Optics manufacturing and automated precision assembly for LiDAR systems for prototyping and mass production
Introduction & Motivation
Challenges in production of LIDAR Systems
Optics Manufacturing and Assembly Technology for LIDAR Systems in Aachen
Fraunhofer IPT – Institute for Production Technology

Market Acceptance ⇔ Performance of LIDAR Systems
Optics in Aachen
From Manufacturing over Assembly to System integration

Glass Optics

Polymer Optics

Fiber Optics

Assembly
Manufacturing

Testing

Automated assembly of Optics

Evaluation of Optics
Introduction & Motivation

High Potential of Replicative Optics Manufacturing

Precision Glass Molding Principle

Heating → Molding

Complex Lens with high accuracy

Manufacturing Costs* per Unit [US-$]

Costs for glass preform excluded

Annual Production Volume

Precision Glass Molding can potentially meet the requirements of complex geometries, high accuracy at low costs
**Precision Glass Molding**

**Product Spectrum & Scope of Application**

- **Wide range of possible geometries**
- **Accuracies can be adjusted according to the field of application:**
  - Imaging
  - Lighting
  - Laser Optics
- **High reproducibility/repeatability as a consequence of the molding process**
- **Scalable production through Spinoff companies and technology transfer**

<table>
<thead>
<tr>
<th>Aspherical Optics</th>
<th>Freeform Optics</th>
<th>Lighting Optics</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Aspherical Optics" /></td>
<td><img src="image2" alt="Freeform Optics" /></td>
<td><img src="image3" alt="Lighting Optics" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diffractive Optics</th>
<th>Micro Optics</th>
<th>Infrared Optics</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Diffractive Optics" /></td>
<td><img src="image5" alt="Micro Optics" /></td>
<td><img src="image6" alt="Infrared Optics" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylindric Lenses</th>
<th>Lens Arrays</th>
<th>Wafer Optics</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Cylindric Lenses" /></td>
<td><img src="image8" alt="Lens Arrays" /></td>
<td><img src="image9" alt="Wafer Optics" /></td>
</tr>
</tbody>
</table>
Precision Assembly and Automation in Aachen

Timeline

- **2008**: First Micromanipulator „Commander 6“
- **2010**: First active alignment of Fast Axis Collimators
- **2015**: Spinoff Aixemtec founded
- **2016**: First Assembly Machine in industrial environment
- **2018**: Multiple applications launched (Lidar, Fiber-Array, Microoptic, ...)
- **2019**: 10+ Machines in the field
  - Automotive
  - Laser Industry
  - Consumer Electronics
  - Datacom
  - Sensing
  - Quantum Photonics
Assembly Technology from Aachen - Aixemtec GmbH

Key facts

Core Business Precision Assembly Machines and Services
Technological Excellence Highly Flexible Precision Assembly Machine Platform
Founded 2016
Ownership 100% Privately Owned
Staff 20 employees
Facilities Cleanroom, Labs and Offices, R&D Machines

Mother Institute

Fraunhofer IPT

Tobias.mueller@aixemtec.com
Automated Precision Assembly
Markets and Applications

- Automotive applications
  - LiDAR systems
  - Driving assistance cameras
  - Headlight systems

- Imaging systems
  - Mobilephone Camera lens (Lens-Barrel)
  - Endoscopes

- Photonic Integrated Circuit
  - Chip Testing
  - Fiber assembly
  - Chip coupling

- Lasersystems
  - FAC-lens assembly

- Consumer electronics
  - Face ID & Gesture recognition

LIDAR Systems
Source: IBEO

Integrated Photonic Circuits
Source: Lionix

LASER Systems

Imaging Systems

Link to press release!
Automated Assembly of Solid State LIDAR Systems

Key facts on Aixemtec’s Solid State Lidar Assembly Machine

- Installed January 2019
- Ultimate alignment precision in micron range for sender/receiver side
- Integrated UV-curing for high bonding repeatability
- Reconfigurability for different FOVs
- Open Source for process tuning through end-customer
- 6 Months projection time due to concurrent engineering
- Commercial Service and Support through Aixemtec
Summary and Outlook

Incubation hub for novel LIDAR products

**Development**
- Product development consulting
- Prototyping and feasibility studies
- Optics manufacturing and assembly

**Market launch**
- Contract manufacturing for low- to mid-volume
- Manufacturing of high-end optics
- Prove of automated assembly

**Industrial production**
- Turnkey solutions for industrial production
- Commercial service and support
- Commercialization through partner companies
What can we provide?
Shortest development cycles for optics and optical system manufacturing
Knowhow in product design for automation
Powerful R&D team and network for industrial dissemination
Shortest time-to-market and efficient scaling of production

What are we looking for?
LIDAR or optical Systems manufacturers looking to develop or commercialize their products
Ambitious companies looking for strong development partners
R&D Projects and industrialization projects
Ultimately:
Making Europe the Innovation Hub for LIDAR Technology