

FRAUNHOFER IPT | BUSINESS UNIT »OPTICS«

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Fraunhofer Institute for Production Technology IPT



The Fraunhofer-Gesellschaft in figures



74 institutes and research facilities in Germany

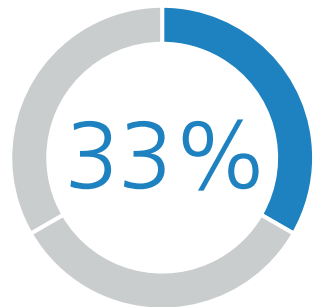


28 000 employees



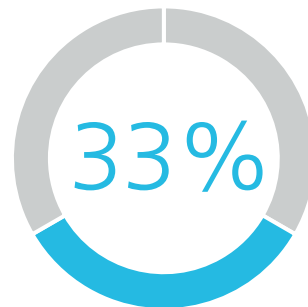
2.8 billion euros research volume

Financing model of the institutes

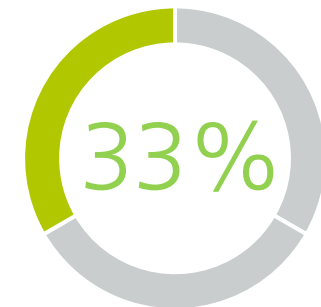


Public sector

90% by federal government, 10% by federal states

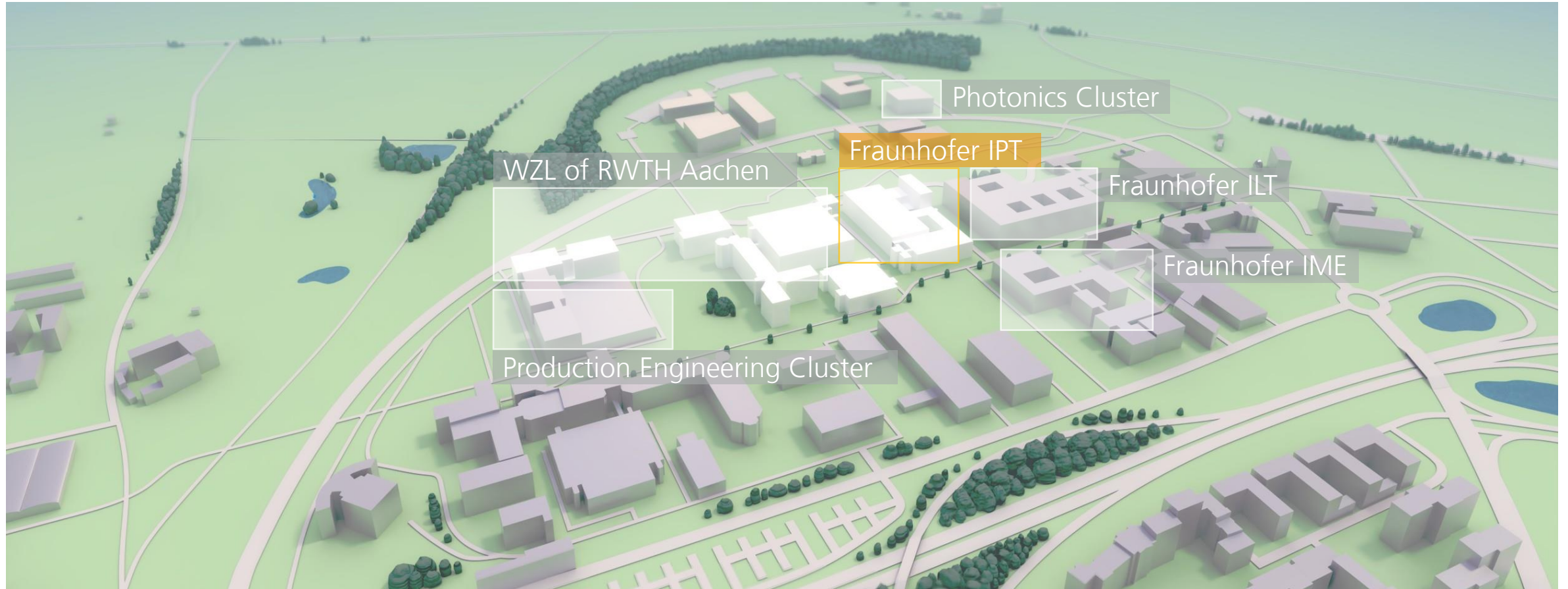


Publicly funded research projects



Industrial R&D

The Fraunhofer IPT is located in Aachen, one of the most important centers of production technology

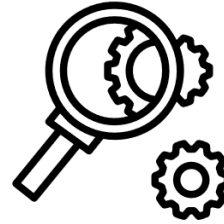


The Fraunhofer IPT presents itself in figures



466

Employees*



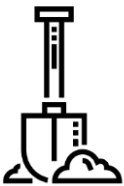
530

Research and industrial projects*



2

Locations



Founded in

1980



8000

square metres of machine halls and laboratories*



32 million Euros

budget*



32

Spin-offs

* in 2019

Agenda

1 Fraunhofer IPT

2 Business Unit »Optics«

3 Special Activities

4 Project proposal: HUD

The Business Unit Optics at Fraunhofer IPT

Networked, adaptive optics manufacturing

Cross-industry development and production of complex optical components and systems along the entire value chain

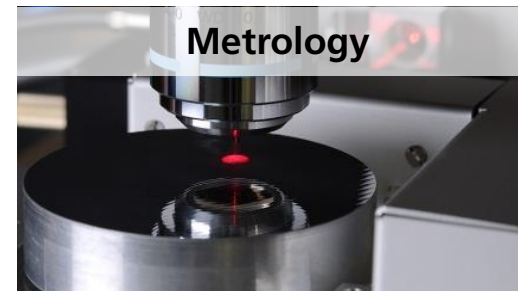
Aachen Center for Optics Production



- Collaborative and consortial research
- Standardization
- Studies
- Surveys
- Researches
- Comparison and feasibility studies
- Trainings
- On-site trials
- Pilot studies
- Committee work
- Publications

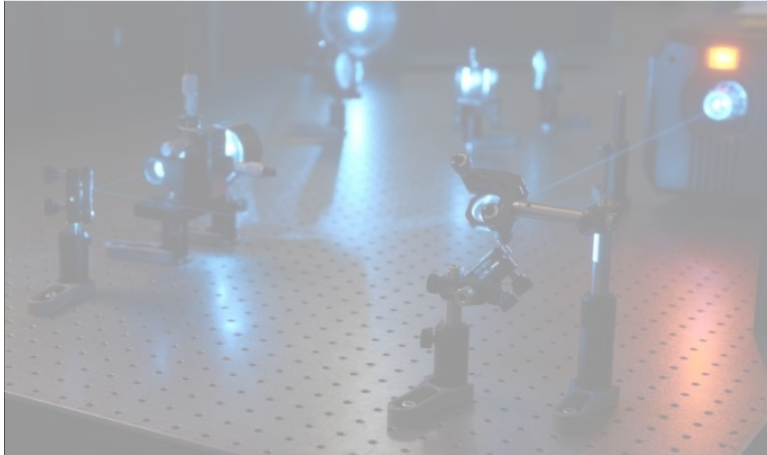


Functional surfaces



Our offer for partners in the optics and electronics industry

LASER SYSTEMS AND APPLICATIONS



SAFETY AND SECURITY



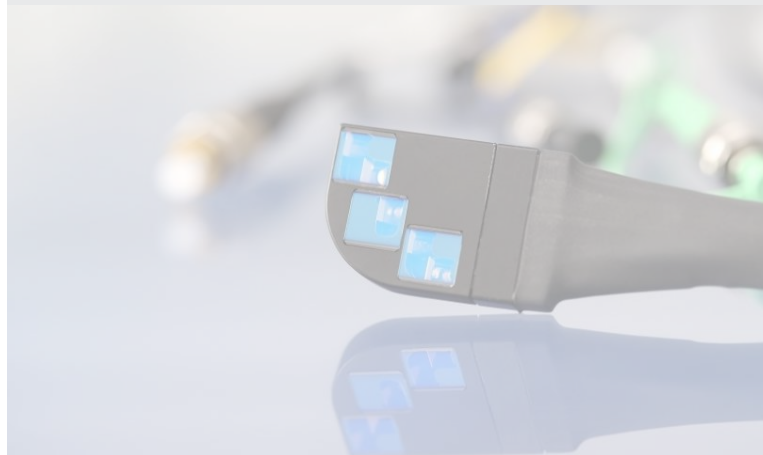
MOBILITY AND TRAFFIC



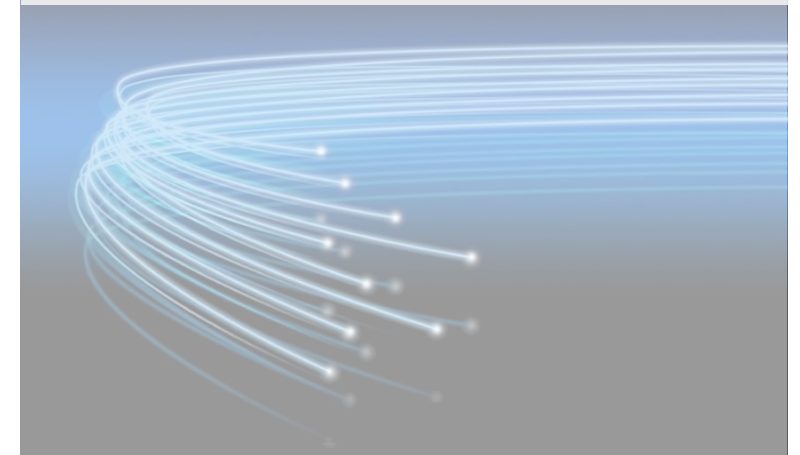
INTERIOR AND LIGHT DESIGN



MEDICAL TECHNOLOGY AND VISUAL AID



COMMUNICATION ENGINEERING

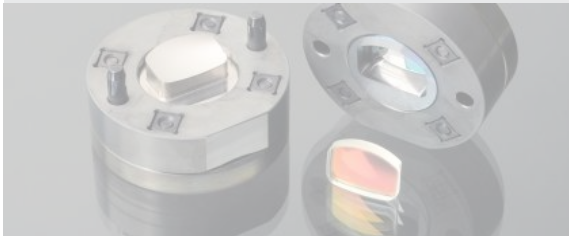


Products

ASPHERICAL OPTICS



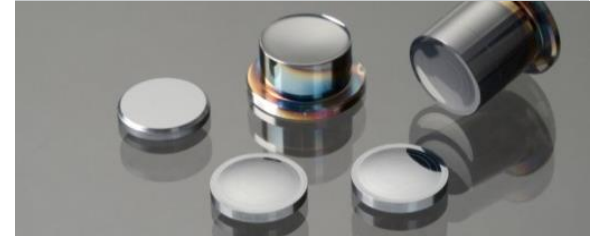
FREEFORM OPTICS



LIGHTING OPTICS



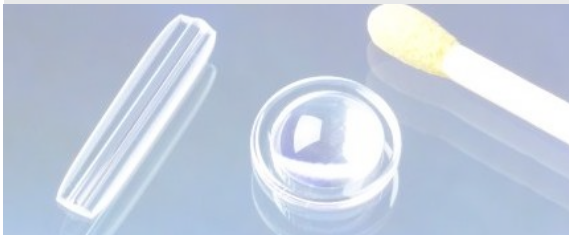
INFRARED OPTICS



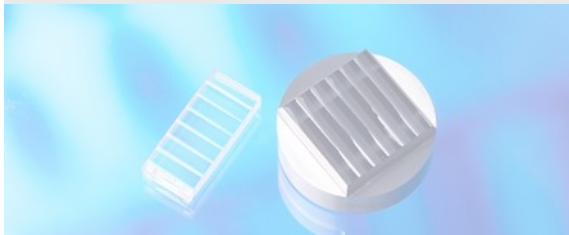
LENS ARRAYS



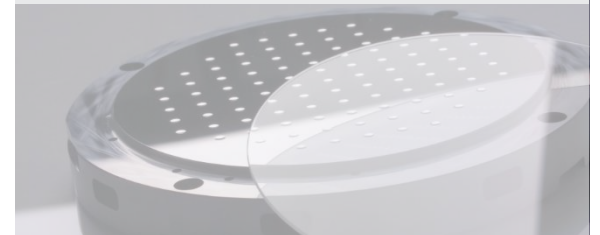
MICRO OPTICS



CYLINDER LENSES



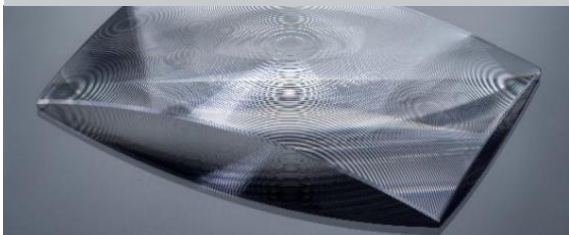
WAFER OPTICS



MICRO OPTICS



FRESNEL-LENS



MIRROR OPTICS

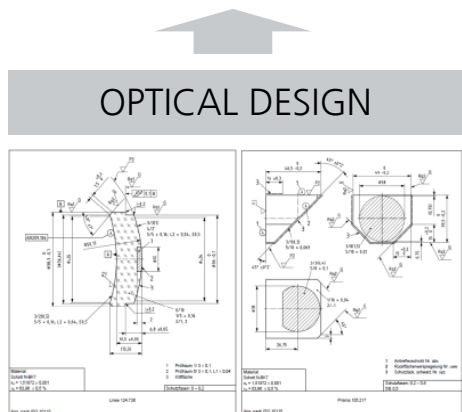


MICROSTRUCTURED OPTICS



Optics Manufacturing

Entire Glass Optics Manufacturing Process in-house



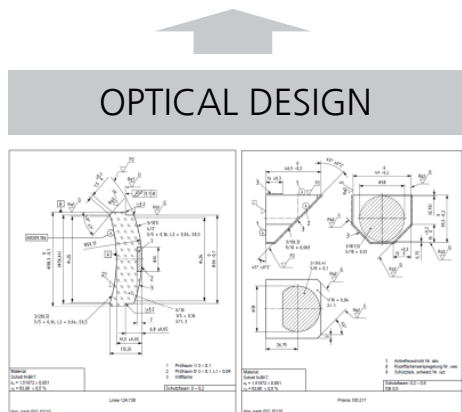
» Based on your optical design we develop technologies for an efficient production of optical components«

» We cover the entire process chain from simulation to qualification of the optics«



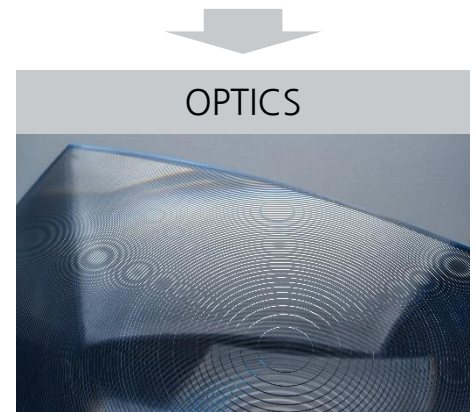
Optics Manufacturing

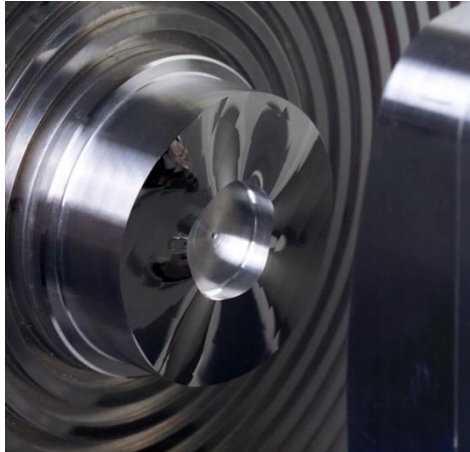
Entire Plastic Optics Manufacturing Process in-house



» Based on your optical design we develop a production process for your plastic optics «

» We support you to optimise every single step in the process chain «





Ultra precision turning

- Free-form geometries
- Microstructures



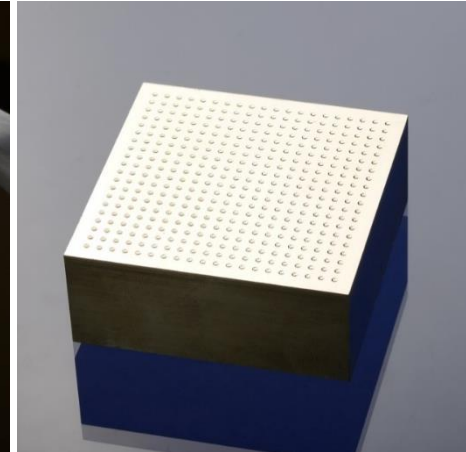
Flycutting & Planning

- Large surface microstructures
- Lineare microstructures
- Pyramide microstructures



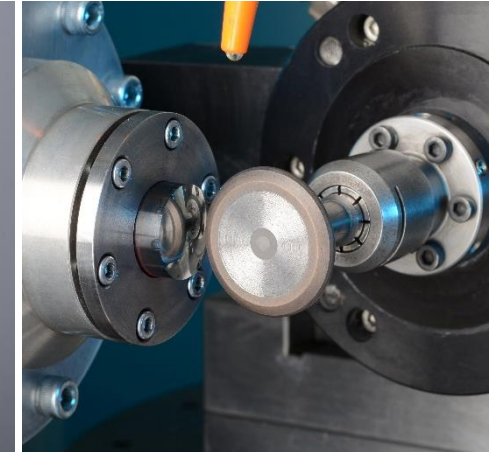
Drum turning

- Fusion: Planning & Turning
- Winding of continuous, flat microstructures for impressions



Ultra precision milling

- Microlenses Arrays
- Free-form geometries with steep flanks (cannot be produced by diamond turning)

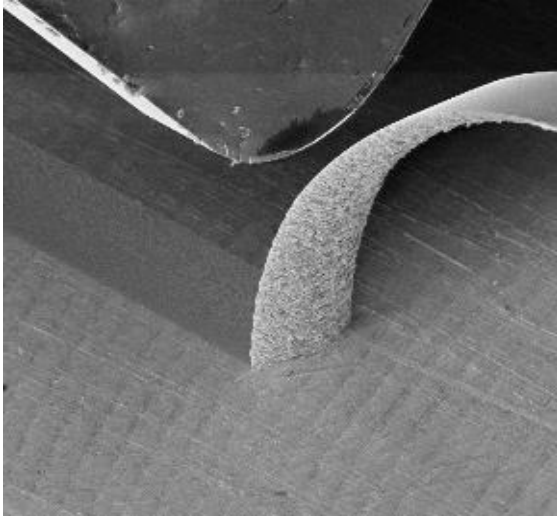


Ultra precision grinding

- Free-form geometries
- Molding tools
- Camera lenses
- Wafer-level

Optics Manufacturing

Tool Manufacturing | Microstructures



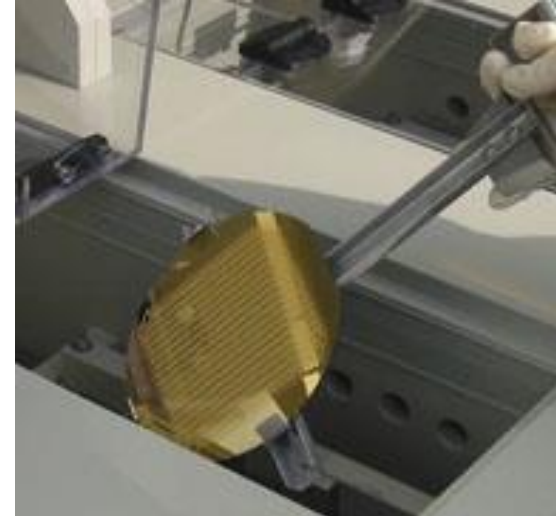
Mechanically

- Precision Milling / Turning / Grinding (with diamond tools)
- Planing (with diamond tools)
- Polishing
- Electrochemical (ECM)
- Spark Erosion (EDM)



Lithographically

- Laserlithography
- Photolithography
- Electron beam and Plasma-technology
- Nano-Imprint Lithography



Galvanically

- Galvanical Nickel-Phosphor-Coating
- Chemically nickel plated
- Galvanical Tooling
 - PMMA-Master
 - Silicon negative
 - UV-resin positive
 - Nickel negative

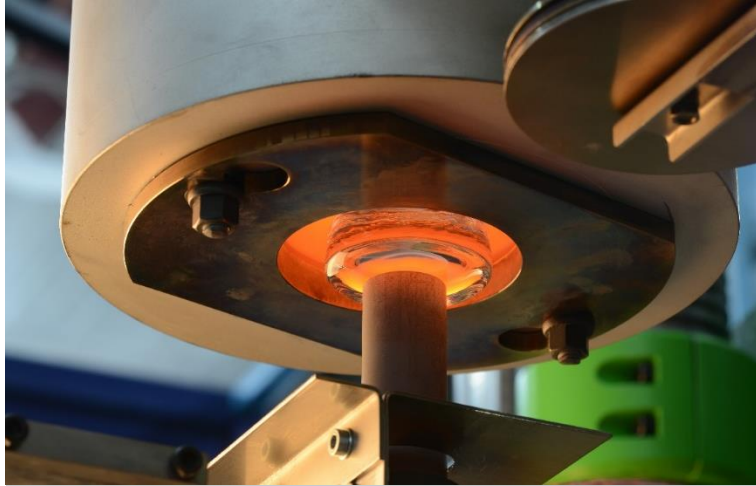


Recombination

- Combination of mechanical lithographical and galvanical Processes
- Step & Repeat

Optics Manufacturing

Glass Optics Replication



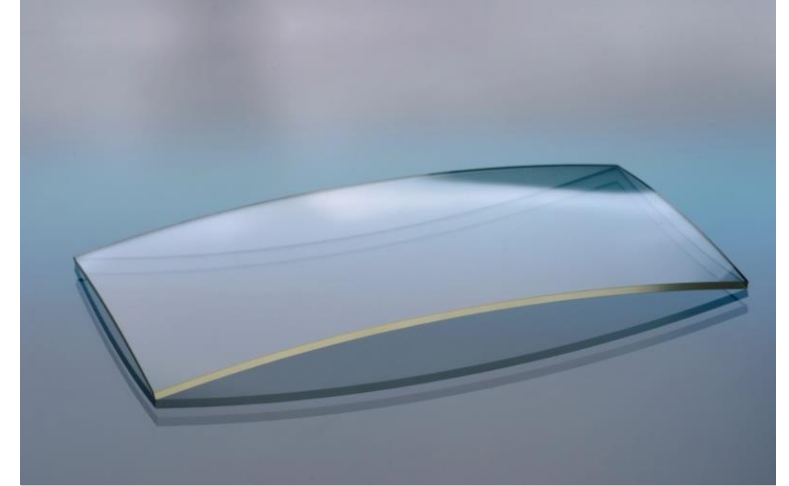
Non-isothermal Glass Molding

- Tool: Single Mold
- Accuracy: $> 5 \mu\text{m}$
- Products: Headlight optics; Urban lighting, Sensor optics
- At IPT: up to 100 mm \varnothing (lenses)



Precision Glass Molding

- Tool: Single/multi cavity mold; Wafer
- Accuracy: $> 200 \text{ nm}$
- Products: Camera lenses; Endoscope optics; Laser beam shaping optics
- At IPT: 1 – 100 mm \varnothing (lenses)



Thin Glass Replication

- Tool: Single Mold
- Accuracy: $> 10 \mu\text{m}$
- Products: Head-up displays; Coverglass; Medical trays
- At IPT: 300x400 mm²

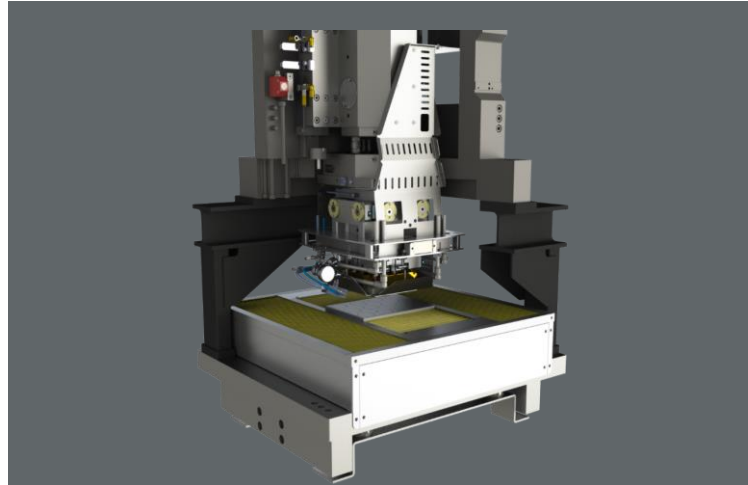
Optics Manufacturing

Plastic Optics Replication



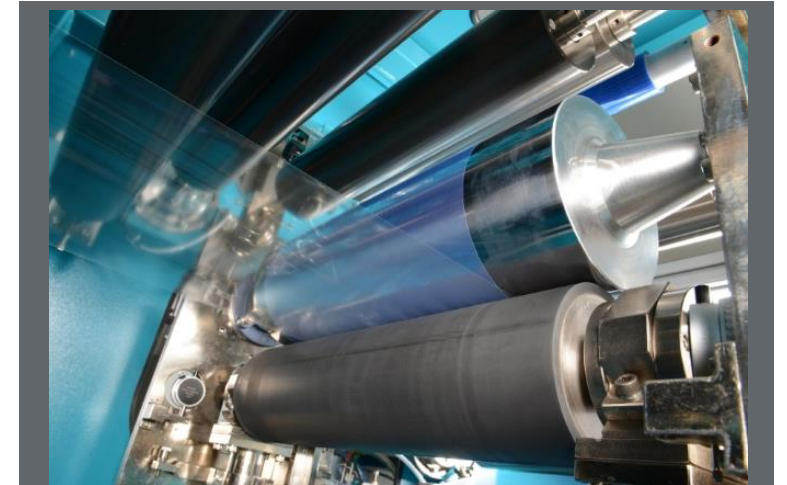
Injection Molding

- Tool: Mold insert
- Accuracy: $>3 \mu\text{m}$
- Products: Structured lenses, lightguides, medical, ...
- At IPT: 320 to clamping force



Recombination

- Tool: Structured die
- Accuracy: $>0,5 \mu\text{m} / 100 \text{ mm}$
- Products: Holograms, V-notches, micro mirrors, ...
- At IPT: $80 \times 80 \text{ mm}^2$

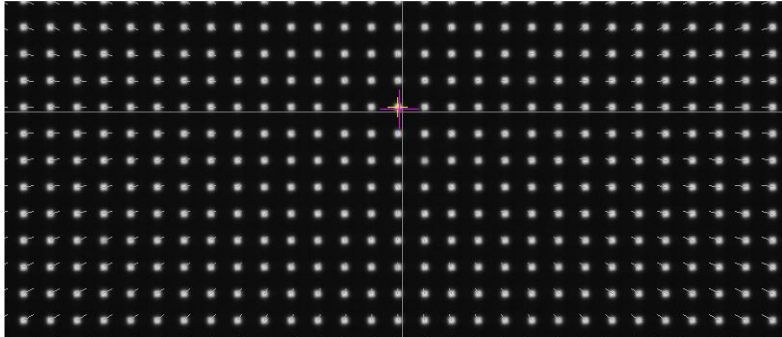


Roll-to-Roll

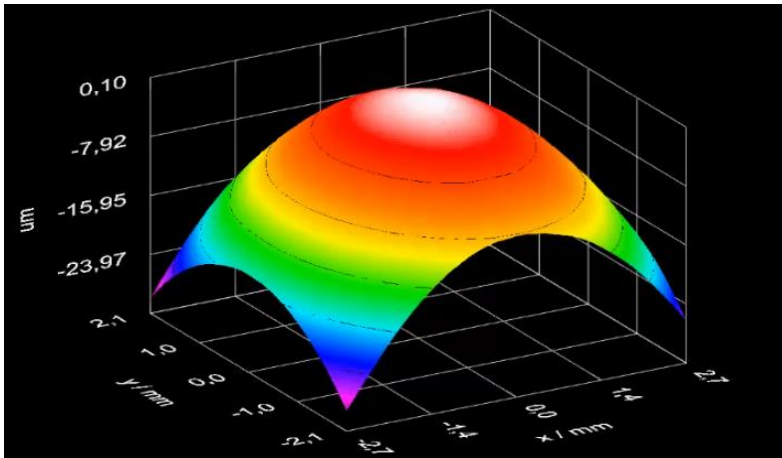
- Tool: Structured drum
- Accuracy: $>100 \text{ nm}$
- Products: flexible films, diffractive and refractive optics, ...
- At IPT: width up to 250mm

Metrology

Wavefront-based optics inspection



Measuring field of a point light source.



Resulting wavefront.

Need and challenge

- Fast and highly accurate measurement of optics
- Measurement of optical function
- Active alignment of mirrors and lenses

Work priorities

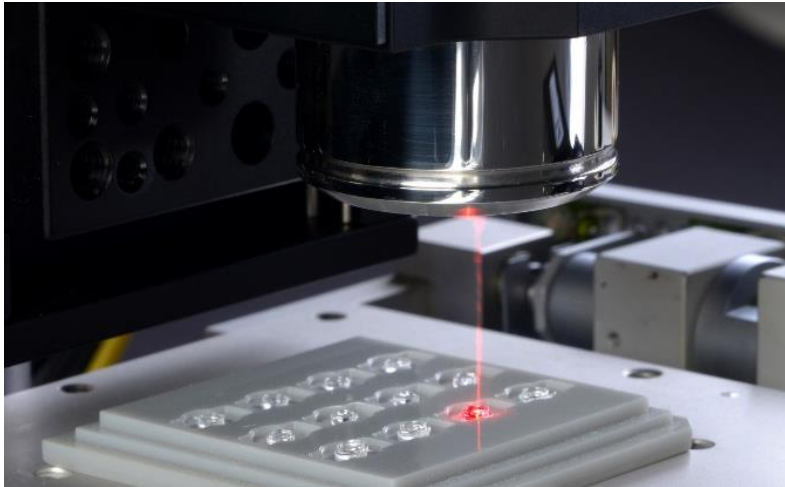
- Active alignment of optical systems by wavefront measurements
- Characterization of aspheric lenses

Technology competencies

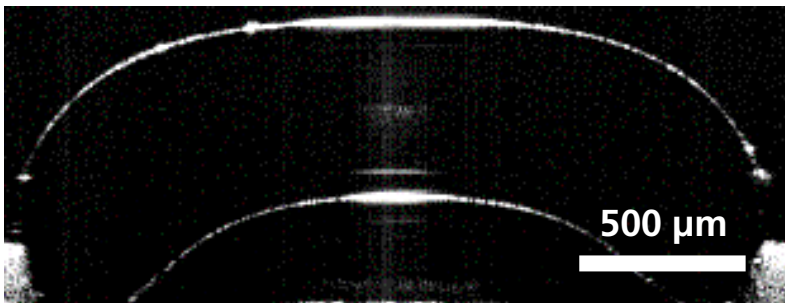
- Adaptive alignment algorithms
- Measurement of freeform surfaces
- Measurement of multi-lens systems

Metrology

Tomographic optics inspection



Measurement of micro lenses in a tray.



Cross sectional image of a polymer micro lens.

Need and challenge

- Form and centering testing of micro-optical (plastic) aspheres
- Measurement of freeform surfaces

Work priorities




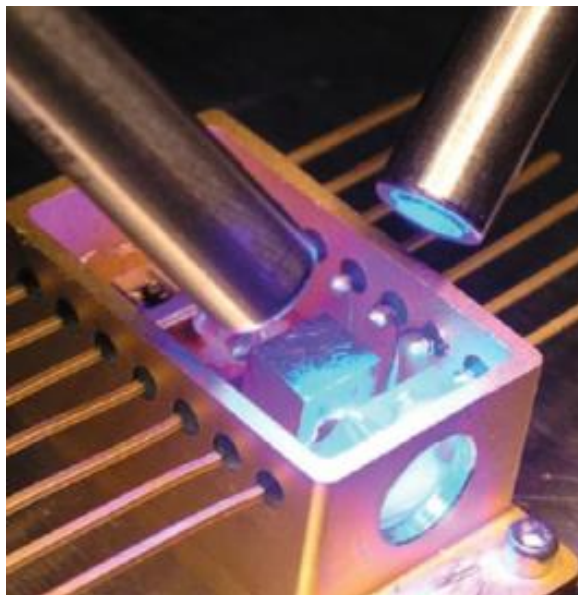
- Development of OCT systems for optical inspection
- Form measurement of aspheric and freeform surfaces
- Centering measurement of polymer aspheres

Technology competencies

- Compensation of distortion of the rear functional surface due to light refraction
- Extraction of characteristic parameters from tomographic data (e.g. curvature radii, aspheric coefficients, center thickness, centration)

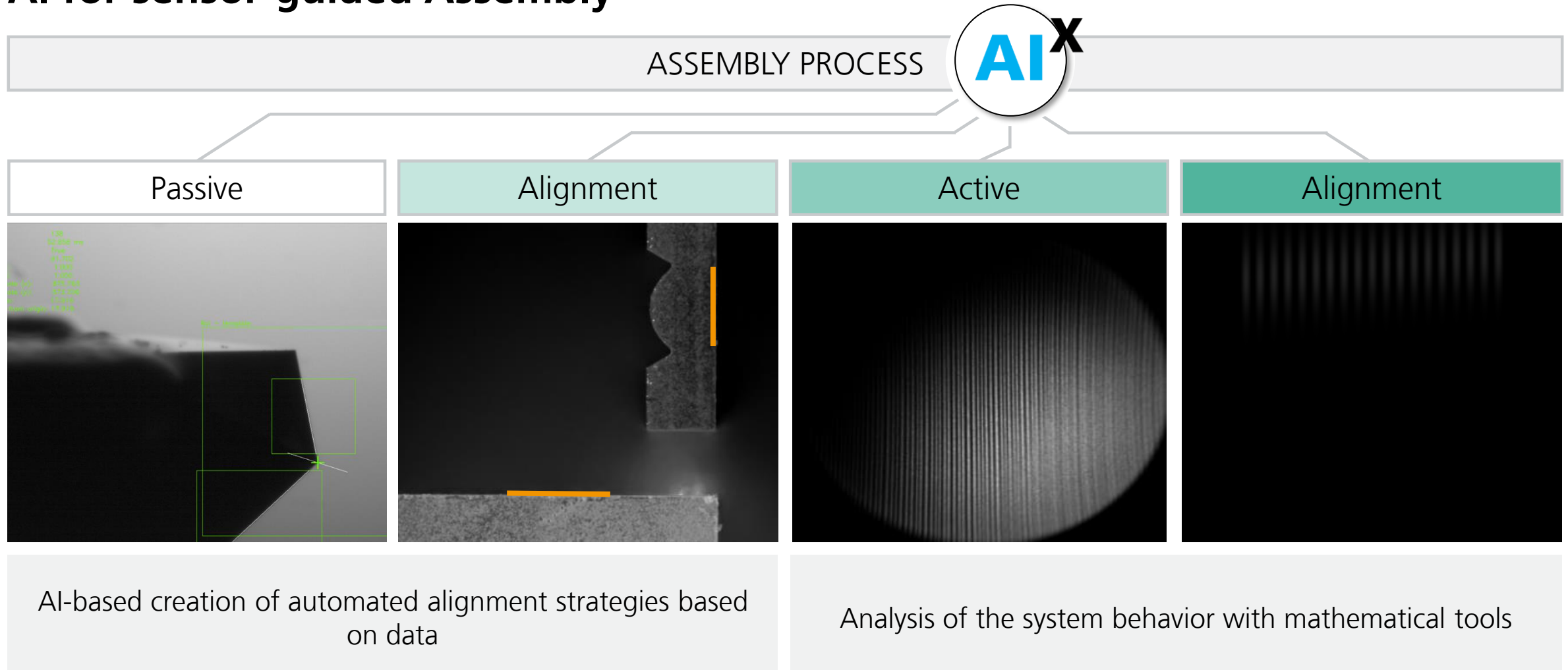
Assembly

Steps along the Assembly Process

Part feeding	Handling	Alignment	Bonding
<ul style="list-style-type: none">■ Ordered■ Partly Ordered■ Unordered	<ul style="list-style-type: none">■ Grippers<ul style="list-style-type: none">– Force closure, Form closure, Adhesive Closure■ Manipulators	<ul style="list-style-type: none">■ Metrology<ul style="list-style-type: none">– Relative alignment– Active alignment■ Algorithms	<ul style="list-style-type: none">■ Gluing■ Welding■ Soldering
			

Assembly

AI for sensor-guided Assembly



Agenda

- 1 Fraunhofer IPT
 - 2 Business Unit »Optics«
 - 3 Special Activities**
 - 4 Project proposal: HUD
-

Objective

ACOP as **technology incubator** for optics production in Central Europe

Developing standards

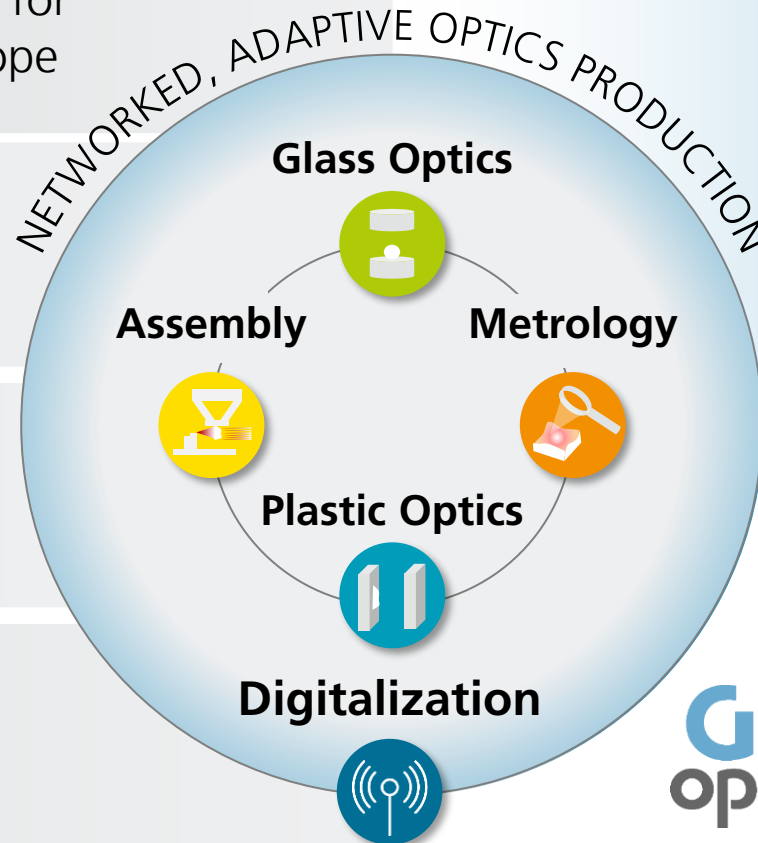
→ *Unify basic tools and processes*

Building infrastructure

→ *Digital and physical networking of the individual process steps*

Robust tolerance chains

→ *Reduce waste and increase product quality*



Organisational

- Collaborative and consortial research
- Standardization
- Studies
- Surveys
- Researches
- Comparison and feasibility studies
- Trainings
- On-site trials
- Pilot studies
- Committee work
- Publications

SICK
Sensor Intelligence.

HELLA

Leica

AGATHON

NTI NanoFilm
ADVANCING TECHNOLOGY SOLUTIONS

IMS

GD optics

FISBA Innovators in Photonics

سابك
sabic

APOD Conference

Aachen Polymer Optics Days

June 01–02, 2022 | Technologiezentrum Aachen

Sessions

- New and conventional materials
- Tool and mold making
- Replication technologies
- Metrology / Quality / Digitization
- Optical Systems
- Shopfloor Tours at Fraunhofer ILT, Fraunhofer IPT and IKV
- Networking Dinner with company pitch sessions

www.aachen.polymeroptics.de

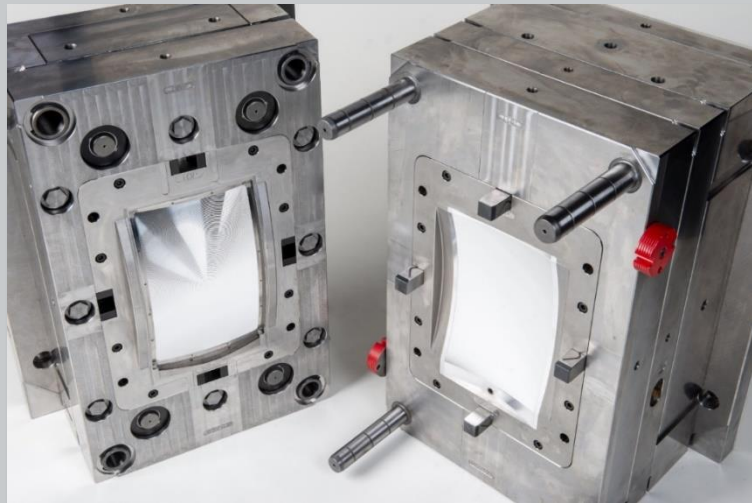
Agenda

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-

PROJECT PROPOSAL: HUD

Recently work done:

Development of a HUD system based on an injection molded fresnel lens



Fresnel lens

- High Accuracy of replication
- Material with high transmittance
- Robust optical design

Combiner

- Integration in windshield
- Optical function optimized with lens
- Retro-fit system with structured foil

Content

- Creation via sensors
- Multi-layer design
- Multi angle design

Contact

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