

BREAK THROUGH OF MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Do we take the last hurdles?

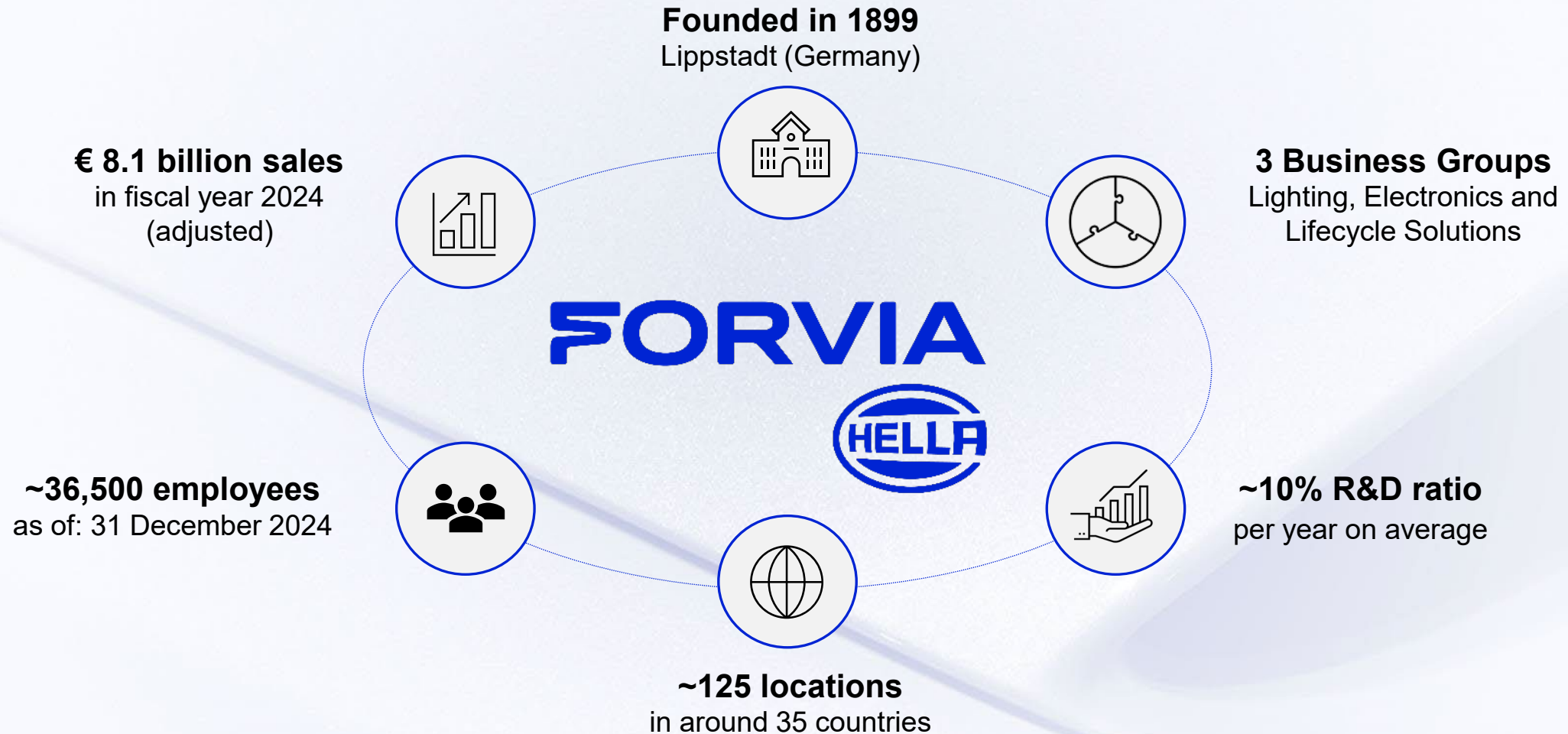
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FORVIA



FORVIA HELLA HAS BEEN SHAPING MOBILITY FOR 125 YEARS

FORVIA HELLA: an overview



A COMPREHENSIVE PORTFOLIO

Six international business groups with differentiating product lines



Seating

- > Seat structures
- > Complete seats



Interiors

- > Instrument Panels
- > Door Panels
- > Center Consoles
- > Sustainable Materials
- > Surface activation



Clean Mobility

- > Ultra low emissions solutions for passenger and light commercial vehicles
- > Zero emission hydrogen solutions for mobility, energy storage and distribution



Electronics

- > Sensors & Actuators
- > Automated Driving
- > Lighting/Body Electronics
- > Energy Management
- > Cockpit Electronics
- > Cockpit Experiences



Lighting

- > Headlamps
- > Rear Lamps
- > Interior Lighting
- > Car Body Lighting



Lifecycle Solutions

- > Independent Aftermarket
- > Workshop Solutions
- > Special Original Equipment

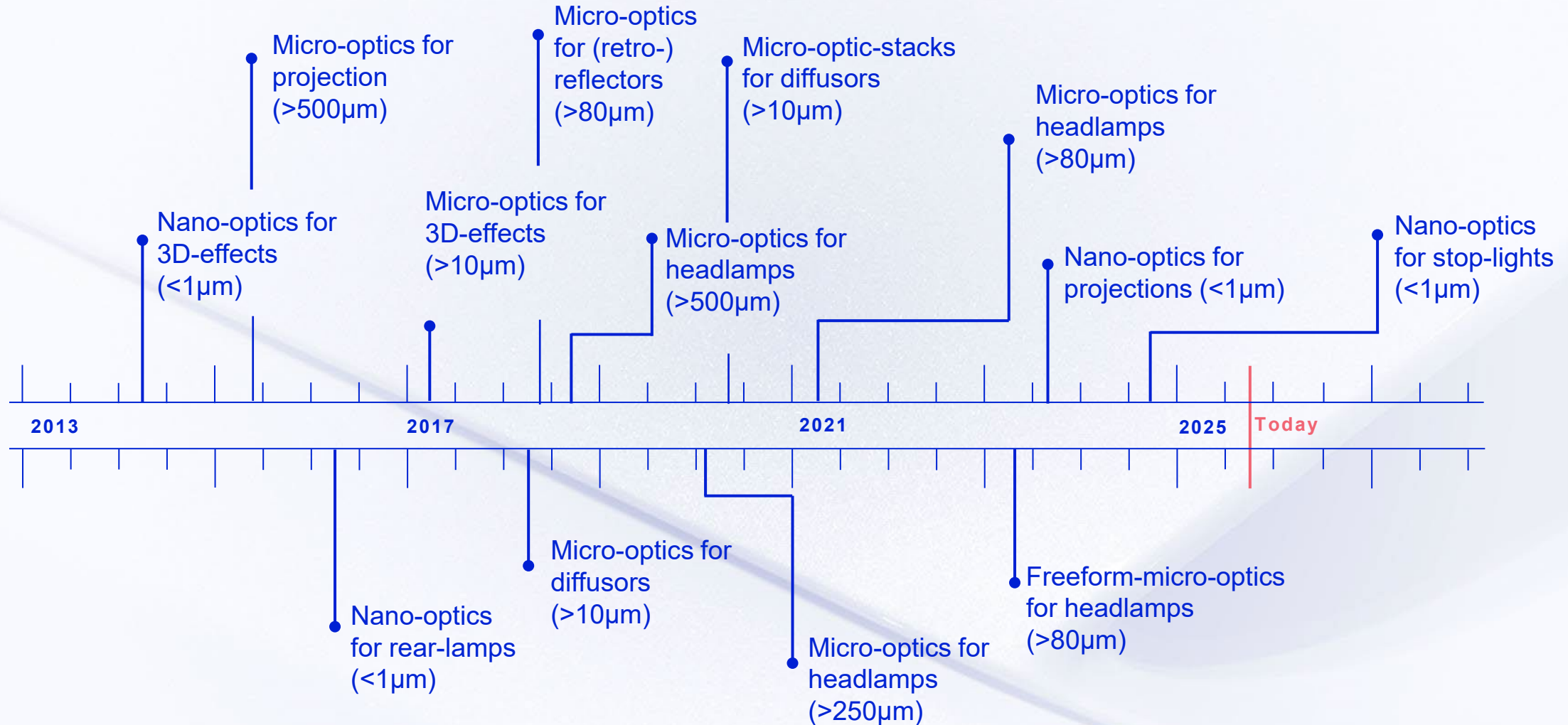
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MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Developments at FORVIA HELLA



MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Achievements

What we already achieved:

- > Integration of „large-scale“ micro-optics for different applications
 - Examples: MLAs, CLAs
- > Integration of micro-optical stacks
 - Example: FORVIA HELLA FlatLight
- > Integration of holographic, diffractive and hybrid diffractive-refractive optics
 - Examples: Diffusor optics for homogeneous luminous surfaces, decorative and functional holograms



Example of a MLA Headlamp Module



FORVIA HELLA FlatLight μ MX modules in a rear lamp.



Example of a holographic module

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 - Examples: Diffusor optics for homogeneous luminous surfaces, decorative and functional holograms
- > PoCs of micro-reflectors, freeform-micro-optics (FFMOs) and meta-optics
 - Examples: FFMOs for headlamp applications, meta-surfaces for symbol-projection

Meta-optics based projector.

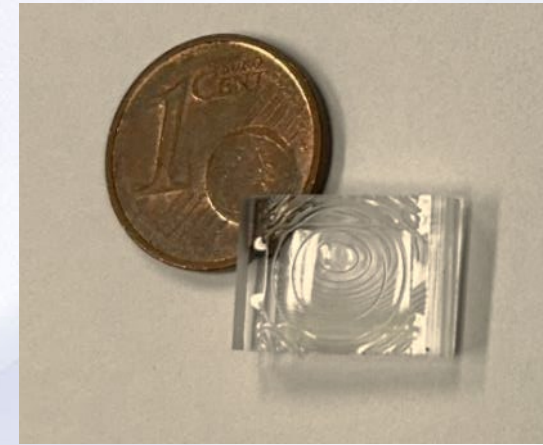
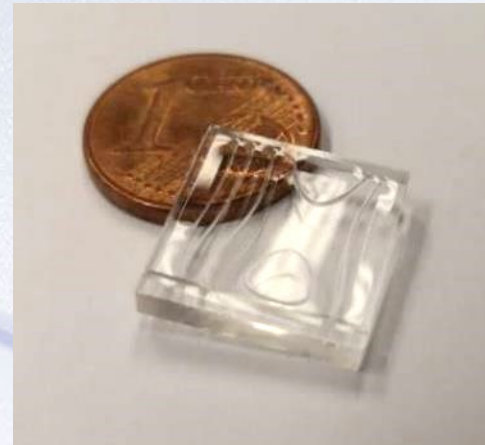
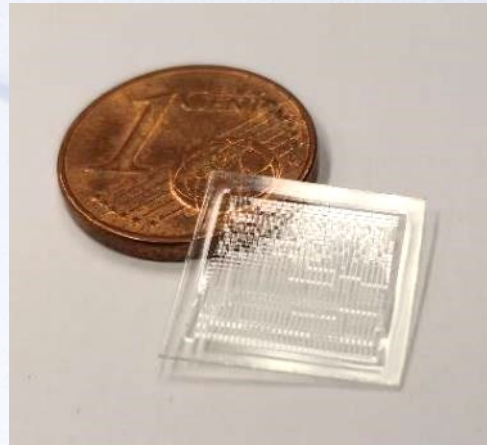


MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Achievements

What we already achieved:

- FORVIA HELLA's activities in the PHABULO μ S project
 - Evaluation of different mid-scale micro-structures to realize high and low beam functions



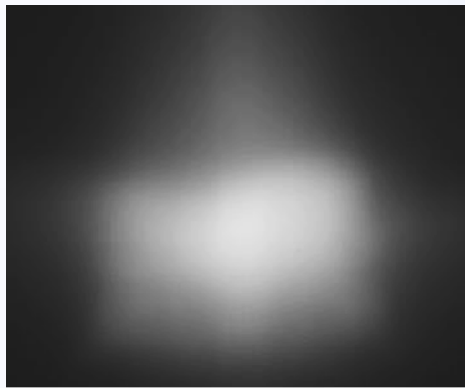
MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Achievements

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 - Evaluation of different mid-scale micro-structures to realize high and low beam functions
 - Optimization of light distribution quality

First trials...



- Small angular range (H: $\pm 5^\circ$)
- Bad efficiency ($\sim 7\%$)
- High amount of straylight

... last result



- great angular range (H: $\pm 30^\circ$ / V: $-45^\circ/+5^\circ$)
- acceptable performance ($\sim 30\%$)
- Acceptable contrast (1:9 over 1° ; 1:46 over 3°)

MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Achievements

What we already achieved:

- FORVIA HELLA's activities in the PHABULO μ S project
 - Evaluation of different mid-scale micro-structures to realize high and low beam functions
 - Optimization of light distribution quality
 - Demonstration of FFMO potentials

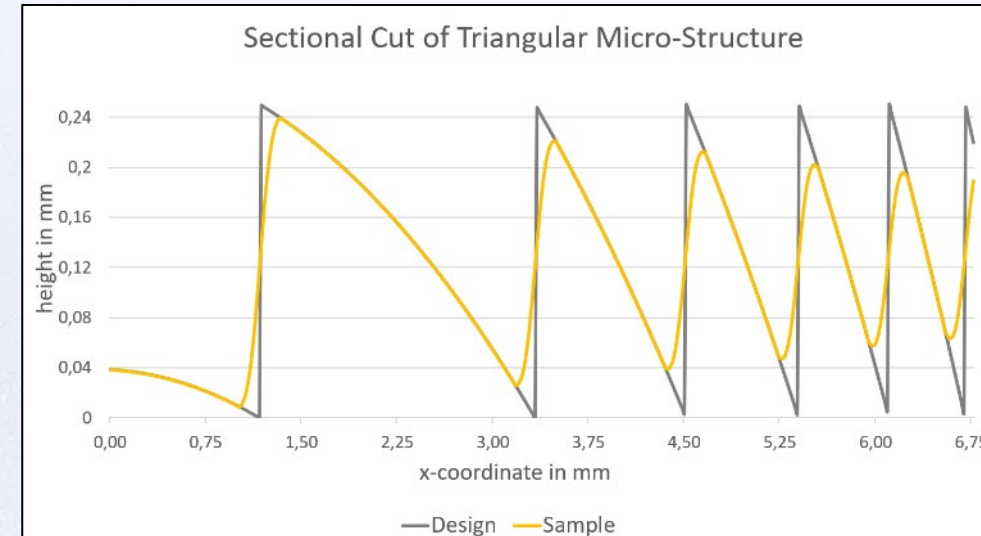


MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Challenges

What we haven't achieved yet:

- Usage of “small- and mid-scale” micro-optics for “white-light-small-package-high-contrast” applications (e.g., low beam distributions)
- Finding mastering solutions for “mid-scale” micro-optics
- Combination of “small-scale” micro-optics with white-light LEDs
- Finding imprint materials that resist automotive conditions



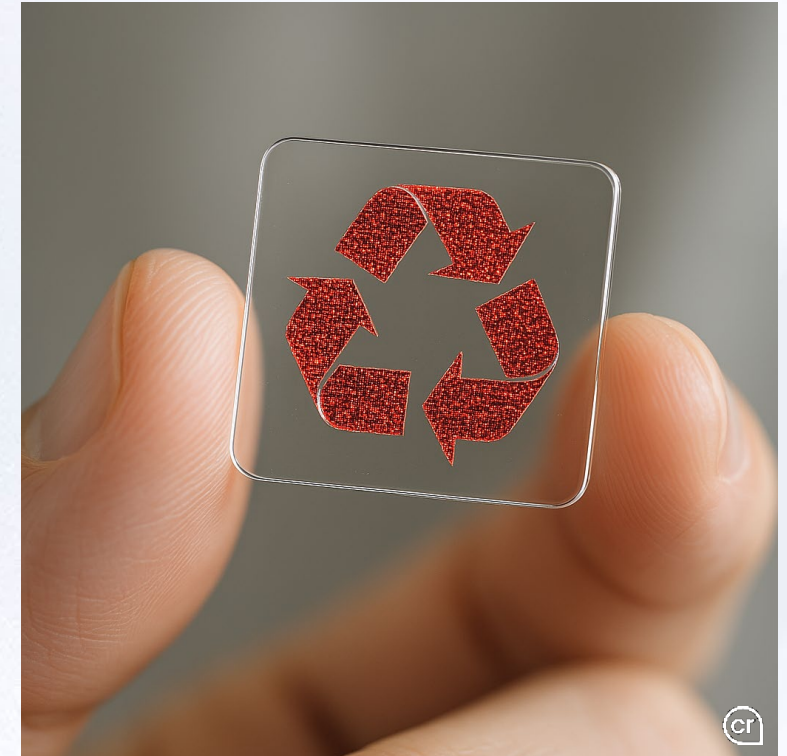
MICRO-OPTICS FOR AUTOMOTIVE APPLICATIONS

Upcoming topics

Aspects we haven't looked at yet: Sustainability

- CO2-Footprint of the manufacturing of ...
- Sustainable materials for ...
- Recycling of ...

... UV-imprinted optics



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