

**DELO**

MEMBER  
of EPIC



# ADVANCED MATERIALS FOR WAFER-LEVEL MICRO-OPTICS

EPIC Meeting on Advanced Microoptics | May 12th | Dr. Stephan Prinz

FAMILY-  
OWNED

€ 170 M.  
REVENUES

820  
EMPLOYEES

WE ARE

WHERE YOU ARE





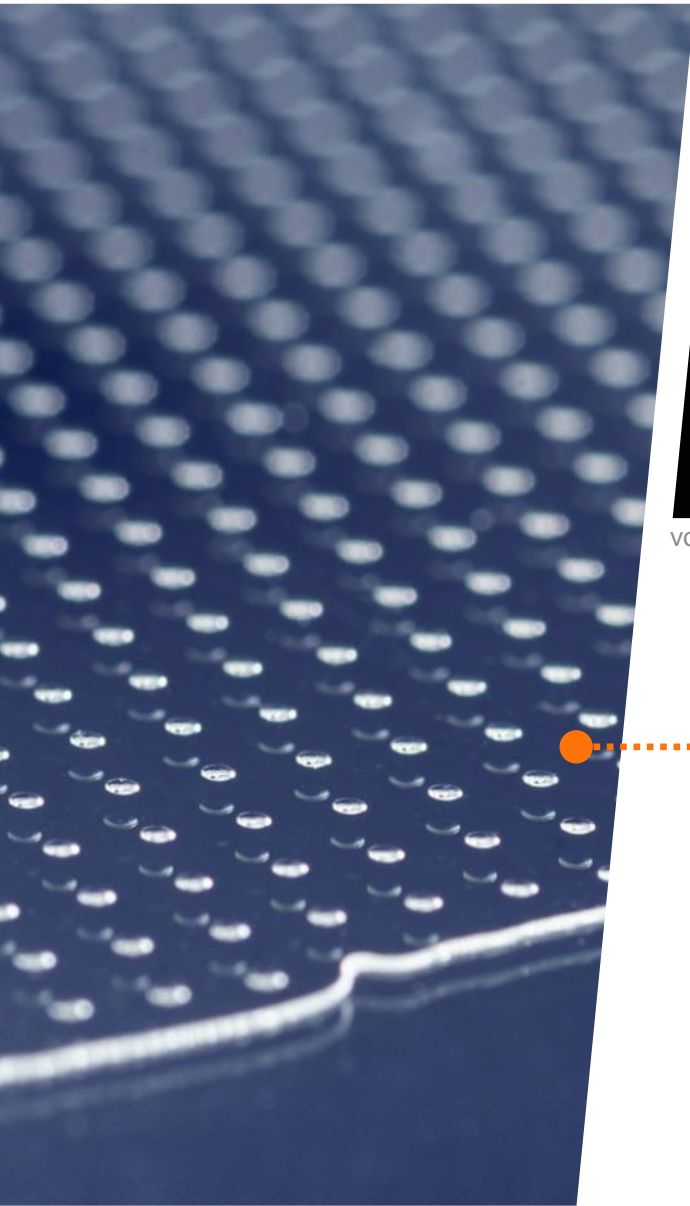
ADHESIVES /  
POLYMERS



DISPENSING  
EQUIPMENT




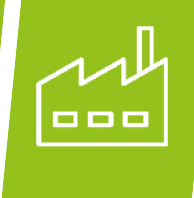


CURING  
EQUIPMENT




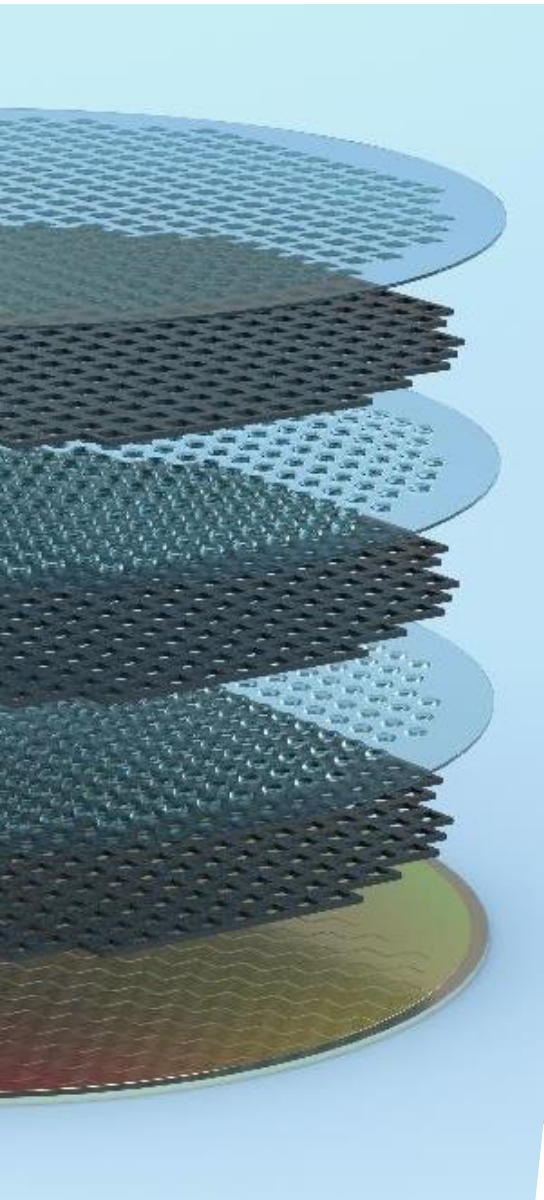
| 3D Sensing                                                                        | Ambient Sensing                                                                    | AR / MR                                                                             | Headlamps                                                                           | Projection                                                                          |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |
| voonze.com                                                                        | entwickler.de                                                                      | techspot.com                                                                        | the-verge.com                                                                       | BMW                                                                                 |

## Wafer-level micro-optics

- ▶ Optical grade polymers
- ▶ Polymer-on-glass or monolithic
- ▶ Mass-manufactured on wafer-level
- ▶ Lenses and DOE

|                                                                                      |                                                                                      |                                                                                      |                                                                                      |
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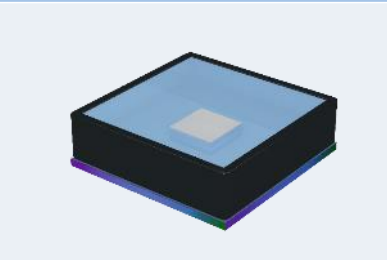
Market leader & premium partner



Nano Structures

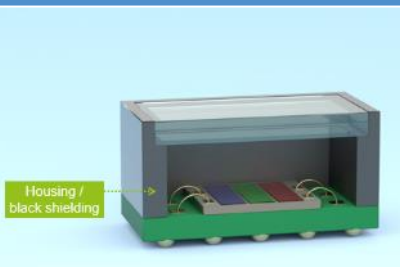


Lens Structures



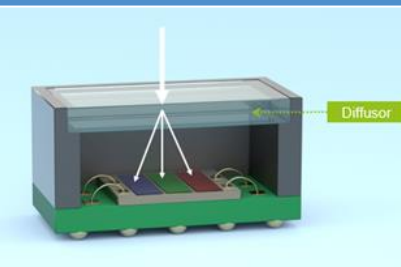
Encapsulation

Optical solutions



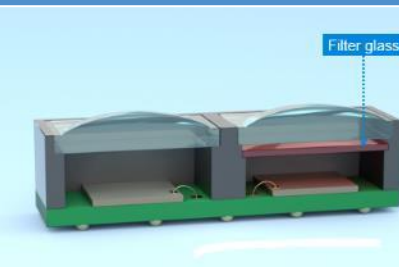
Housing / black shielding

Light Blocking



Diffuser

Diffuser Material




Filter glass

Filter Material

Functional solutions



Wafer Bonding

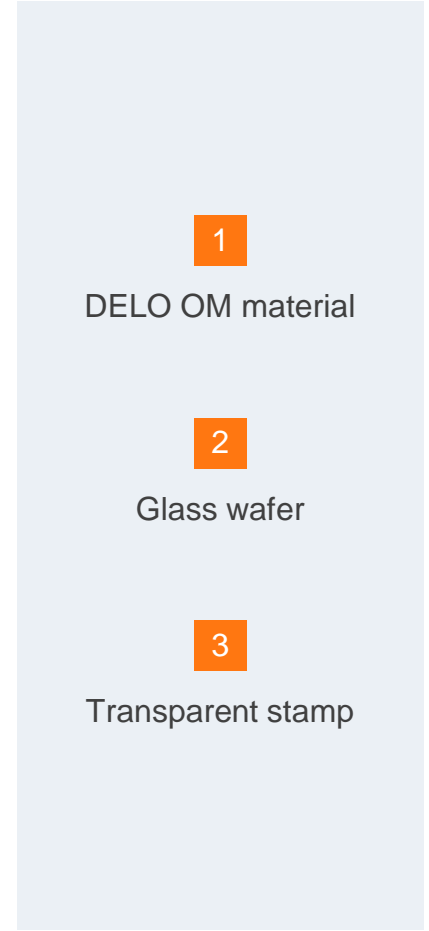
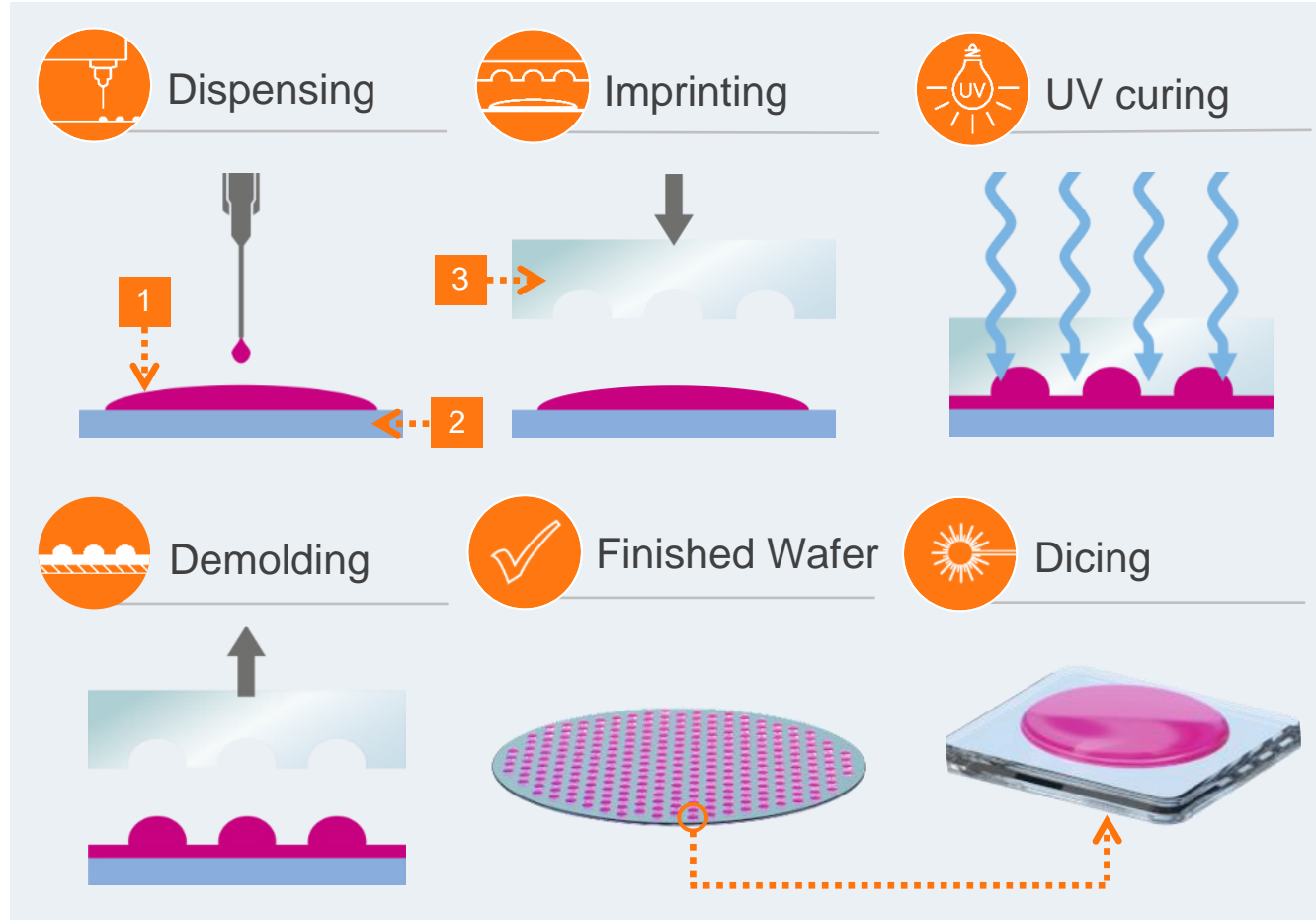
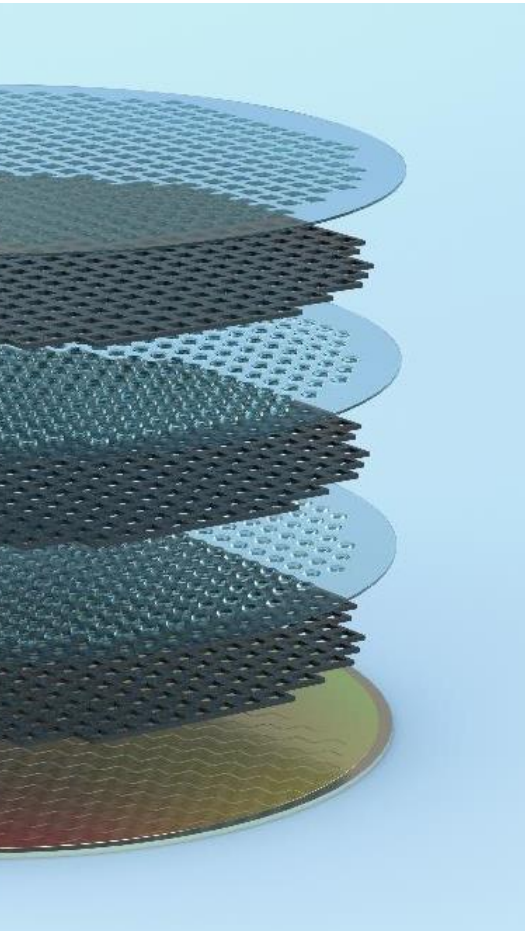


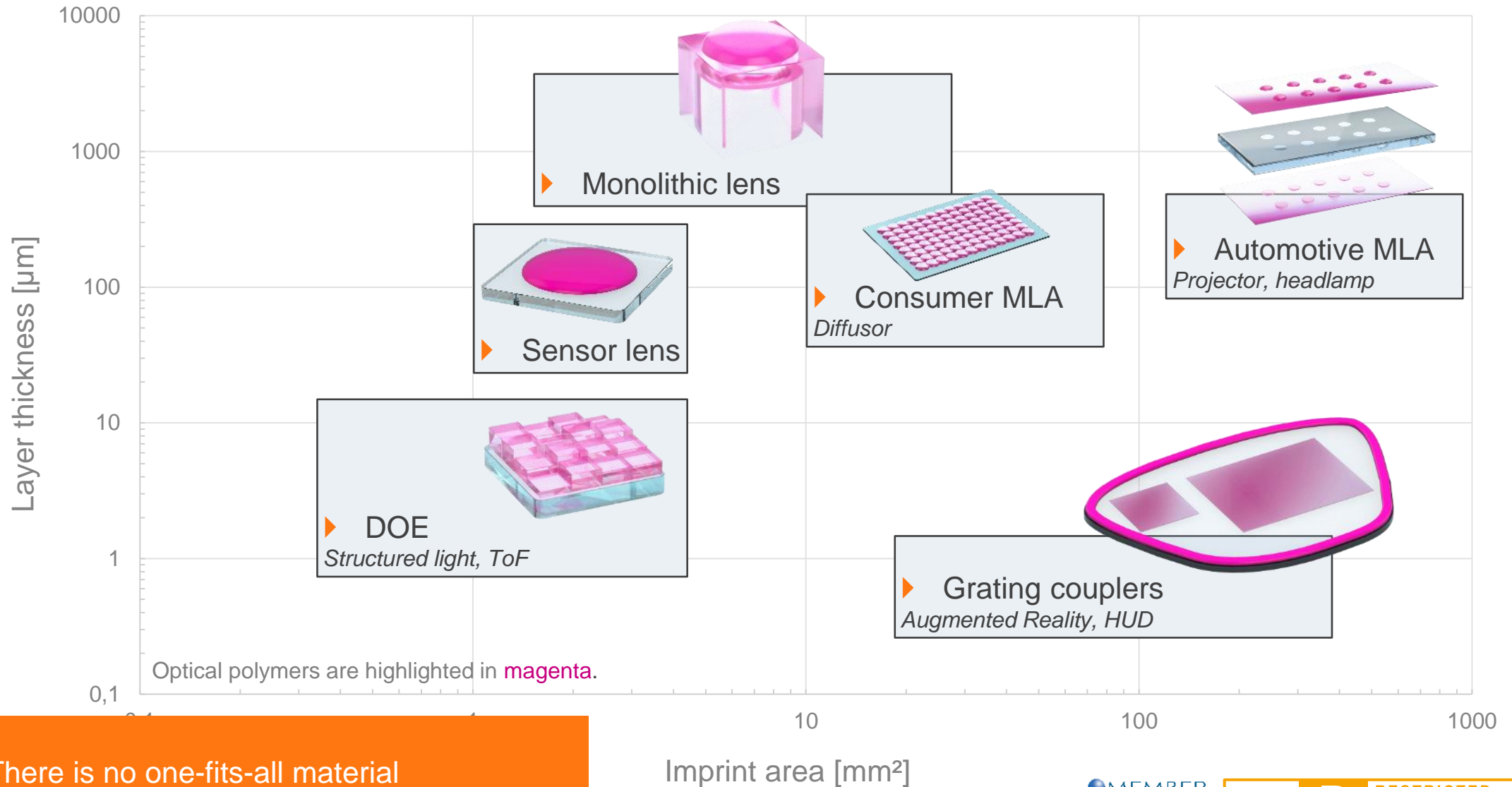
Wafer Stacking



Stamp Material

Process solutions





➡ There is no one-fits-all material

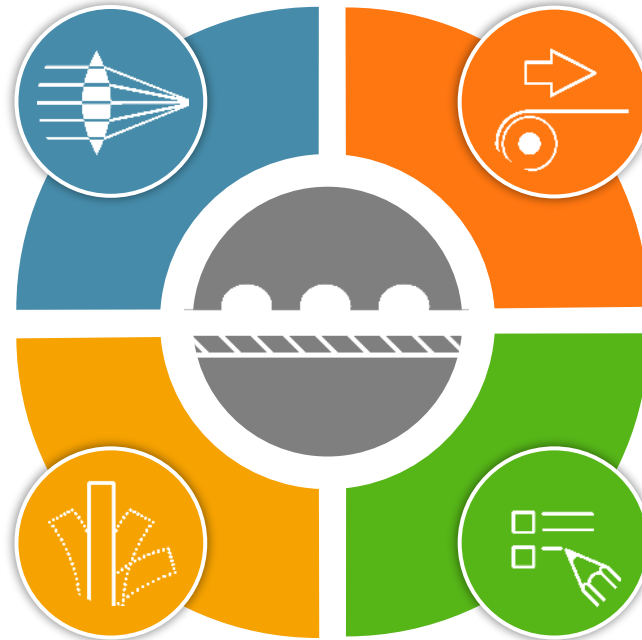


## *Optical Properties*

- Index of refraction
- Dispersion
- Transmission
- Scattering

## *Mechanical Properties*

- Young's modulus
- Glass transition temperature
- Thermal expansion
- Scratch resistance



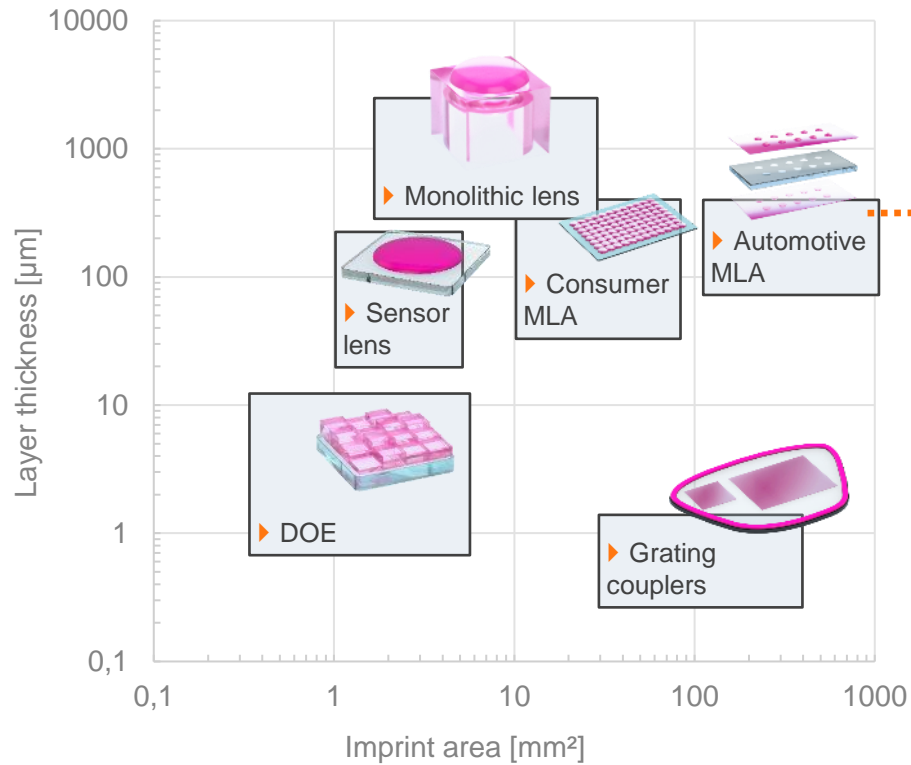
## *Processing*

- Good filling of structures
- Stamp interaction
- Demolding
- Shrinkage control
- UV curing

## *Reliability*

- Optical stability
- Dimensional stability
- Adhesion to substrate

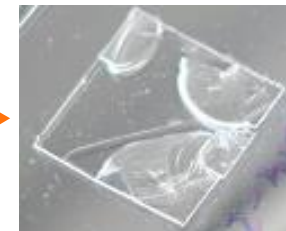
➔ High flexibility in material design to meet the requirements for different applications



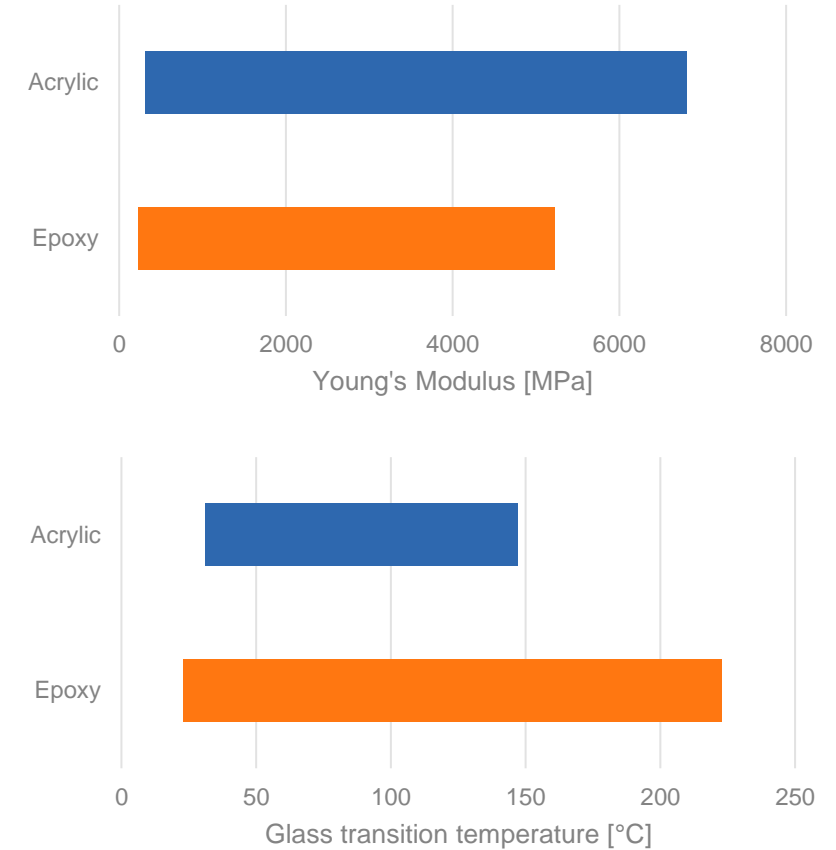
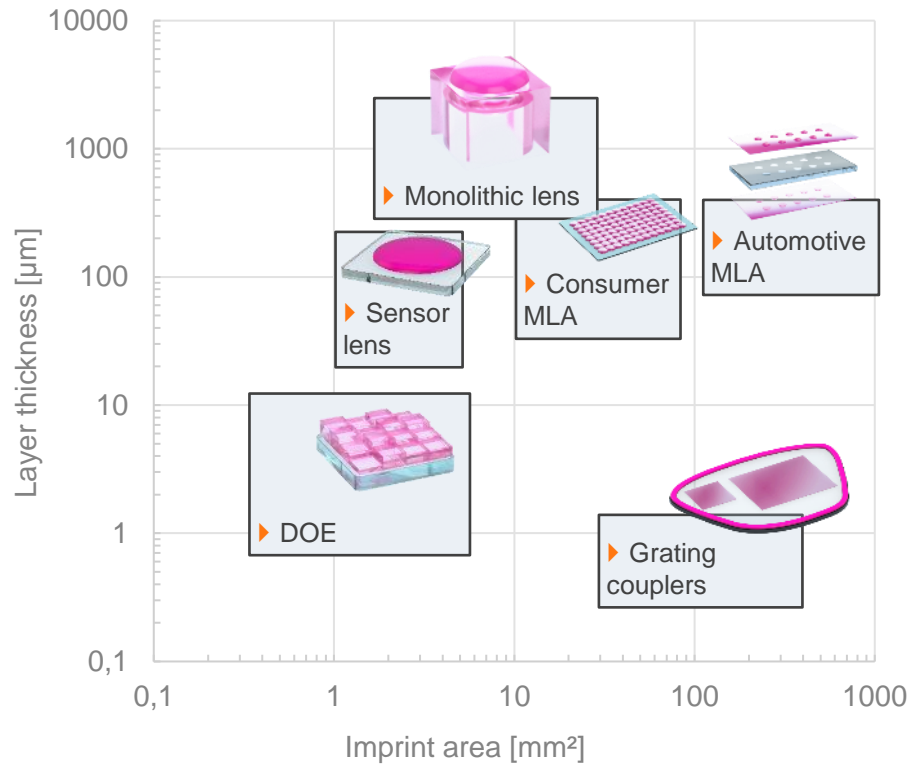
## Performance after T-shock

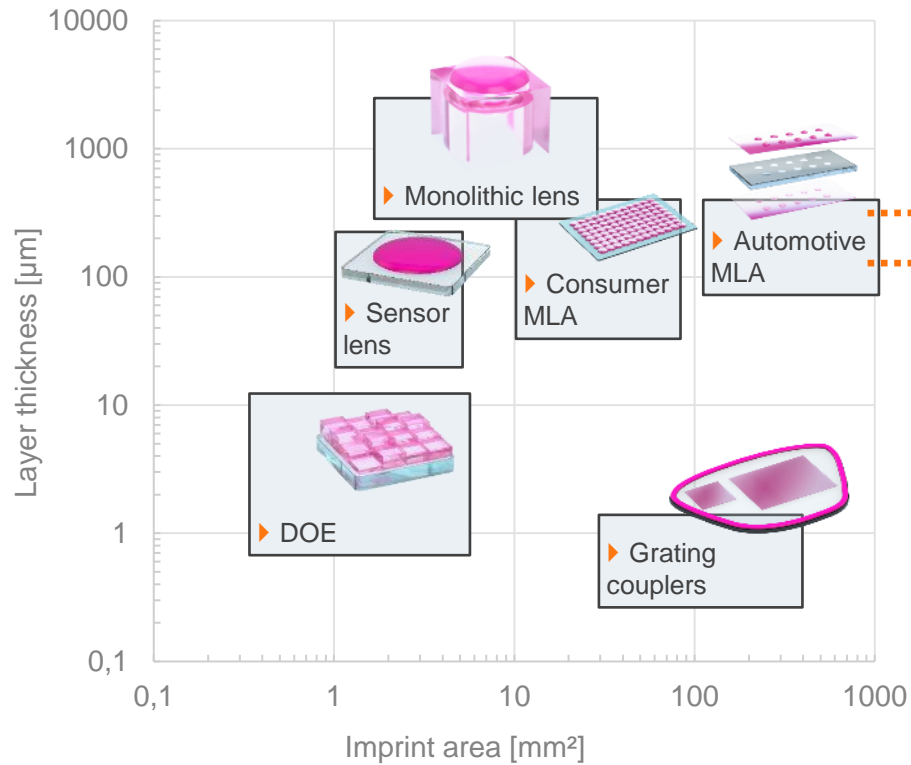
-40°C / +120°C for 500 cycles

Hard Polymer



➔ Matching mechanical properties to applications

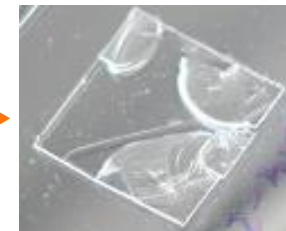




## Performance after T-shock

-40°C / +120°C for 500 cycles

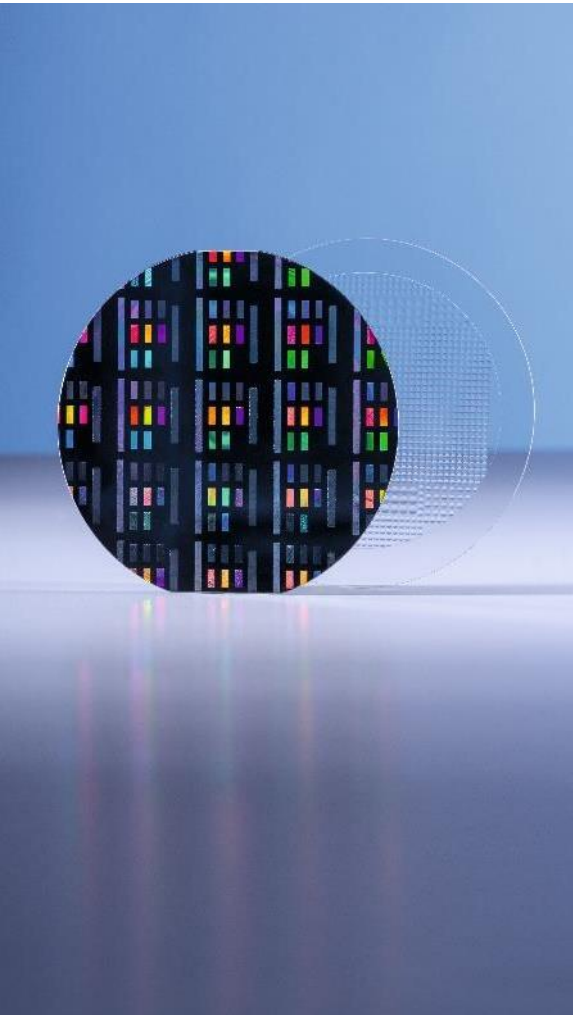
Hard Polymer



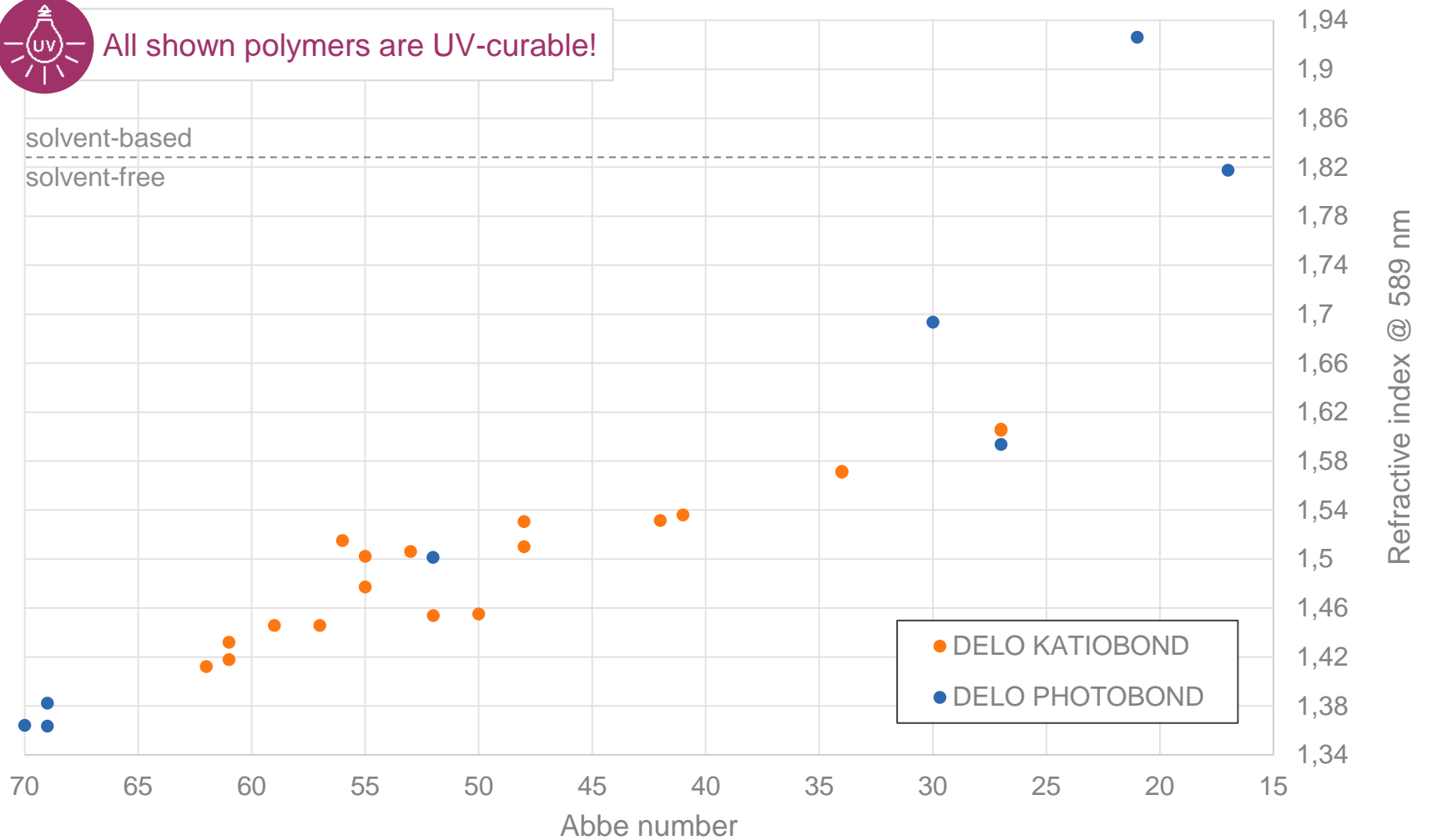
Soft Polymer



➡ Optimized performance achieved by tailored material properties

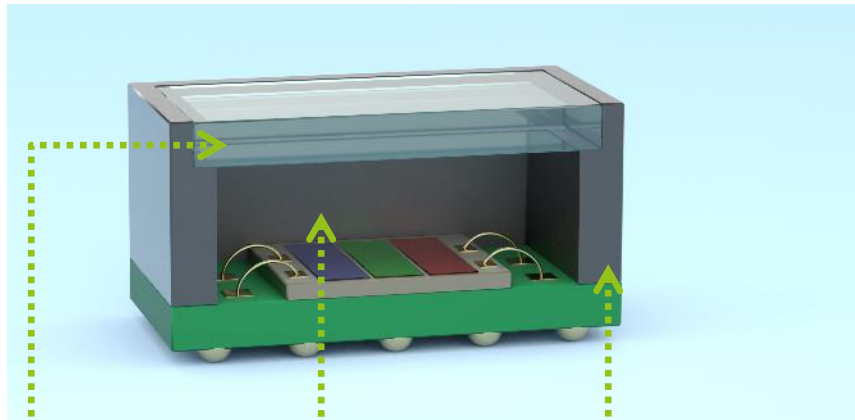


All shown polymers are UV-curable!



➔ Broad range of refractive indices available

## Ambient light sensor



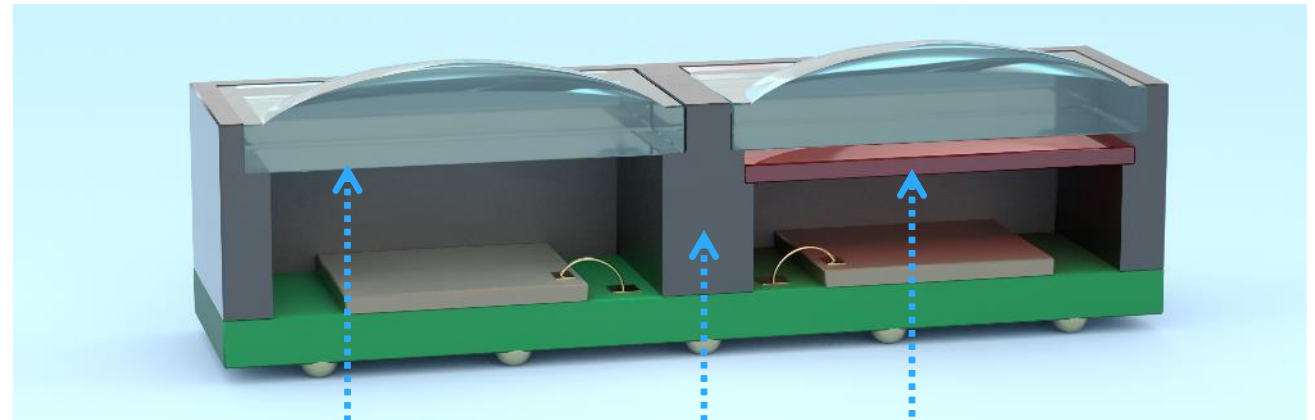
Diffusor

Encapsulation + black shielding



Combined DELO solution

## Proximity sensor



Lens imprint + encapsulation

Black shielding

Filter glass + encapsulation



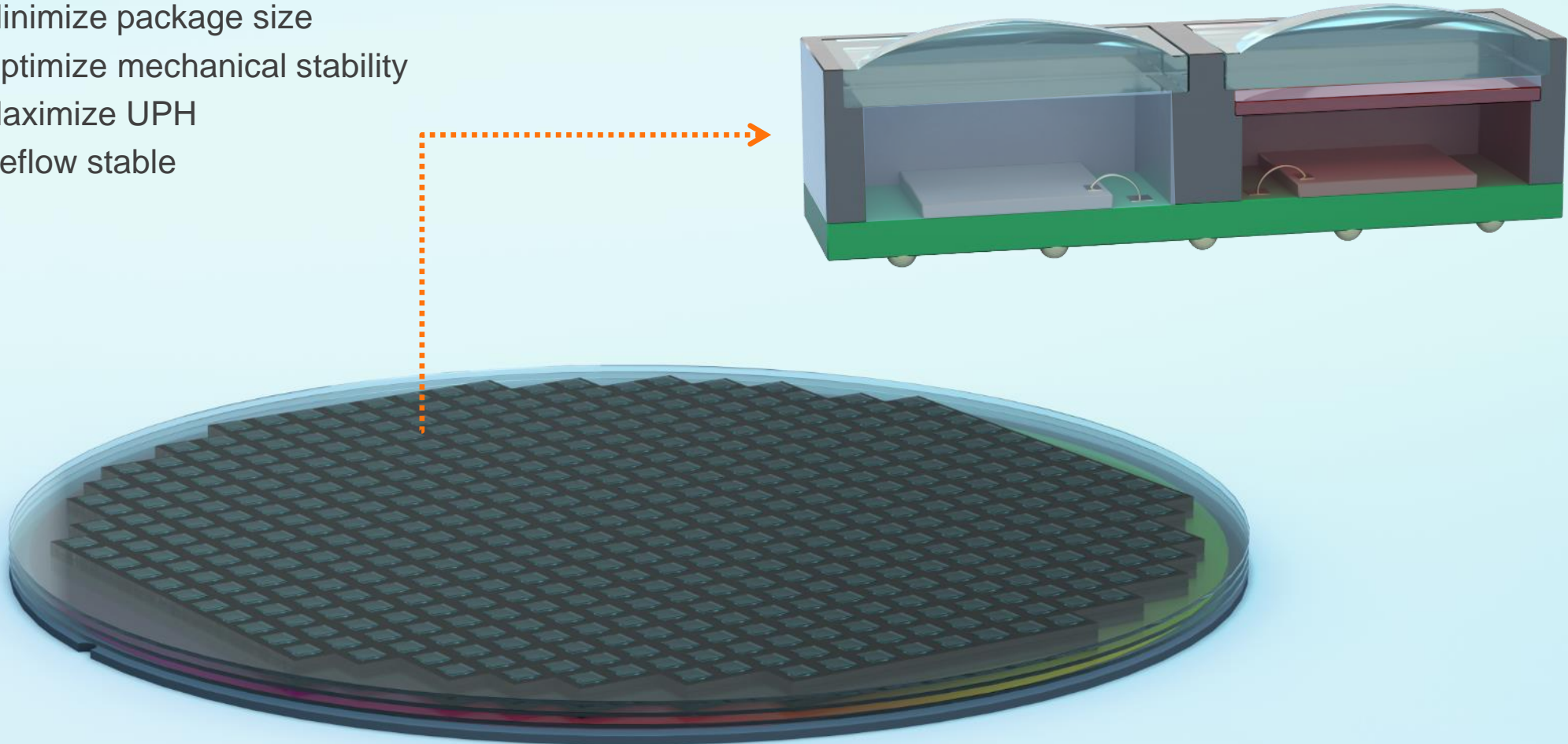
Combined DELO solution



All microstructures can be made of liquid optical materials, and are highlighted in **magenta**.

## Advantages of wafer-level packaging

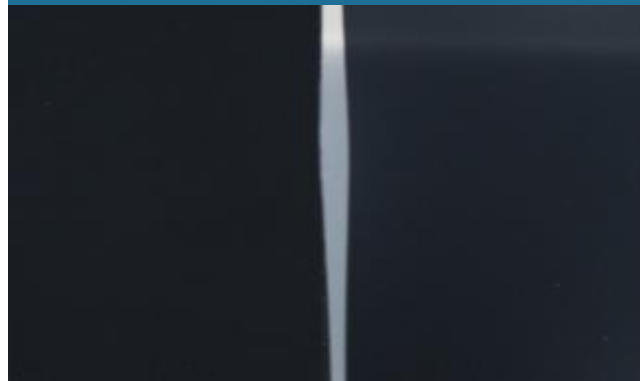
- ▶ Minimize package size
- ▶ Optimize mechanical stability
- ▶ Maximize UPH
- ▶ Reflow stable



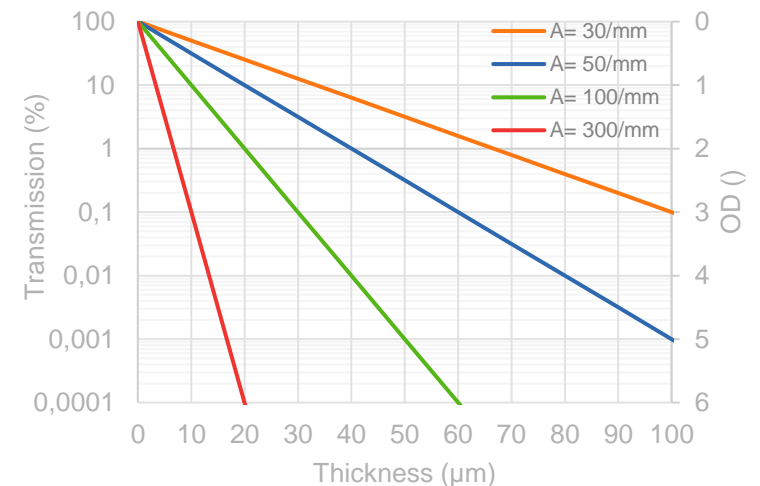
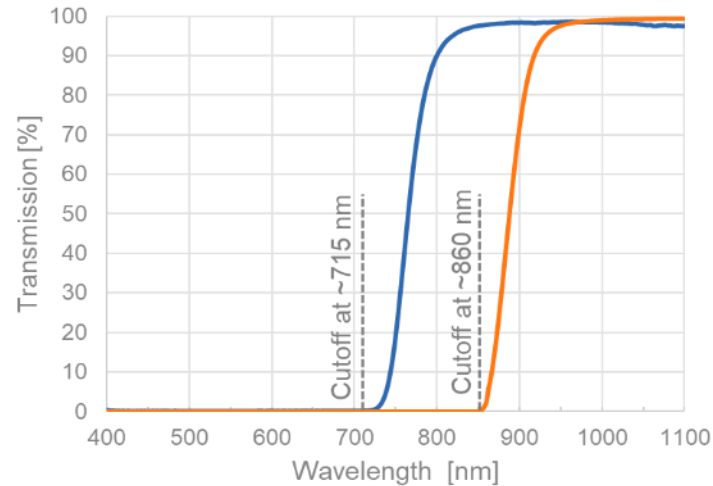
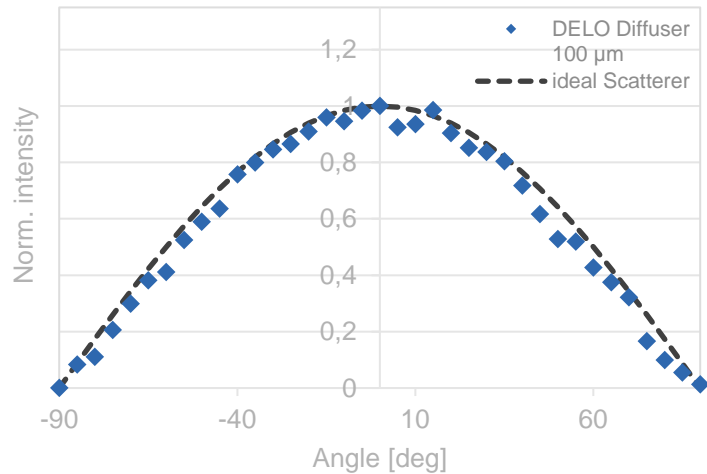
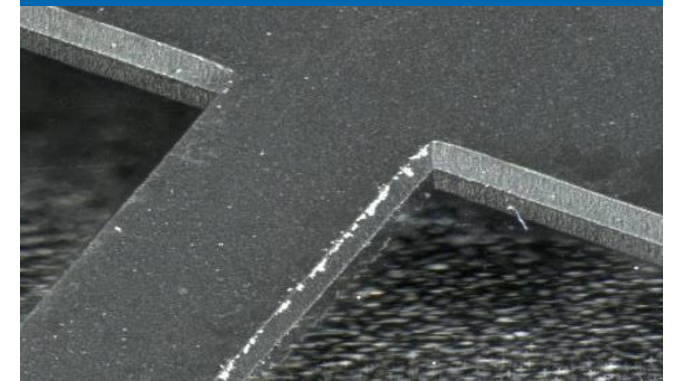
## Bulk diffusor



## Spectral filter



## Ultra-black

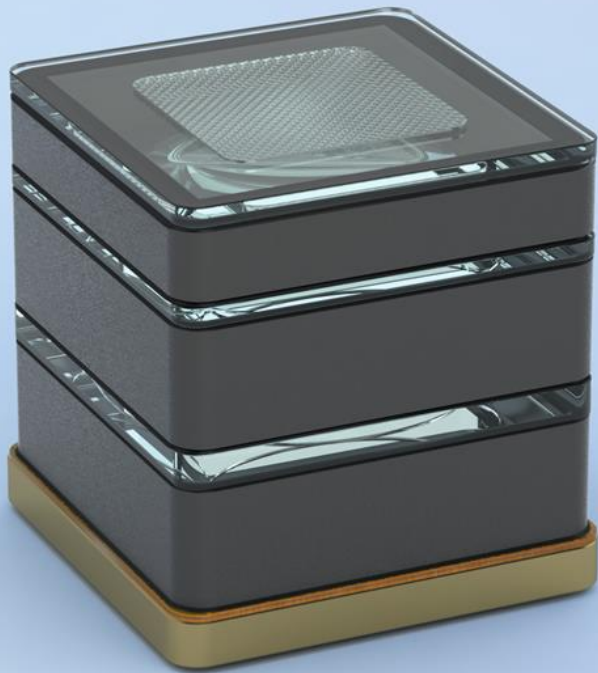


⇒ Cosine scattering profile from thin bulk diffusor

⇒ Tailored spectral filtering  
⇒ Adjustable refr. index

⇒ High optical density achievable in thin layers





Customized optical & mechanical properties



Excellent Reliability



Wafer-level processability



Complete material solution package



New raw materials  
Application ideas  
Partnerships along supply chain

## 3D Sensing



voonze.com

## Ambient Sensing



entwickler.de

## AR / MR



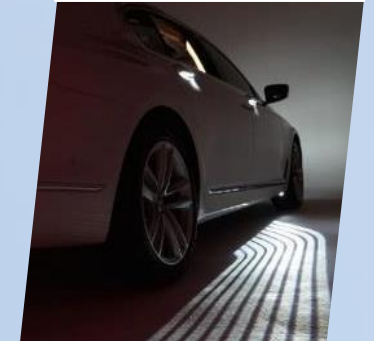
techspot.com

## Headlamps



the-verge.com

## Projection



BMW



Contact us for discussion:  
[WLMO-Experts@DELO.de](mailto:WLMO-Experts@DELO.de)

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