

**OST**

Ostschweizer  
Fachhochschule

# Microtechnology Approaches for Customized Photonic Packages

**Swiss PIC Event – Photonics Integration and Packaging  
Neuchatel '24**

Tobias Lamprecht

IMP - Institute for Microtechnology and Photonics  
School of Technology

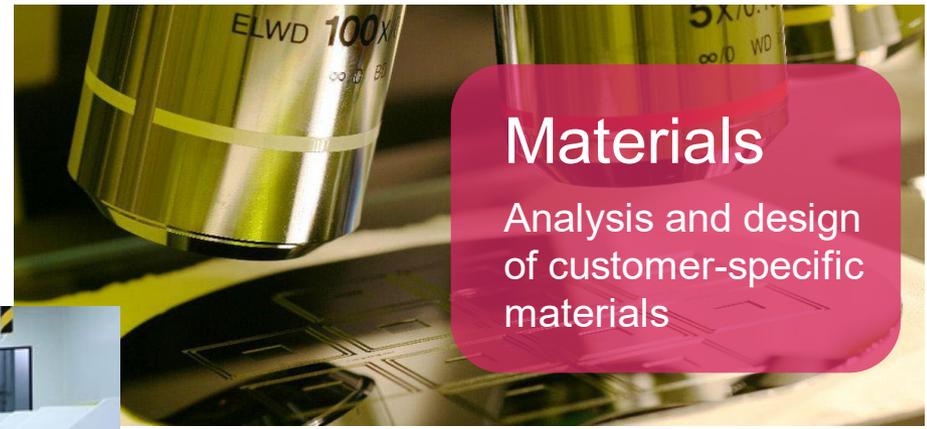
# Outline

- Who we are
- Offering: Development in Miniaturization and Customization of Devices
- Examples

# IMP Institute for Microtechnology and Photonics

## Microtechnology

MEMS for medical, environmental, industrial applications in a connected world.



## Materials

Analysis and design of customer-specific materials

## Cleanroom

Wafer processing and for innovative microsystems



**IMP** | Institut für Mikrotechnik und Photonik

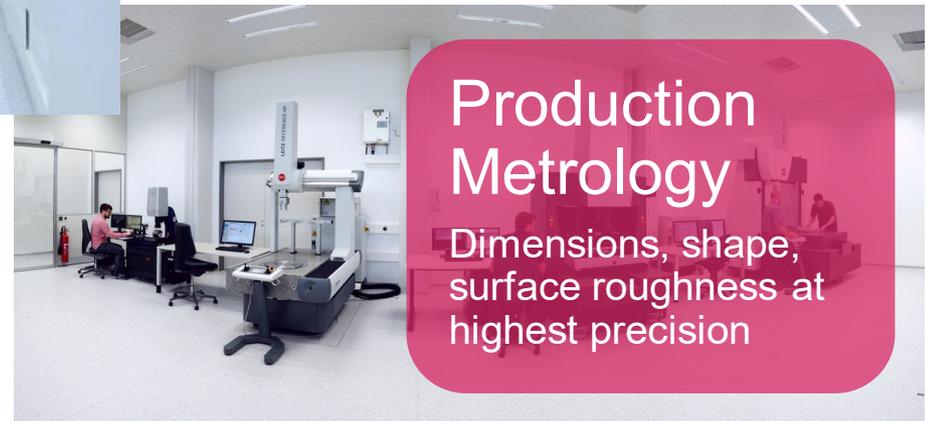
## Photonics+Optics

from development to production



## Production Metrology

Dimensions, shape, surface roughness at highest precision

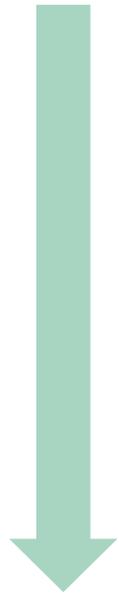


# Position in the Value Chain

## Value chain



Technologies



MEMS devices and packaging

photonic devices

photonic assembly

technology integration

system integration



IMP offering

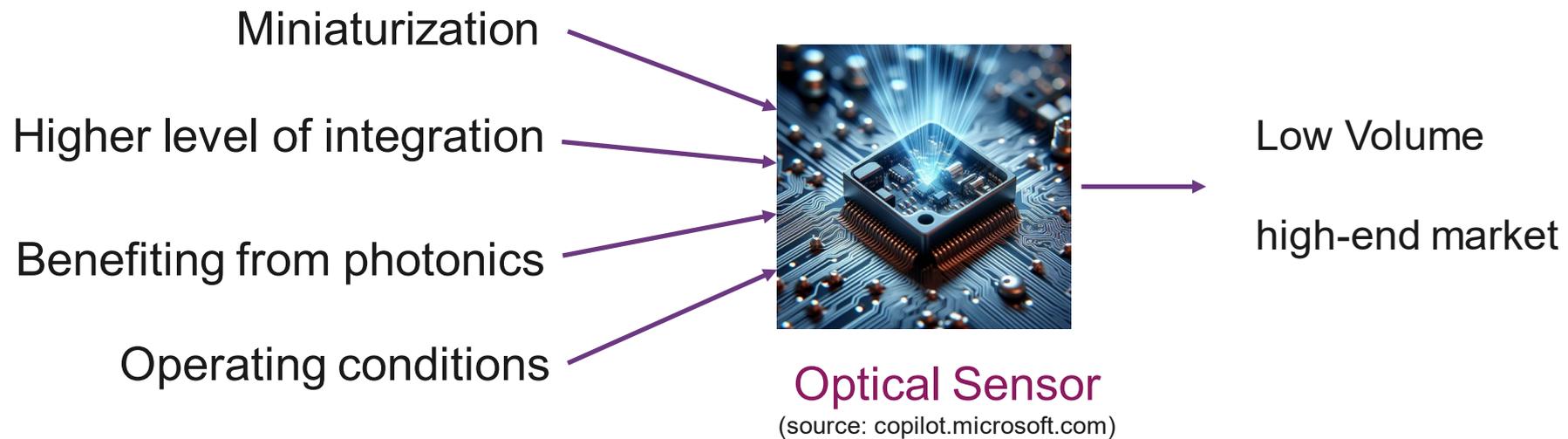
customer

Transfer

contract manufacturer

# Typical Requests

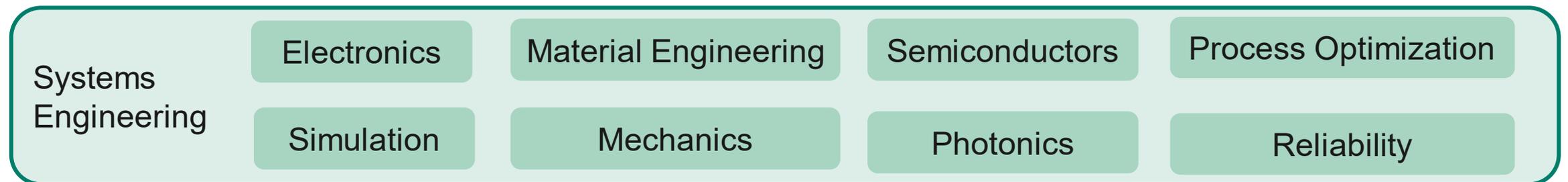
- Start-ups, SMEs to larger companies
- Complementing customers in-house technologies or providing full technology stack



# Systems Engineering for Miniaturized Optical Systems

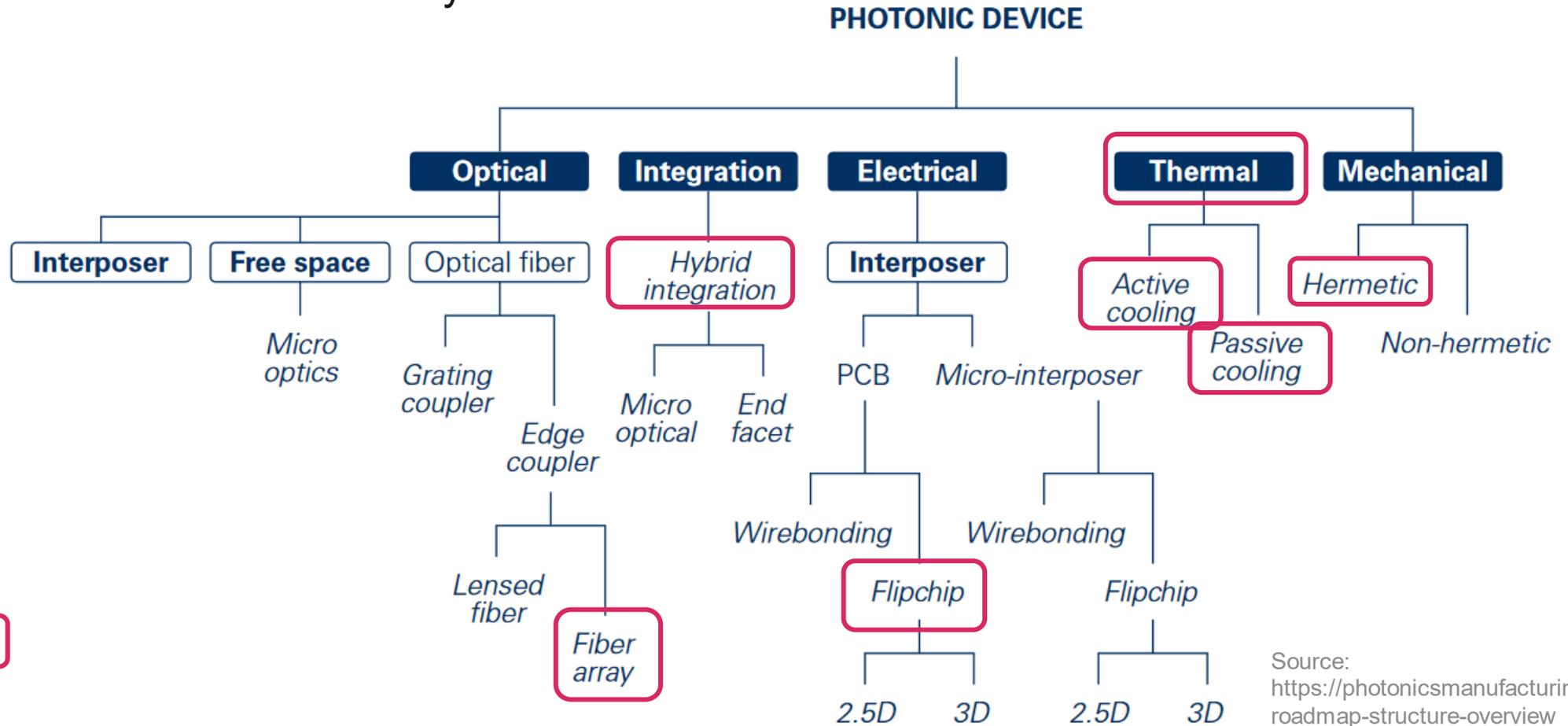
- Efficient miniaturization
  - High-level of integration → Systems engineering
  - Holistic development across disciplines (mech, optical, electrical, assembly, packaging, etc...)

Example: digital light processor (TI)



# Systems Engineering

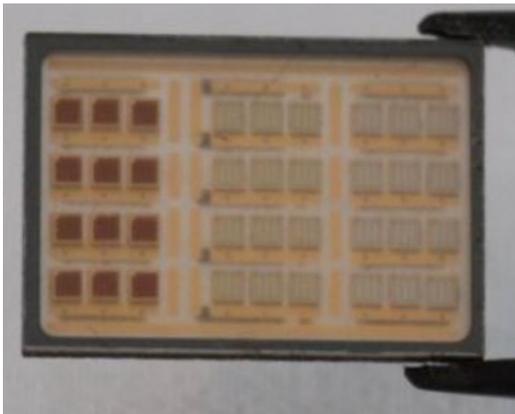
- Photonic devices: multi-domain systems



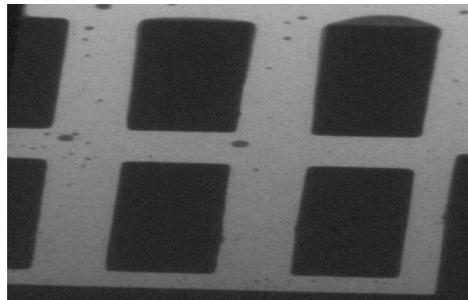
## Packaging Example

# Hermetic LED Package

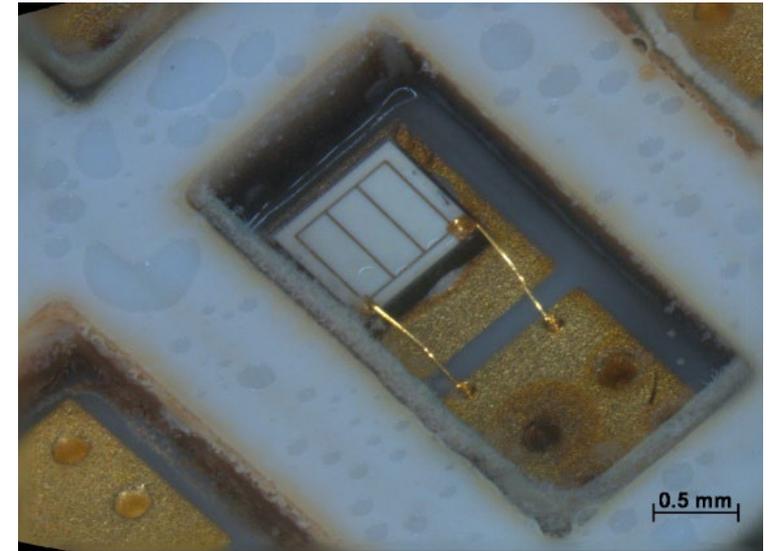
- Combination of various materials (ceramic, glass,...)
- Hermetic
- Autoclavable 2000+ cycles
- Glass soldering



fabrication substrate



Nearly defect free bonding



LED in ceramic frame

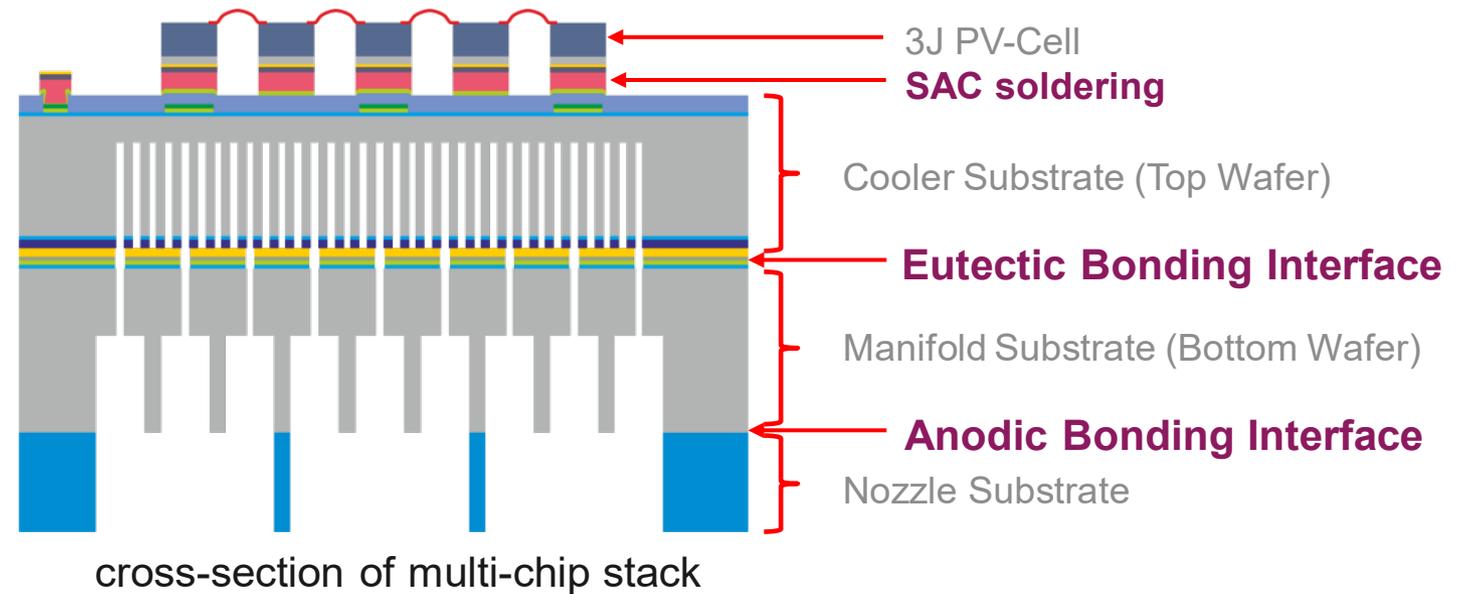
## Packaging Example

# Packaging of High-Power Photovoltaic Module

- Thermal cooling of photovoltaic → thermal energy harvesting
- Reliable joining technologies on large areas
- Various materials



Assembled module

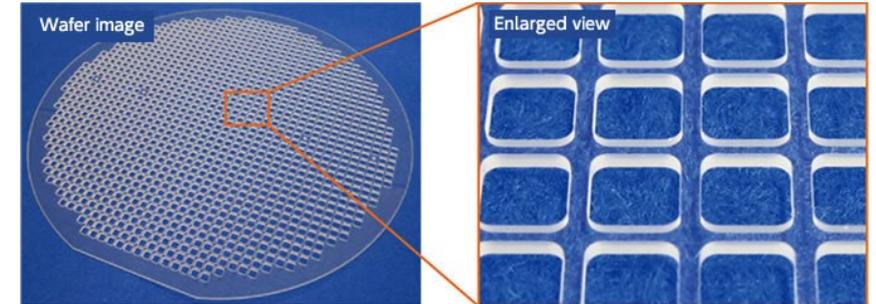


# Microtechnology – Potential for Miniaturization of Photonics

- Foster innovation by cross-technology developments
- Potential topics for joint developments of optics and microtechnology
  - Assembly utilities using mechanical alignment on wafer-level
  - Wafer-level based subassemblies
  - Microtechnology based subassemblies

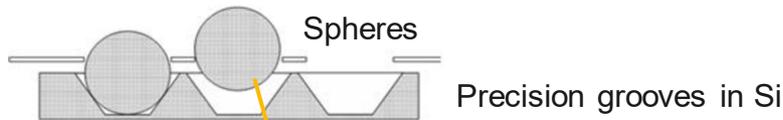
# Microtechnology – Mechanical Alignment Concept

- Accurate positioning (micrometer): mechanical datum
- Assembly direct on substrates
- Precision tooling, utilities (transfer, pre-alignment)
- Wafer-level passive assembly



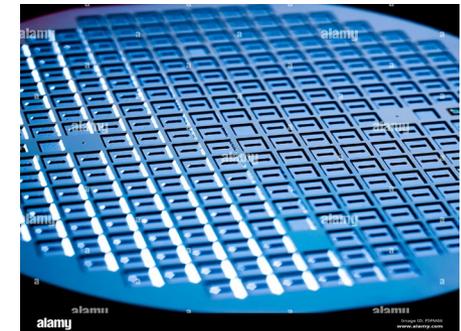
Precision spacers or apertures

Source: [www.tecnisco.com/](http://www.tecnisco.com/)



Ball lenses assembled in carrier wafer for IR sensor wafer stack

Source: A. Kulkarni; ISBN: 978-0-9988782-1-8



Hundreds of identical devices per wafer

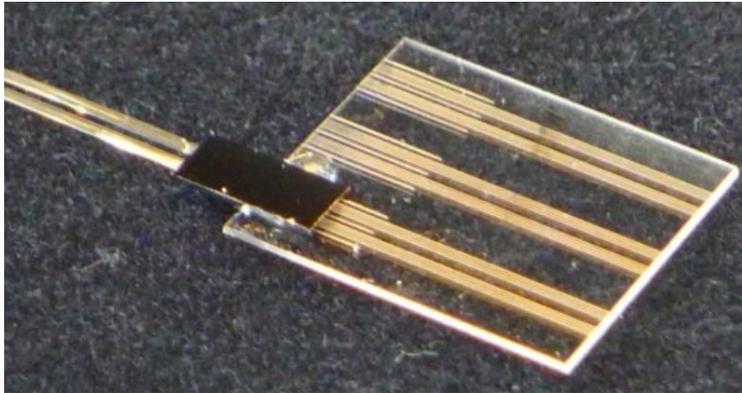
Source: [www.alamy.com](http://www.alamy.com)

## Packaging Example

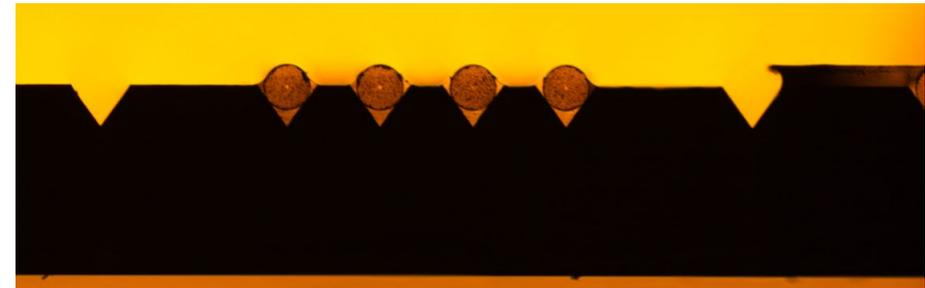
# Fiber to Waveguide - Passive Alignment

- Custom fiber array <math>< \pm 1 \mu\text{m}</math> positioning accuracy (IL)
- Silicon based micro-mechanical bench

Fiber array to waveguide board

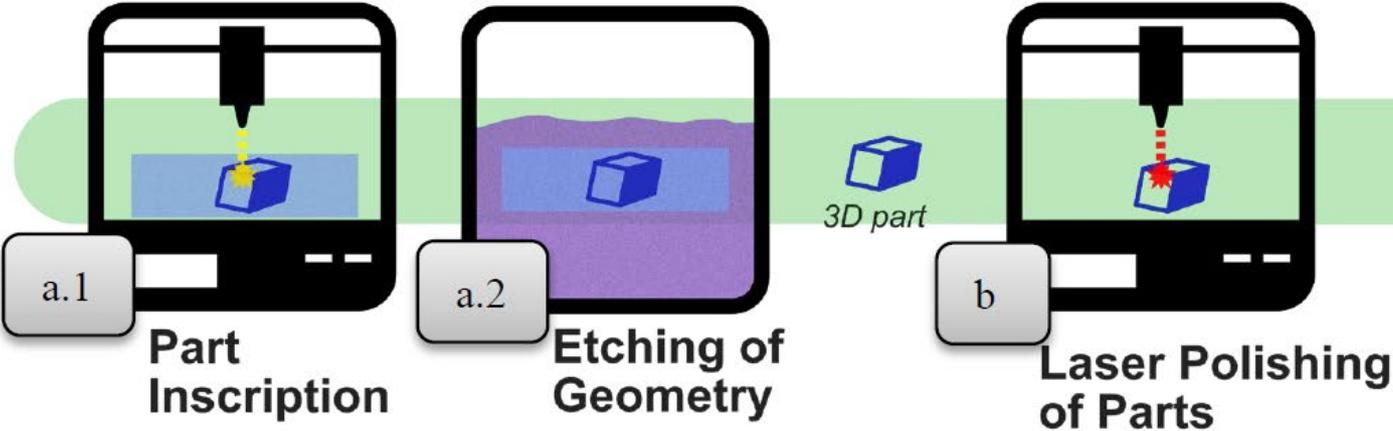


Fiber array in custom v-groove device

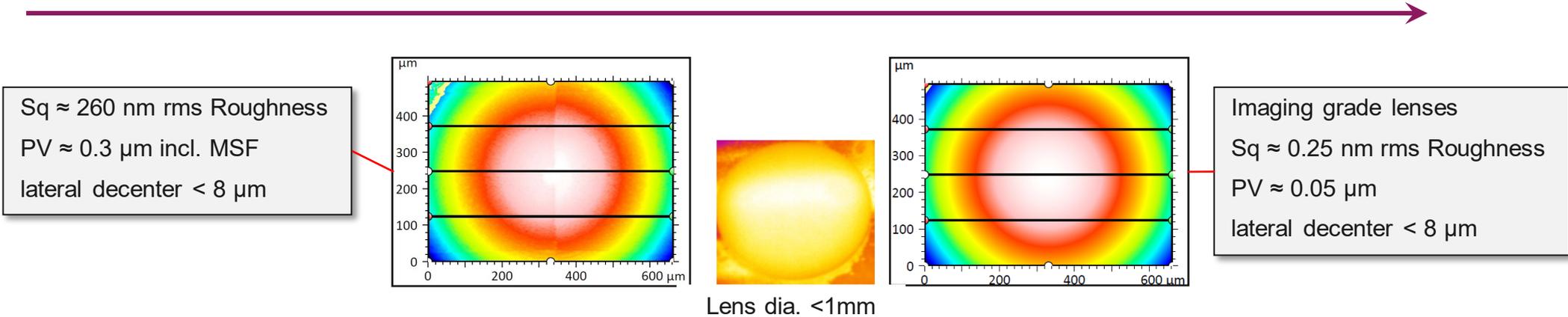


Source: OST (NTB), J. Kremmel, urn:nbn:de:gbv:ilm1-2019000511

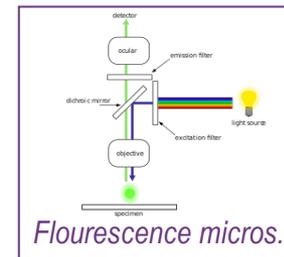
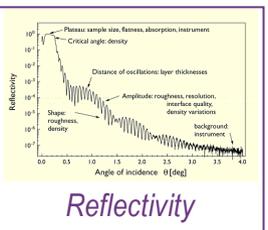
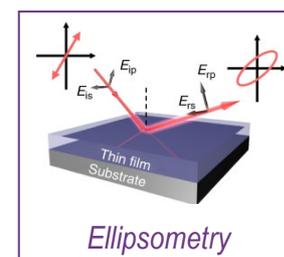
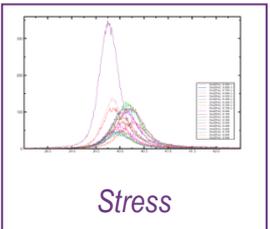
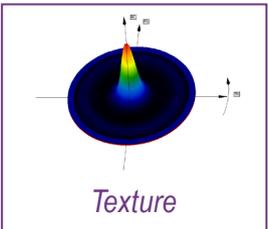
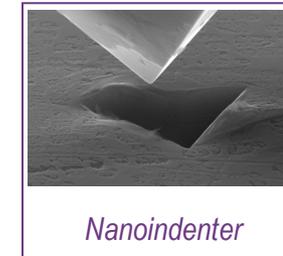
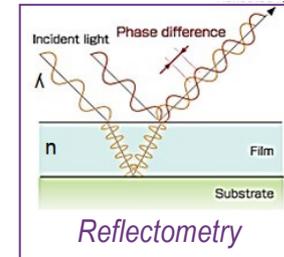
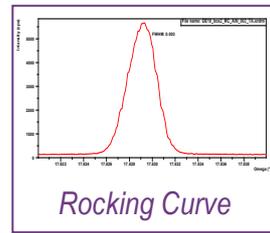
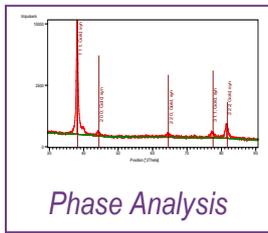
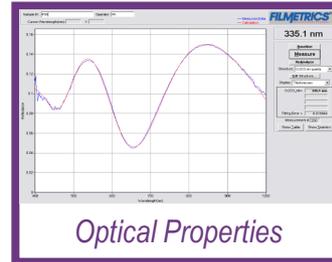
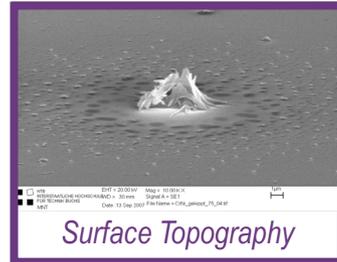
# Contactless Micro-Optics Manufacturing @ OST: the Selective Laser Etching (SLE) – Laser Polishing (LP) Chain



Lens array fabricated by SLE and laser polishing



# Analytics – Expertise to Support Industry



# Advancing Photonics with MEMS

## Contact Information

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Your attention is kindly appreciated.

## Q&A

Precision Photonics Systems Conference  
4./5. Sept. 24 – OST Campus Buchs