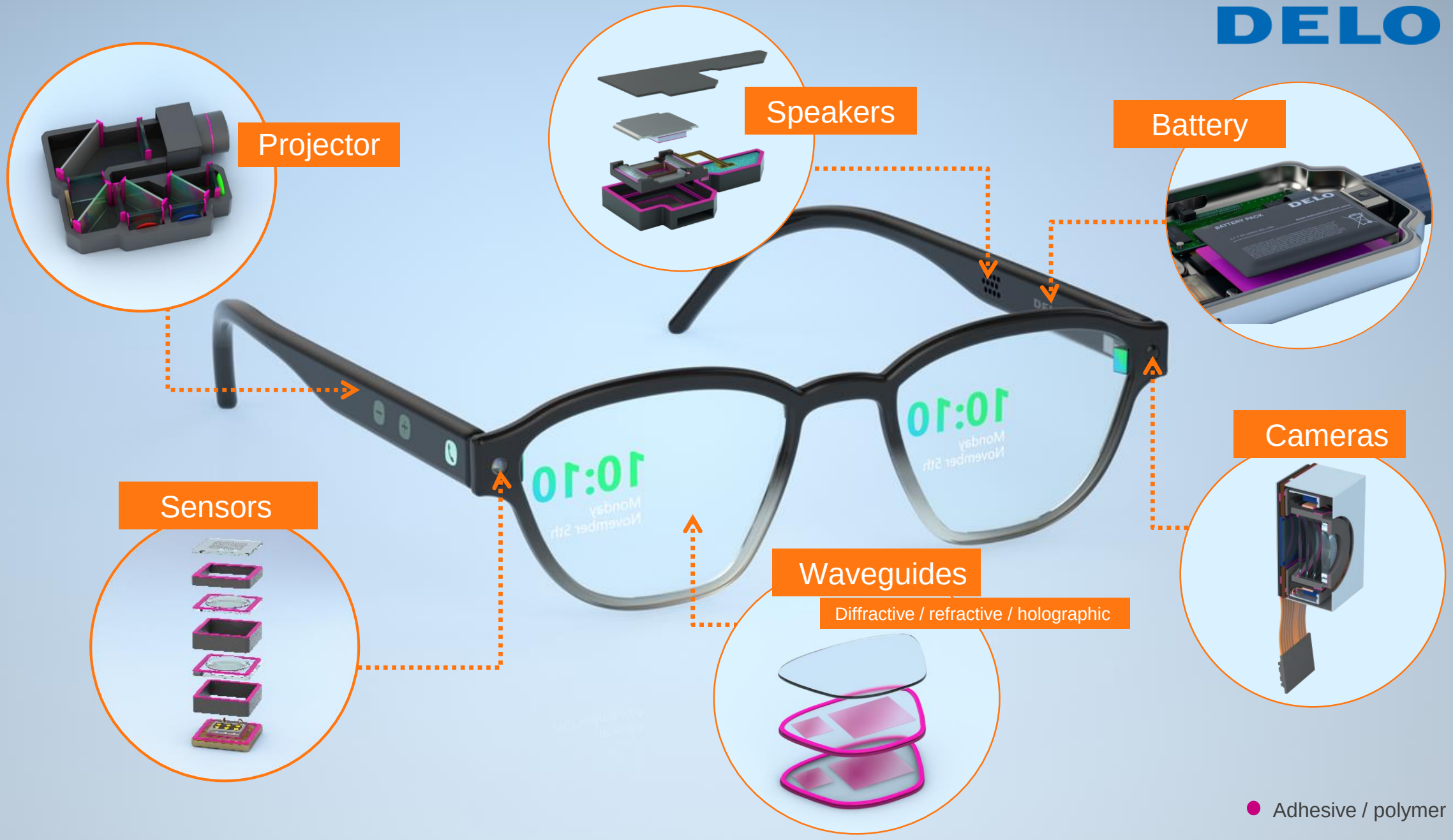
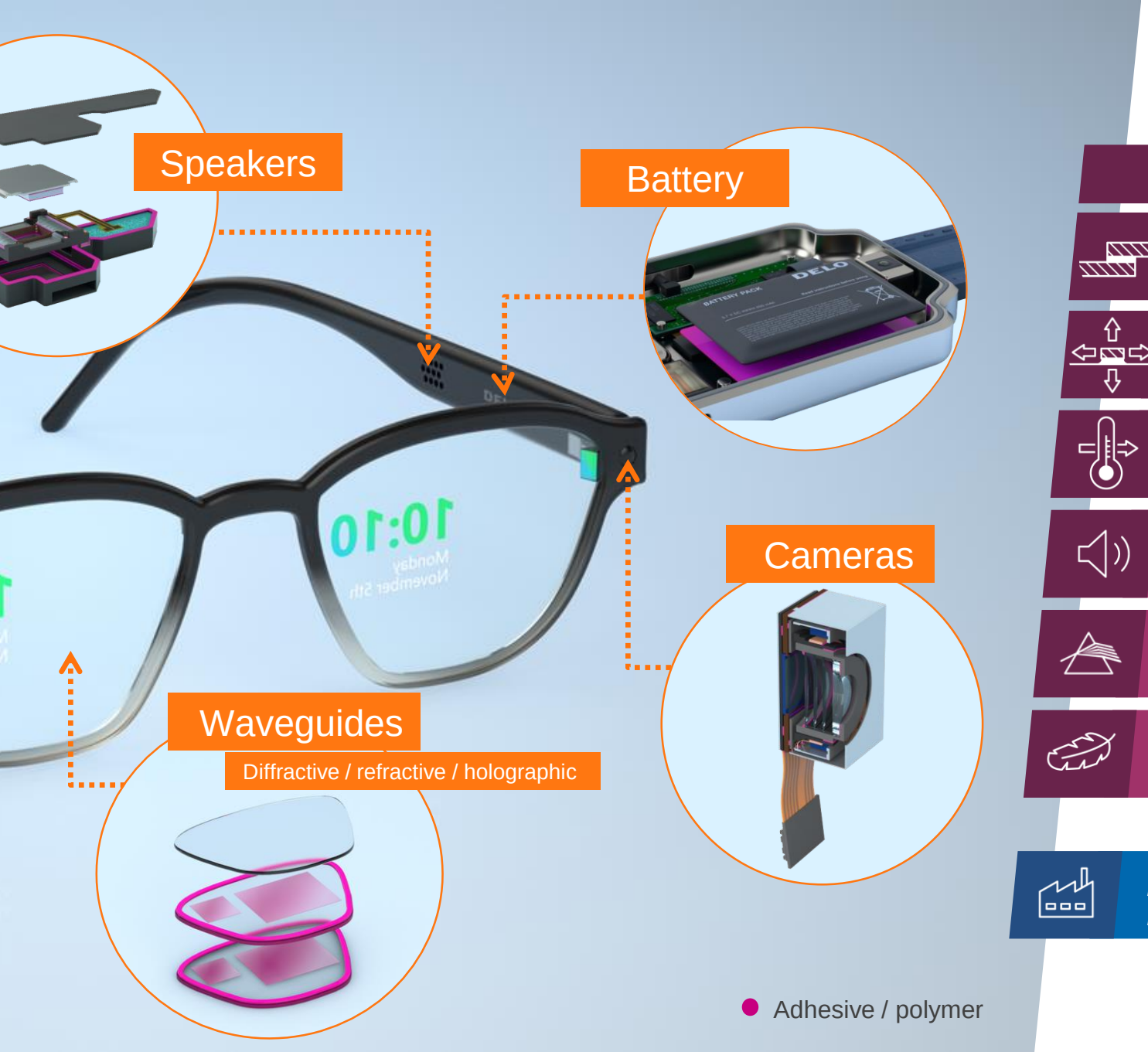

DELO
Projector
Speakers
Battery
Cameras
Sensors
Waveguides
Diffractive / refractive / holographic
Adhesive / polymer



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Some adhesive key functions

Reliable bonding
Of various materials and components

Precise & fast alignment
Of sensitive optical components

Thermal / electrical conductivity
For heat dissipation / electrical connections

Acoustic damping
To improve the sound quality

Optical functionality
Optically clear / adjustable RI / tailored transmission

Lightweight
Lighter than glass or metal

Enable mass production
Fast and reproducible processability for high UPH

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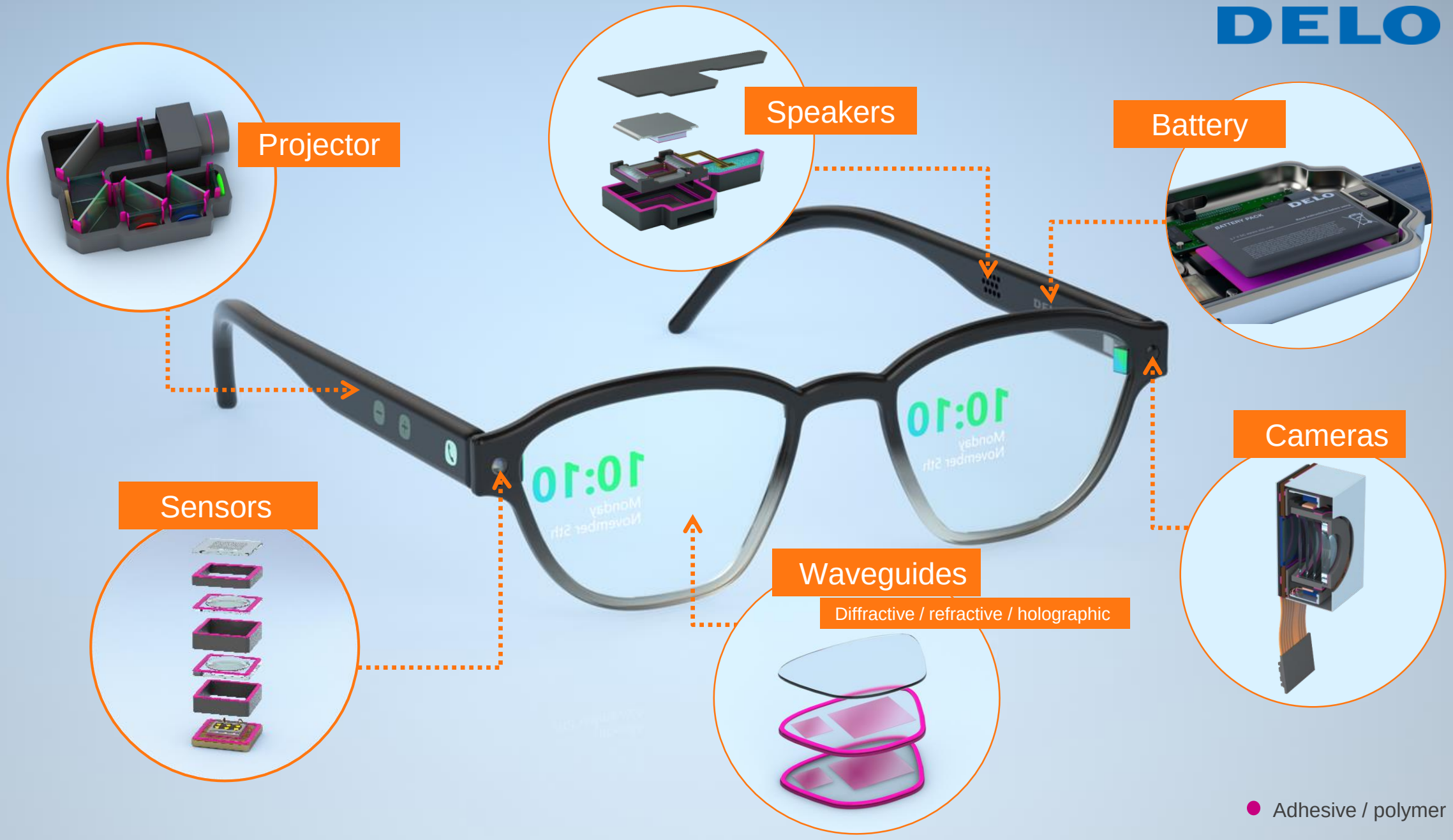
CURING MECHANISMS

DUAL CURING FOR HIGHER PRODUCTION RATE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Adhesive / polymer

Compact camera module - bonding challenges

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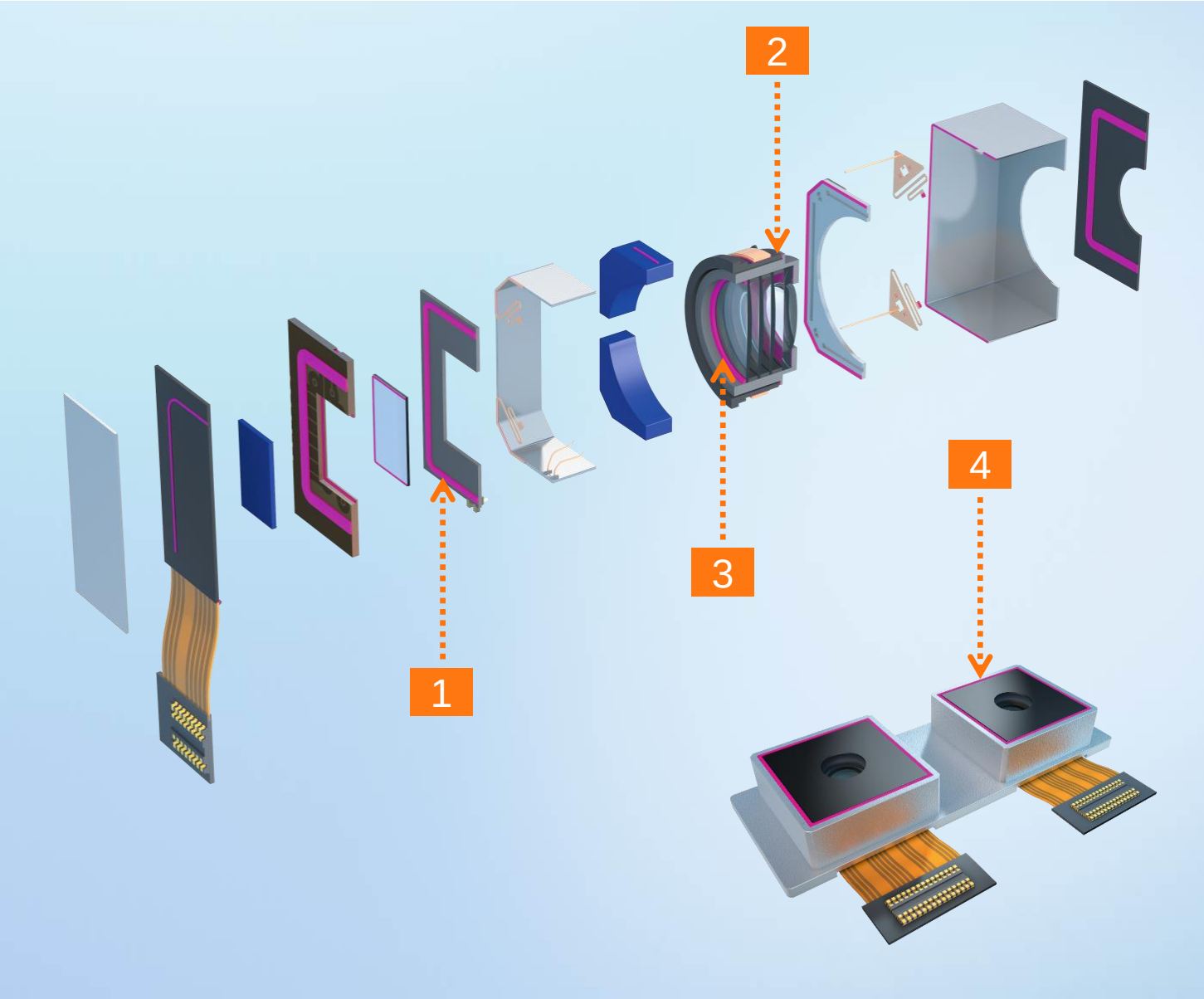


1 Active alignment
- fast preliminary UV fixation for high-precision placement of housing

2 Lens barrel attach
- adjusted flowability
- good bonding strength to PC/LCP

3 Retainer ring replacement
- black dual-curing adhesives
- fast UV / light fixation

4 Bracket bonding
- heat-curing adhesives
- very good flow properties

● Adhesive / polymer

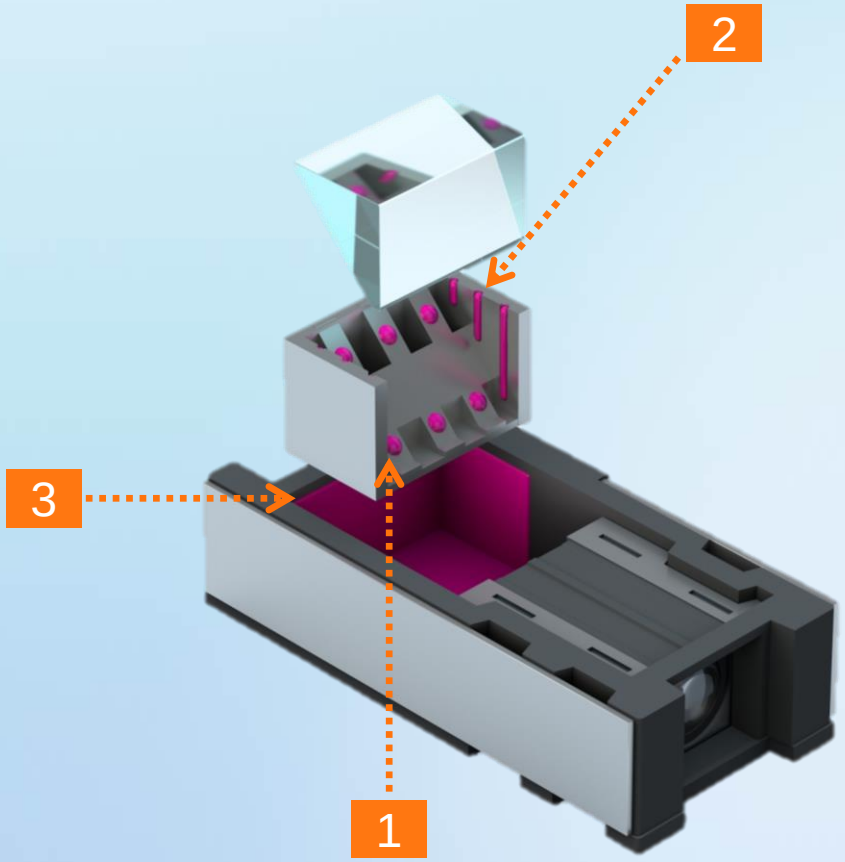
Active alignment

Active alignment process

Adhesive technical properties

- High UPH due to UV fixation
  - << 1 s with DELOLUX 503
- Very low shrinkage for high optical stability
- Low temperature curing
  - typically +80 °C, +60 °C also possible
- Excellent adhesion to plastic substrates
- Passes all reliability tests, for example
  - +85 °C / 85 % r.h. > 500 h
  - Drop test, tumble test
  - Temperature cycling

Bonding challenges for Periscope Cameras



1 Prism Attach:
Low stress glass prism attach. Also optimized for bonding on black masking or coating

2 Prism side fill / reinforcement:
Reinforcing the Prism for good drop test resistance with good flowability

3 Prism Holder attach:
Low viscous filling or high viscous attach

Prism Attach

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Technical properties

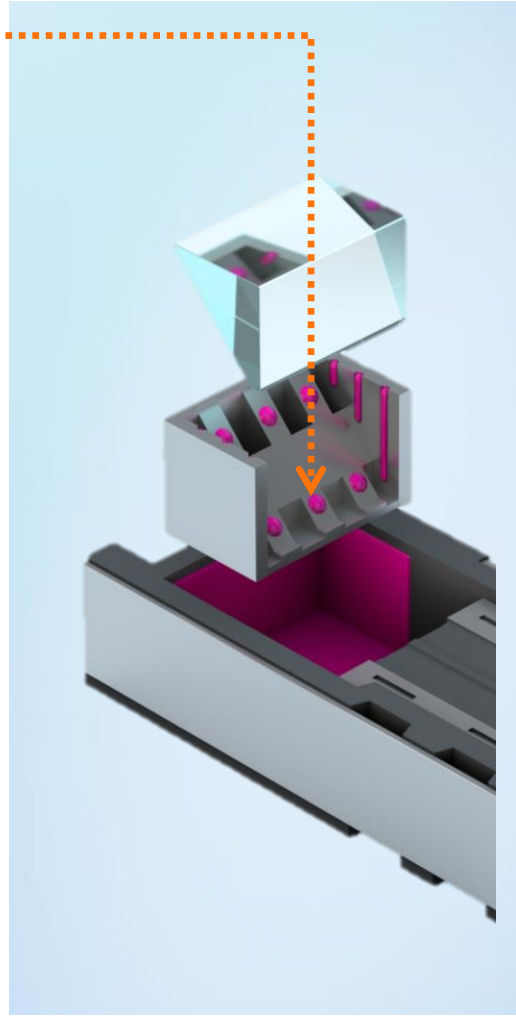
- Dual curing adhesive needed for fixation of prism in perfect optical position
- Low shrinkage for high optical stability
- Moderate modulus to prevent stress on prism
- excellent adhesion to prism and/or coatings on prism
- Medium to high viscosity to avoid flowing away
- Low-temperature curing at temperatures starting from +60 °C to avoid damage of optical components and coatings
- Low outgassing

DELO's light- and heat-curing adhesive

UV light fixation in less than 0.5 s

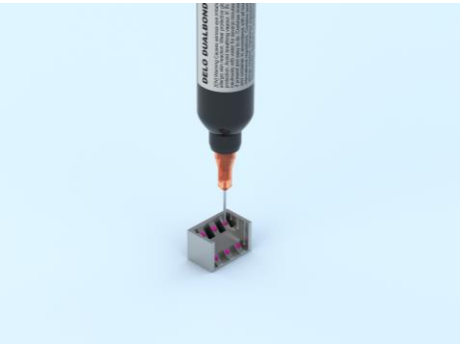
Fast heat curing at +60 °C

DELO DUALBOND LT series

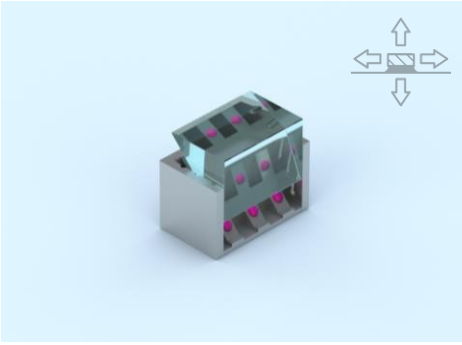


Prism Attach

Active alignment process
with DELO DUALBOND

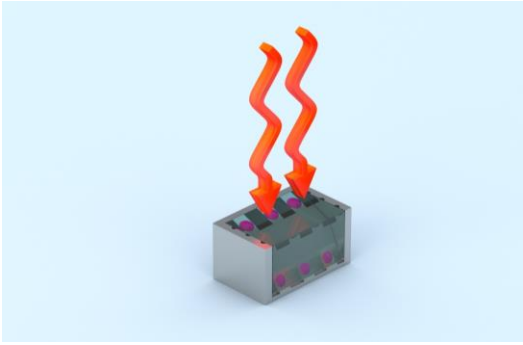


1 Dispensing



2 Alignment

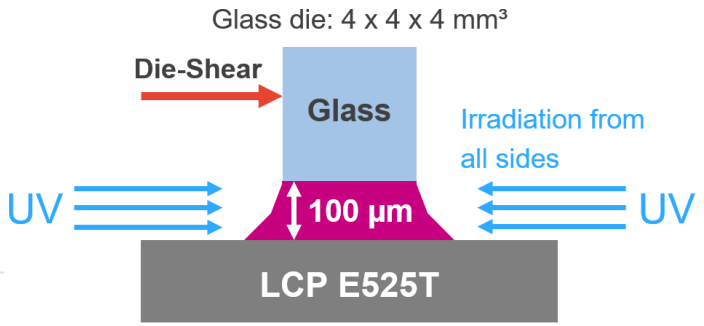
3 Light fixation

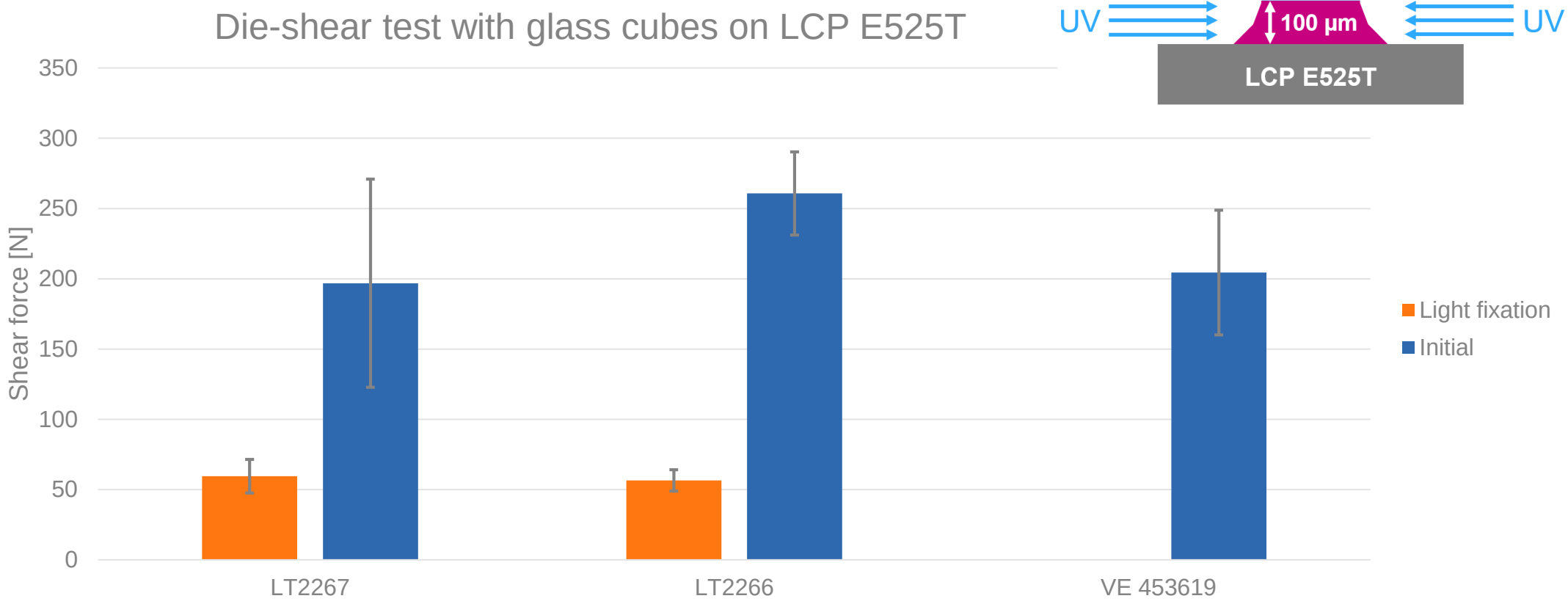


4 Curing

Prism Attach

Bonding strength of glass cubes (4 x 4 x 4 mm³) to LCP E525T





- Bonding to glass or black mask?
- What material is black mask?

Side Fill

Technical properties

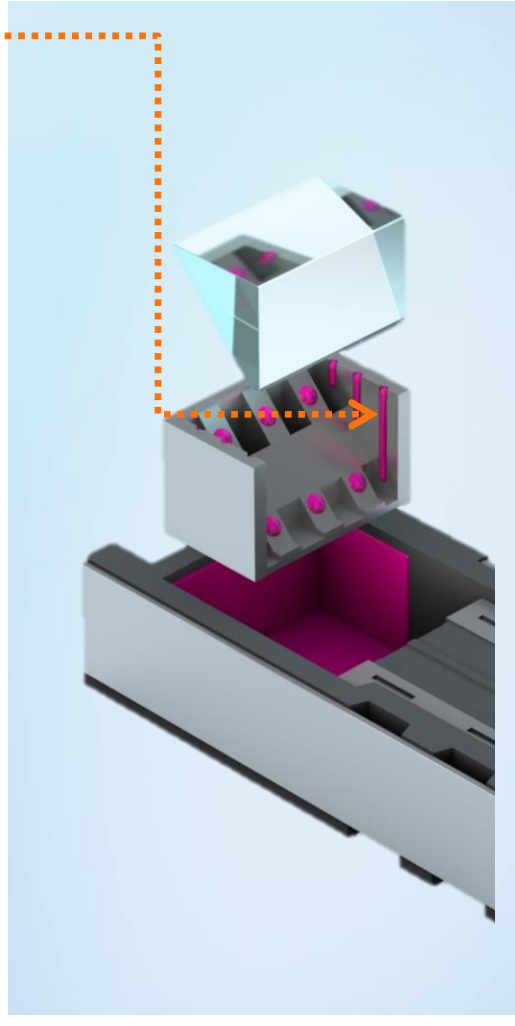
- Multiple Options: Purely heat curing or dual curing adhesive for prefixation
- Low modulus for high optical stability
- excellent adhesion to prism and/or coatings on prism and holder (LCP/PC)
- Low viscosity to fill small gap (down to 50µm)
- Jetability of adhesive for fast dispensing
- Low-temperature curing at temperatures starting from +60 °C to avoid damage of optical components and coatings
- Low outgassing

DELO's light- and heat-curing adhesive

UV light fixation in less than 0.5 s

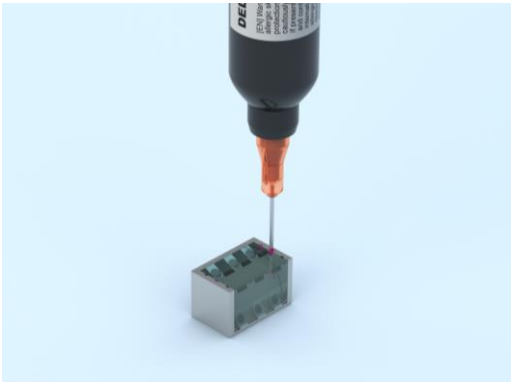
Fast heat curing at +60 °C

DELO DUALBOND LT, SJ series

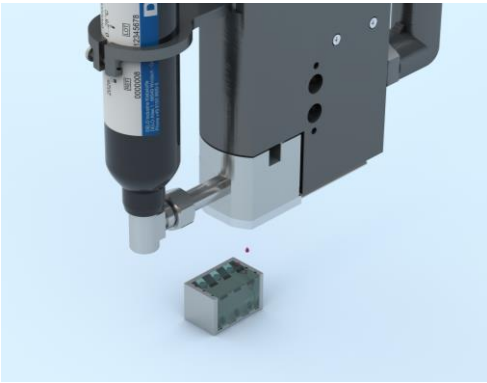


Side Fill

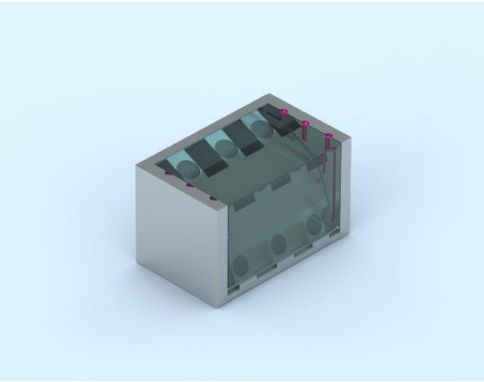
Active alignment process
with DELO DUALBOND



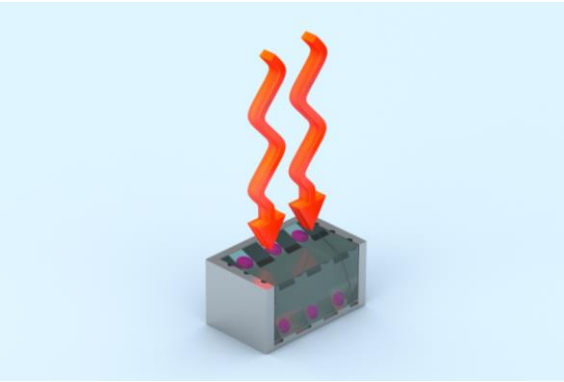
1a Dispensing via Needle



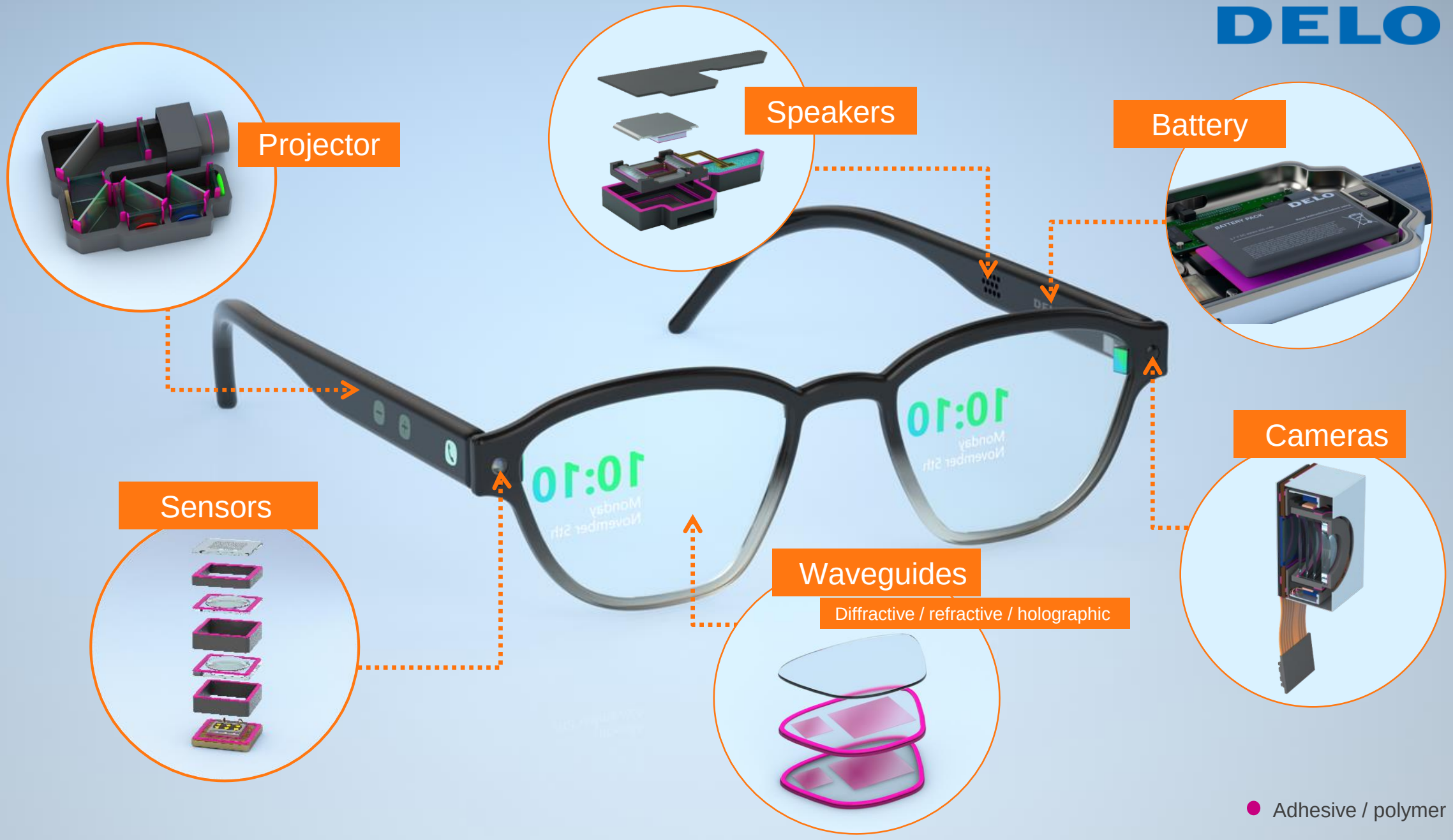
1b Dispensing via Jetter



3 Flow of adhesive within seconds



4 Curing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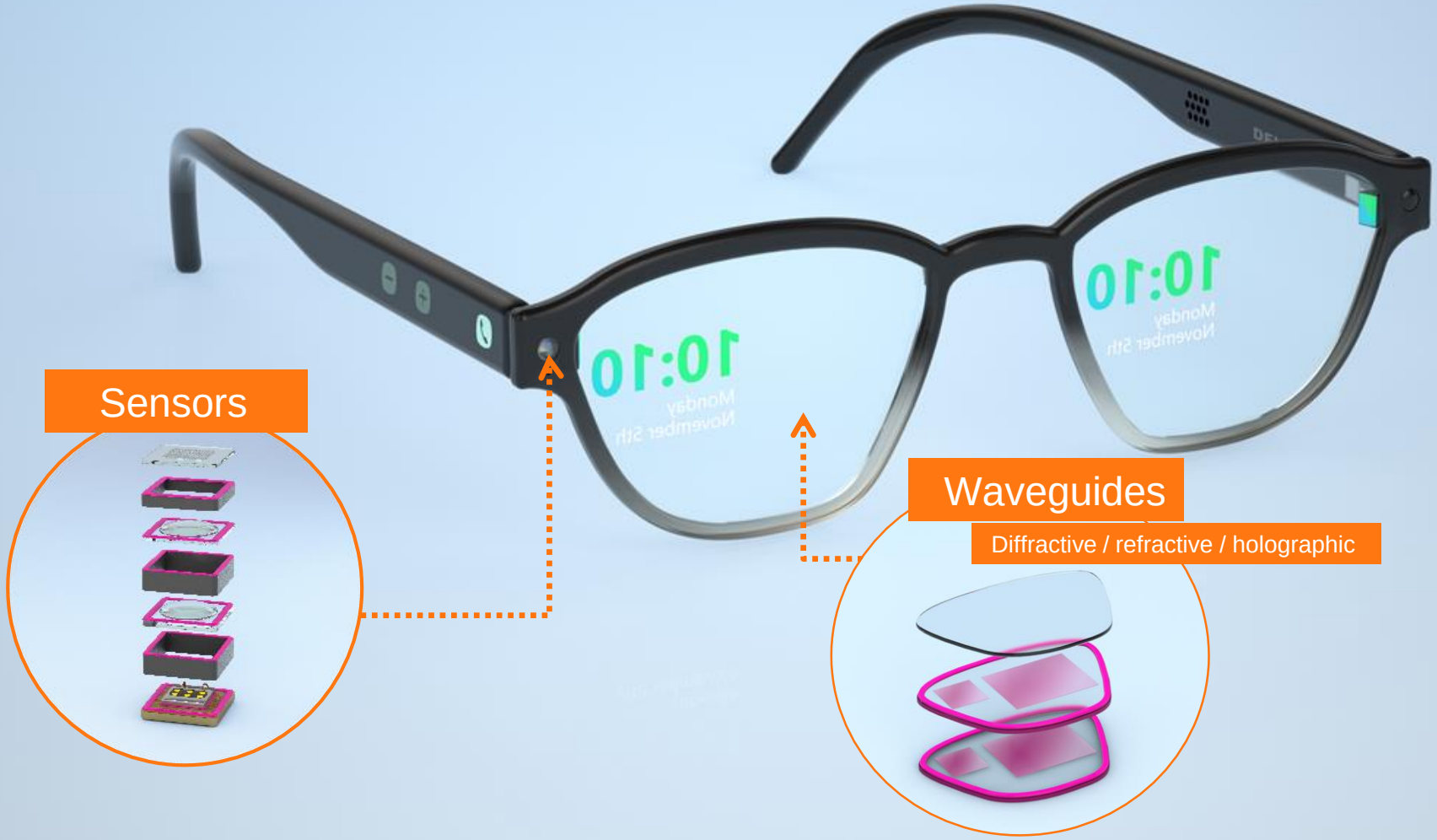
Replication of optical elements (lens, DOE) from a UV-curing optical polymer

Nanoimprint Lithography (NIL)



● Adhesive / polymer

Nanoimprint Lithography (NIL)

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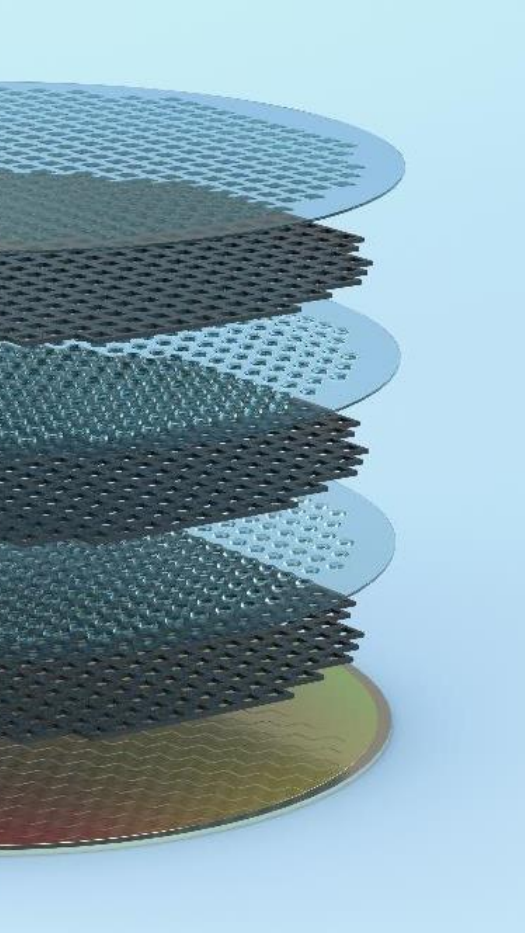

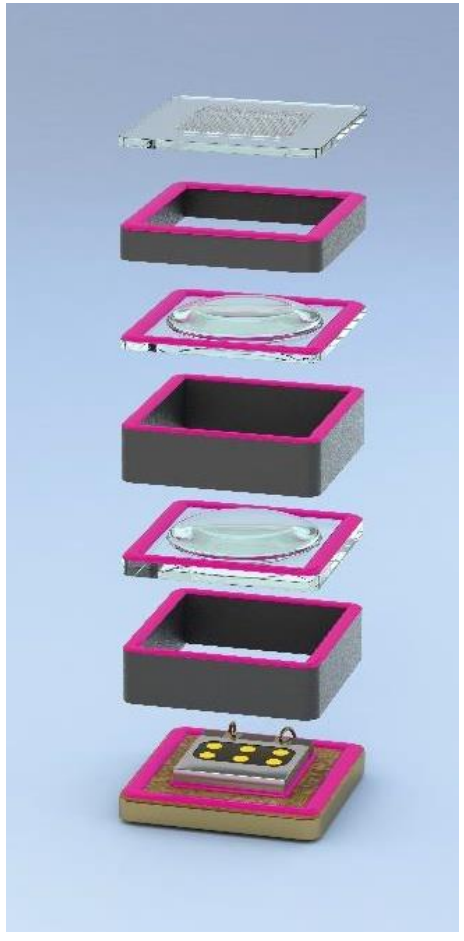

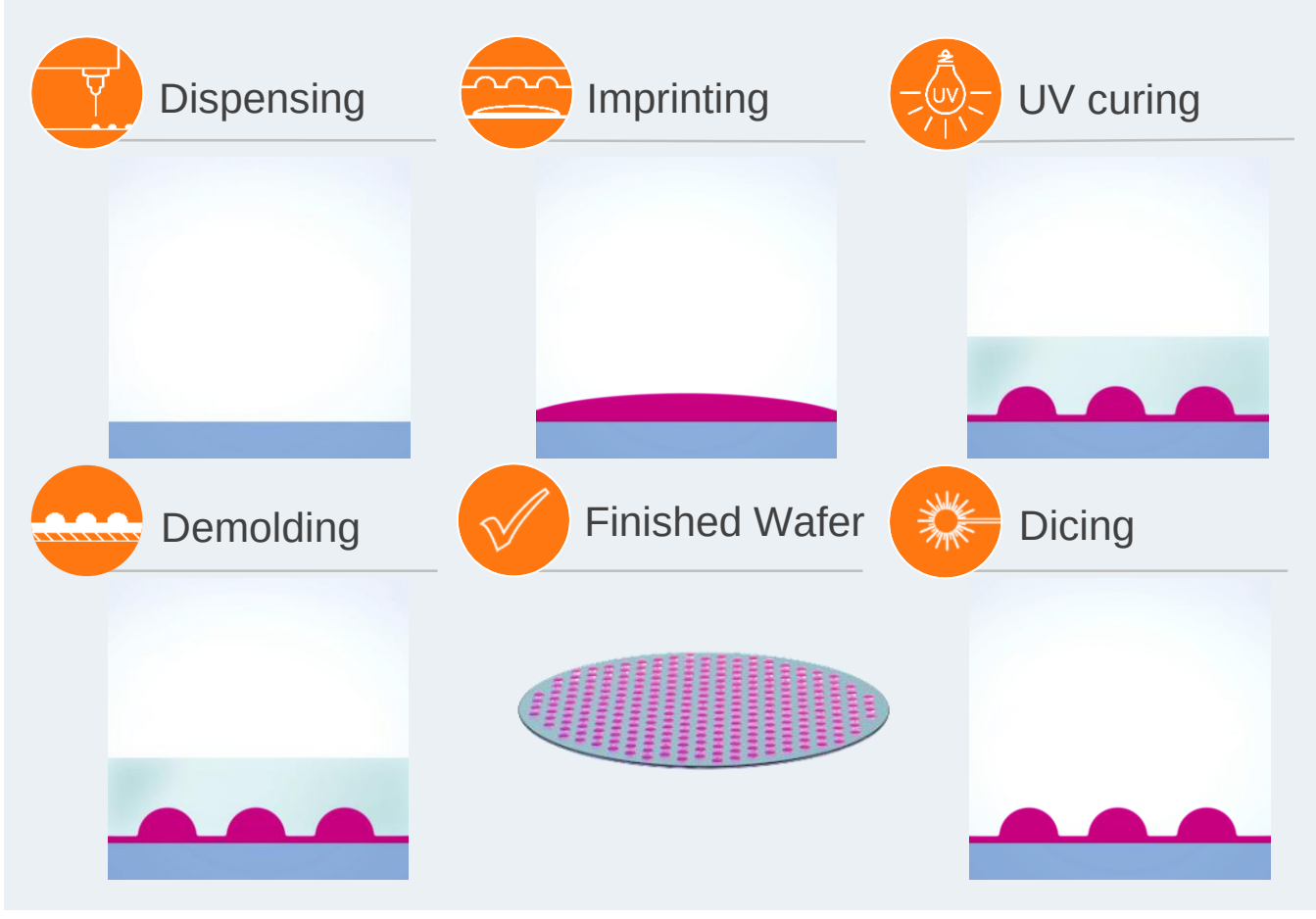

Adhesive / polymer Substrate (glass) Stamp

Material solutions for wafer-level micro-optics

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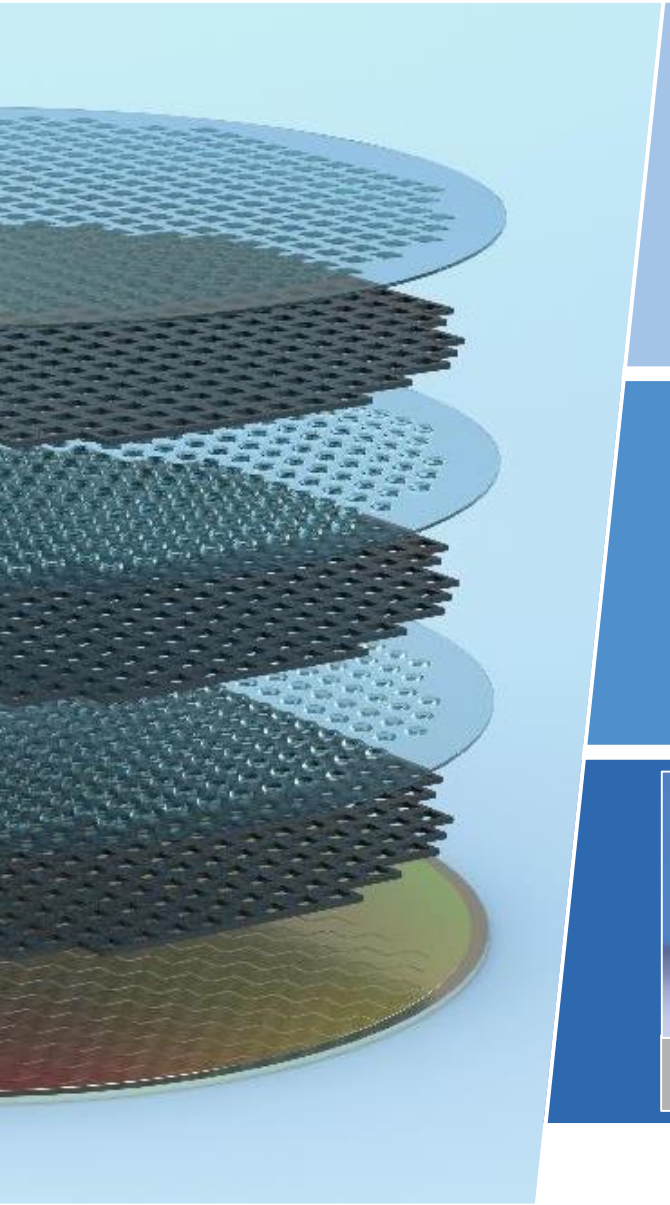
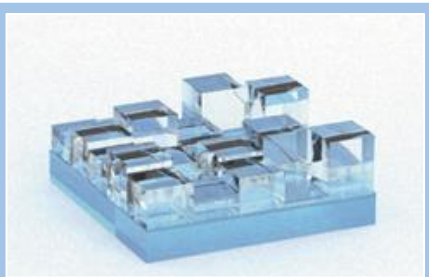
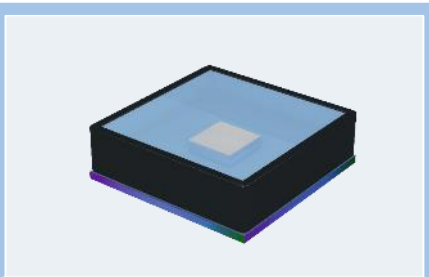


Optical solutions



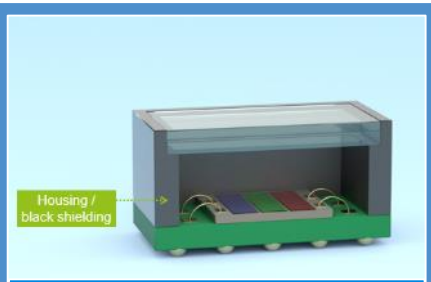
Nano Structures

Lens Structures

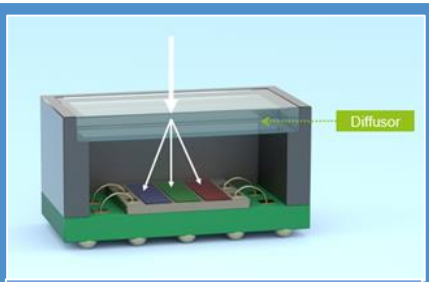


Encapsulation

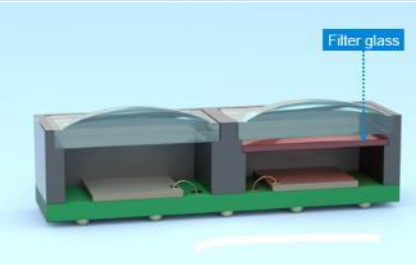
Functional solutions



Light Blocking

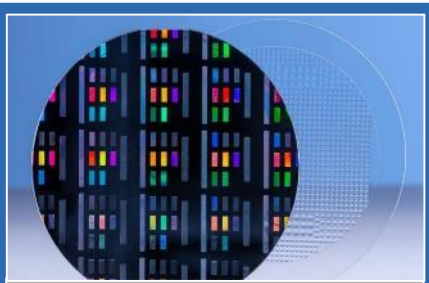


Diffuser Material

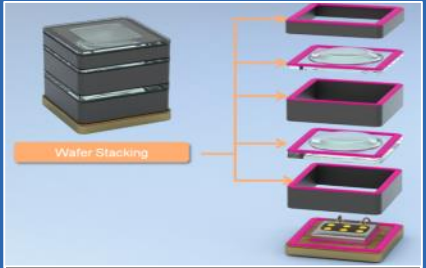


Filter Material

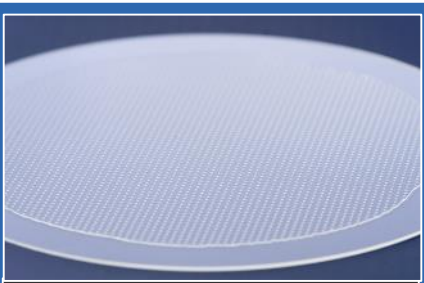
Process solutions



Wafer Bonding

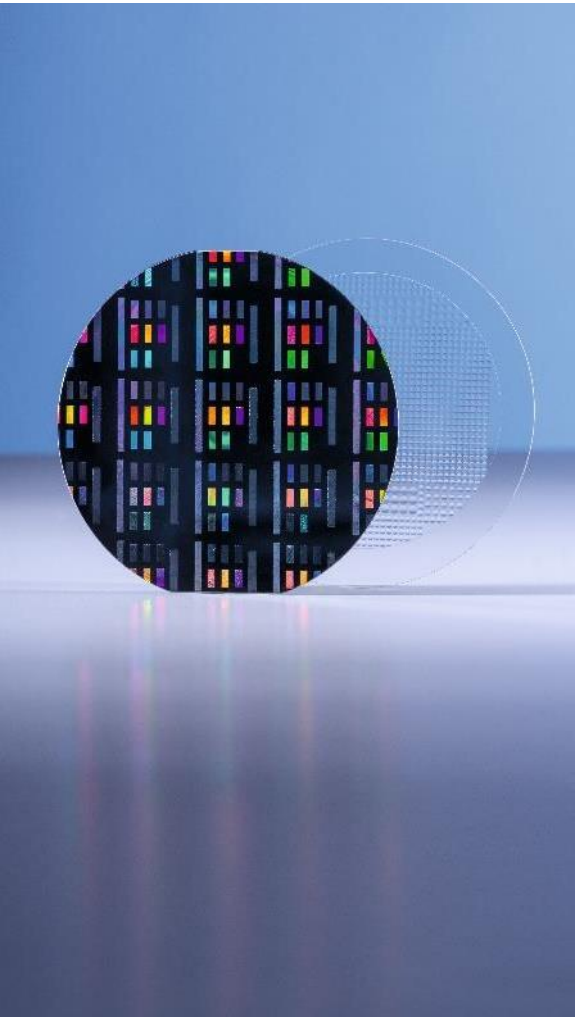


Wafer Stacking

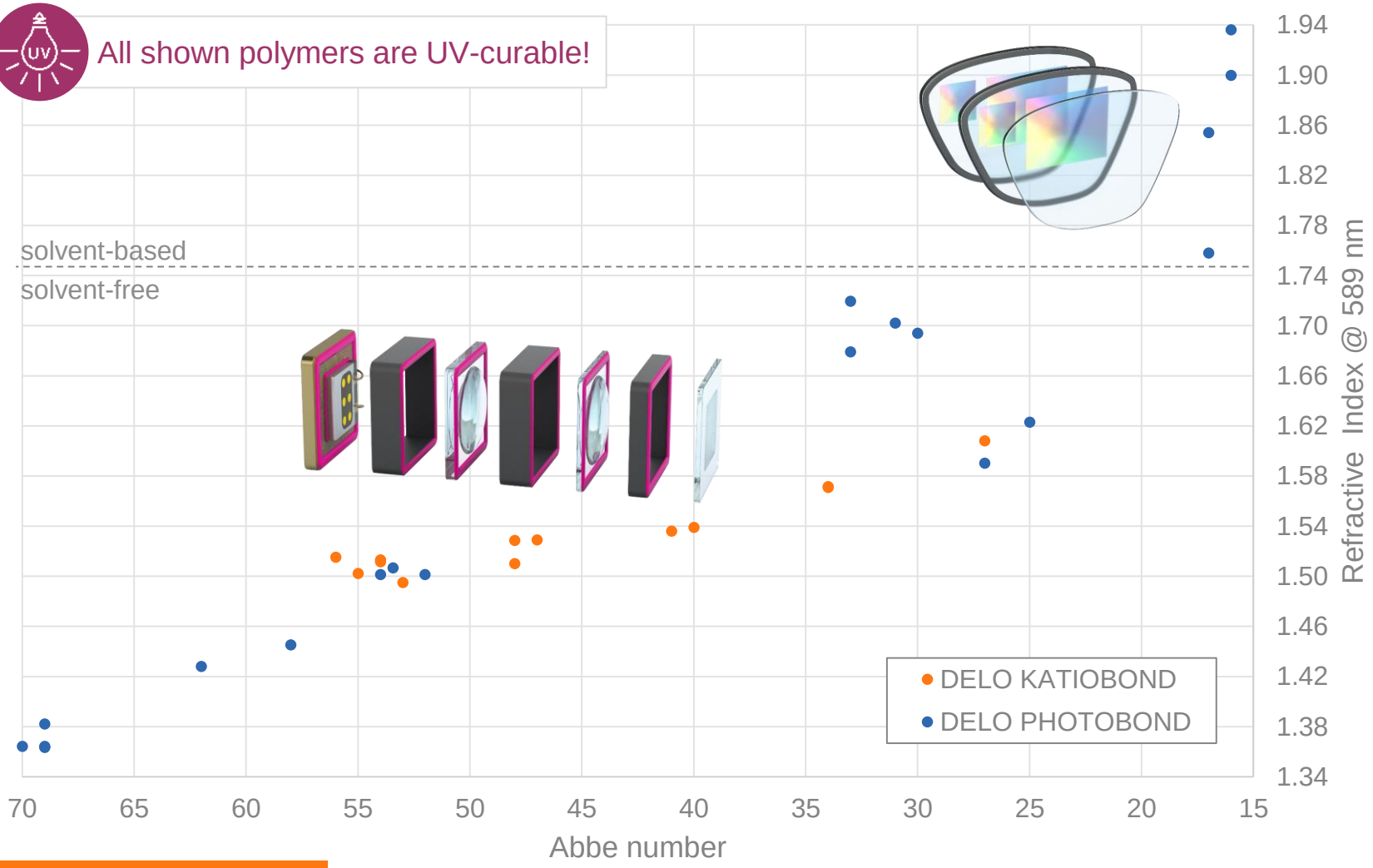


Stamp Material

Adjusting Refractive Index

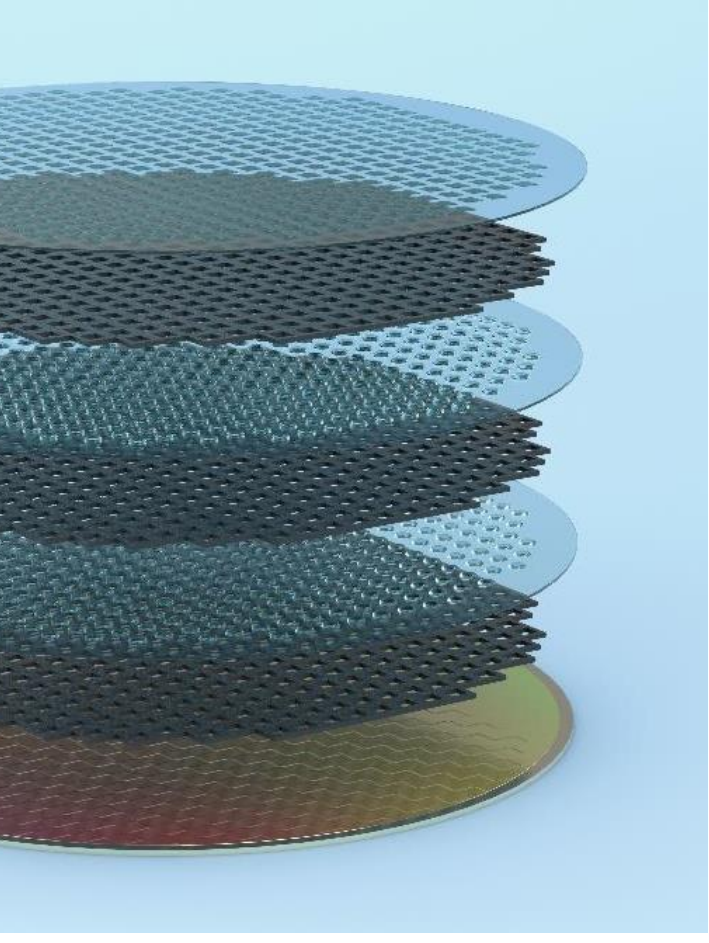


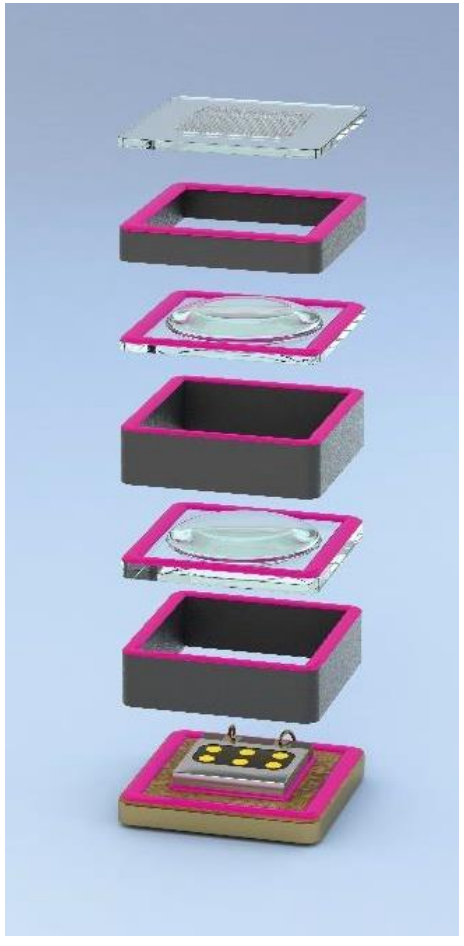
All shown polymers are UV-curable!



Broad range of RI available to enable optical design freedom

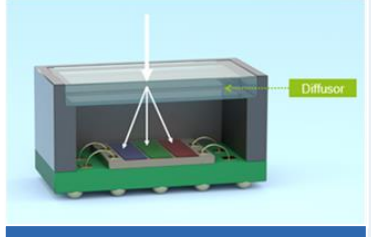
Nanoimprint Lithography (NIL)





Benefits of wafer-level packaging with polymers

- All liquid process
- Maximum design freedom
- Minimum package size
- Maximize UPH
- Optimized mechanical stability
- Reflow stable package



Ambient light sensing

ToF sensing

3D sensing

Nanoimprint of grating structures

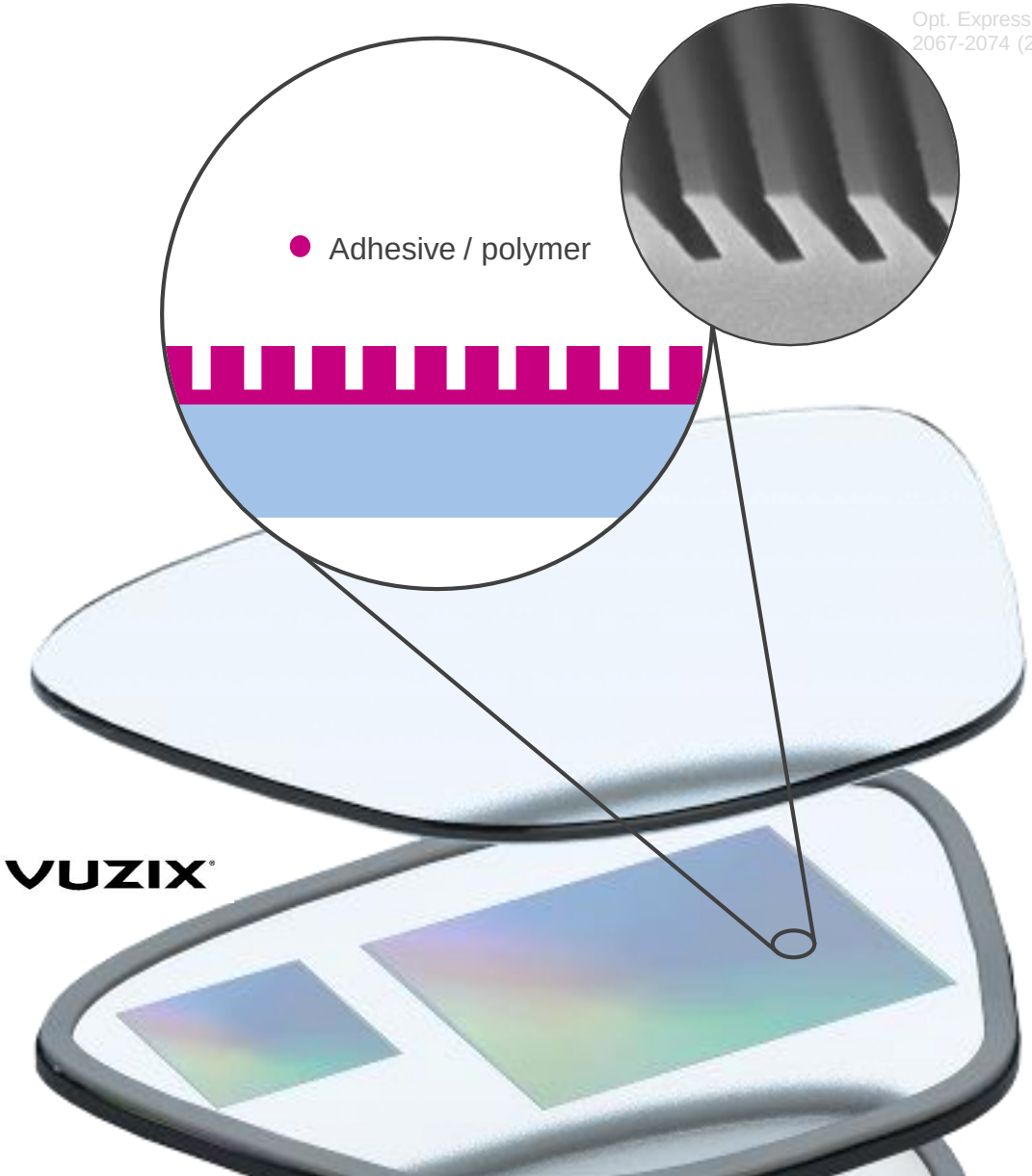
DELO

Opt. Express 15, 2067-2074 (2007)

Polymer-based diffractive optical elements

- Surface relief gratings (SRG) imprinted on glass waveguide
- High refractive index of polymer
- Allows arbitrary grating structures*
  - » slanted, blazed, binary, analog
  - » Modulation of depth, slant, duty cycle
- Mass-producible on the wafer- or panel-scale via UV Nanoimprint Lithography (UV-NIL)

*depending on master template



Microsoft HoloLens

magic leap

VUZIX

⇨ Combines high quality glass substrate with easy and fast processability of polymer

⇨ Currently dominant waveguide technology

Summary

Adhesives enable ARVR

- Adhesives can do more than just bond parts together!
- Smart usage of adhesives enables completely new designs and processes
- Involve adhesive experts early in your project to benefit from their know-how
- Be smart – don‘t underestimate the importance of proper adhesive selection!

We are looking for…

- New process ideas and partners to transfer those into mass production
- Raw materials to extend our current product portfolio
- Innovative companies who want to push boundaries for high-tech adhesives

DELO with engineering lab
DELO office
DELO covered countries

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