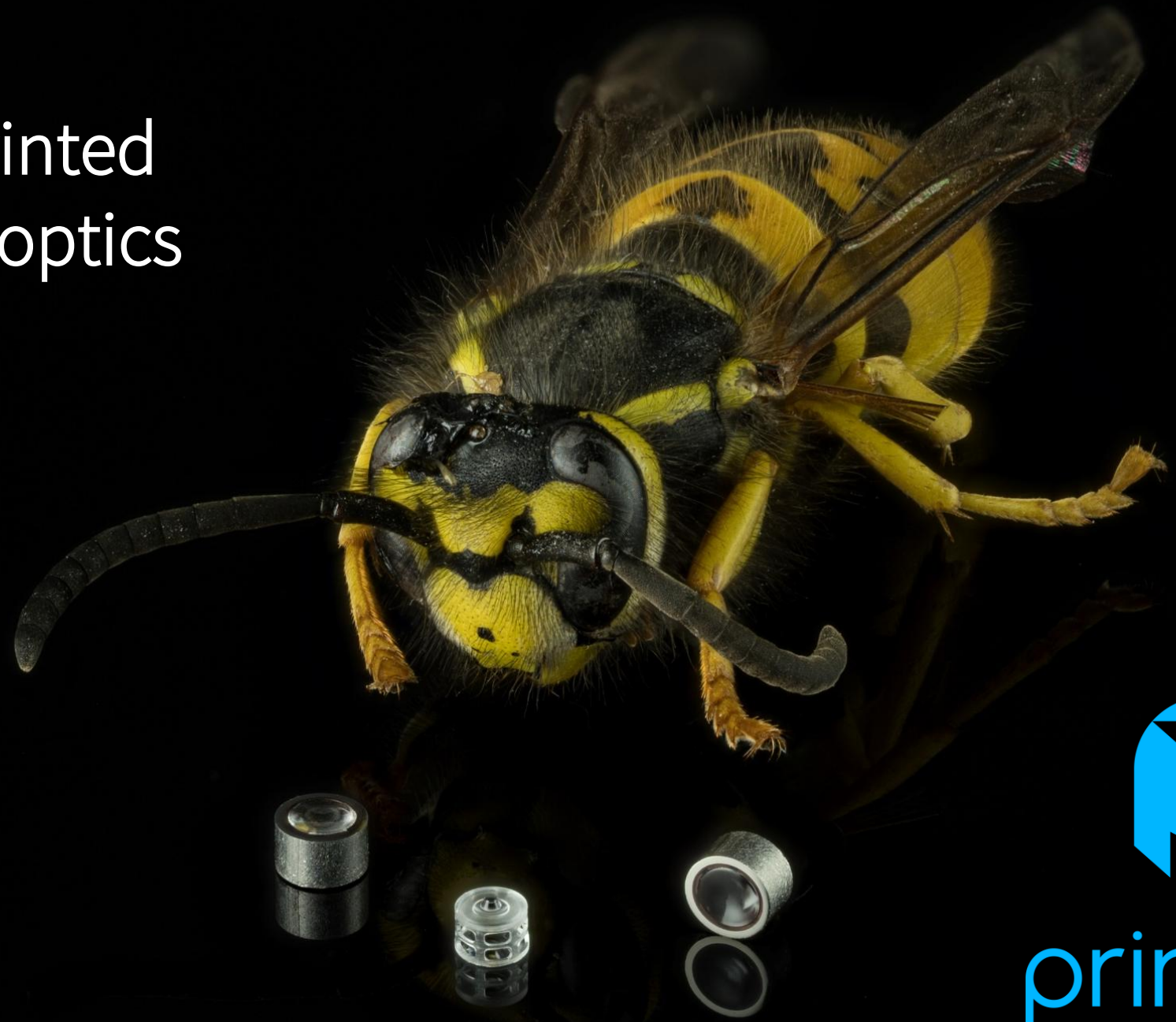
3D-Printed Micro-optics



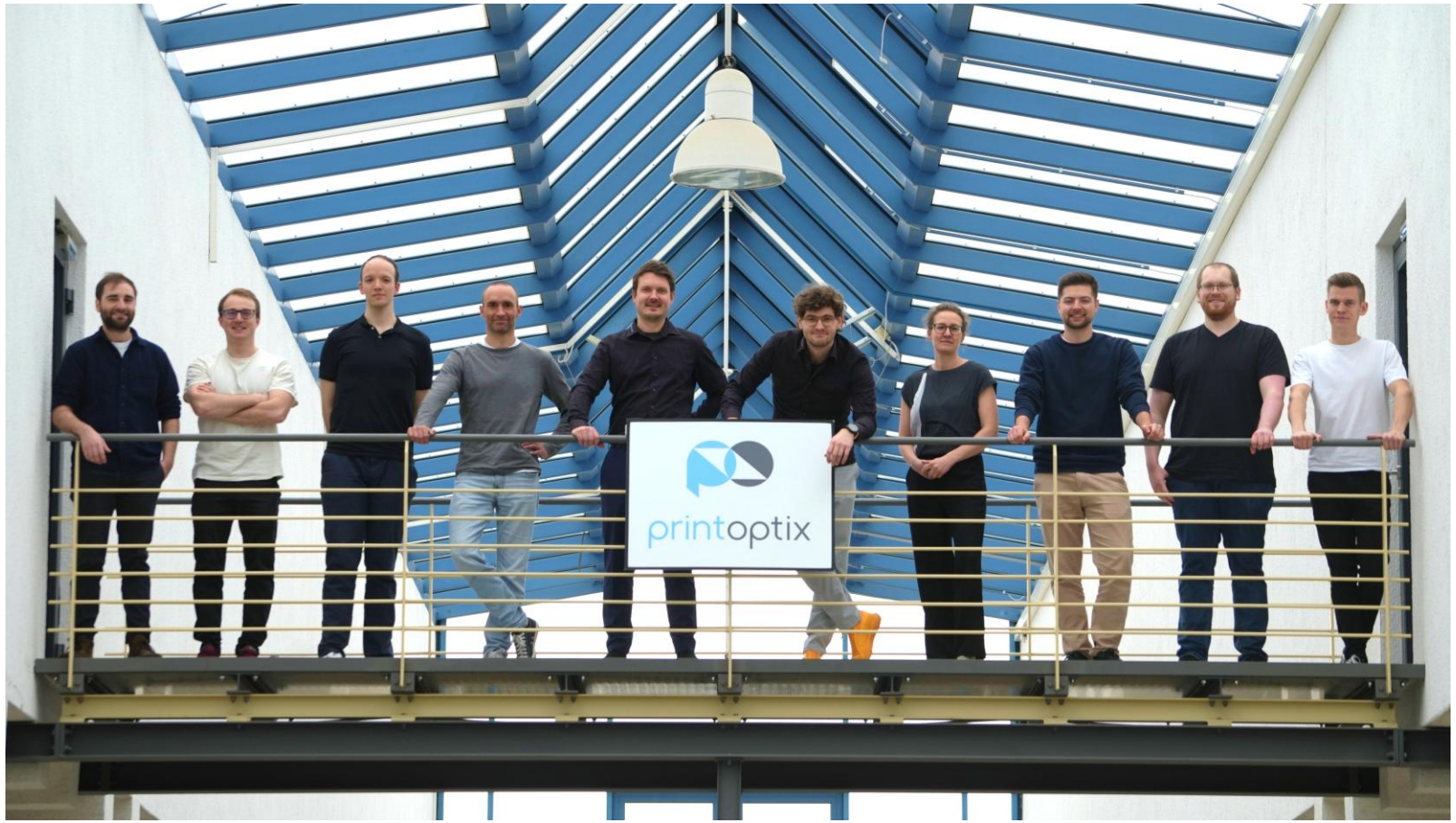
Simon Hartlieb

2025-04-08

printoptix

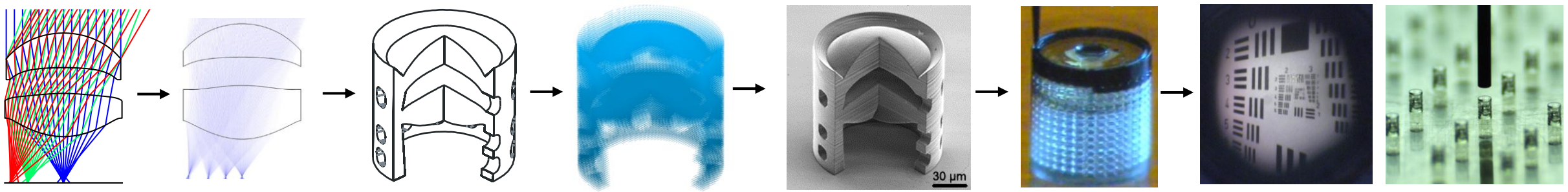
Who We Are

- Based in Stuttgart
- Founded in Dec. 2021
- 9 Team Members



What We Do

Optical design and simulation	Structural design / Process development	3D printing service	Additional processing	Measurement and analysis	Series production



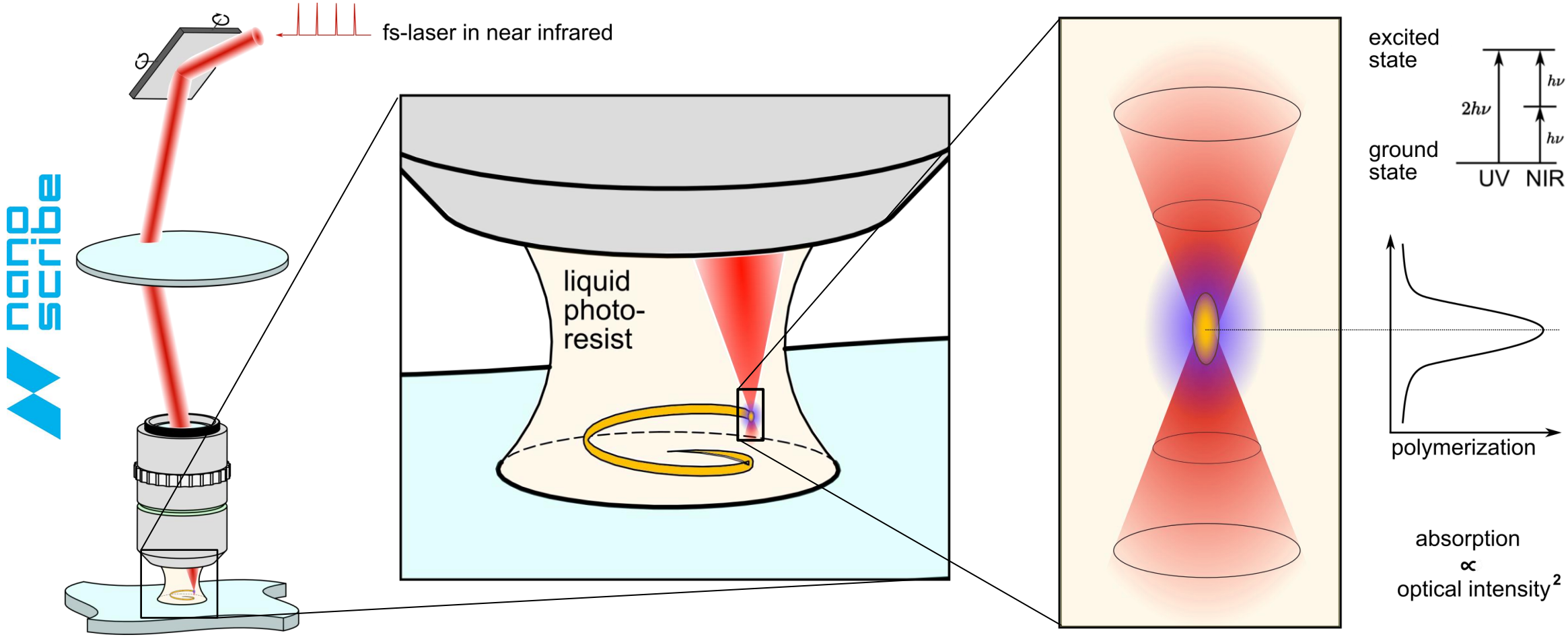
…And Where We Do It

Own infrastructure:

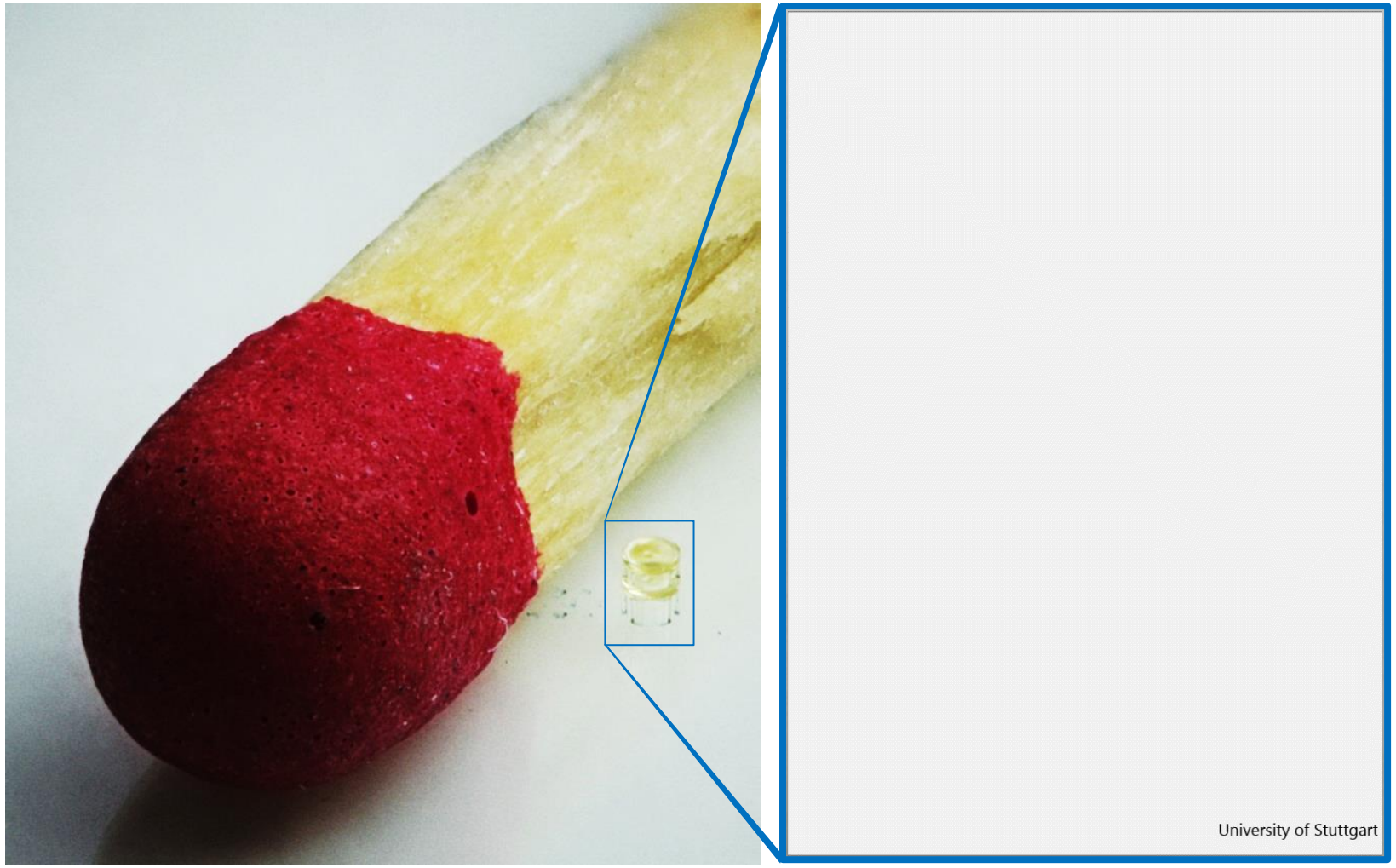
- ISO5 mini cleanroom
- Nanoscribe QuantumX Align 3D printer
- Measurement equipment

How Does It Work?

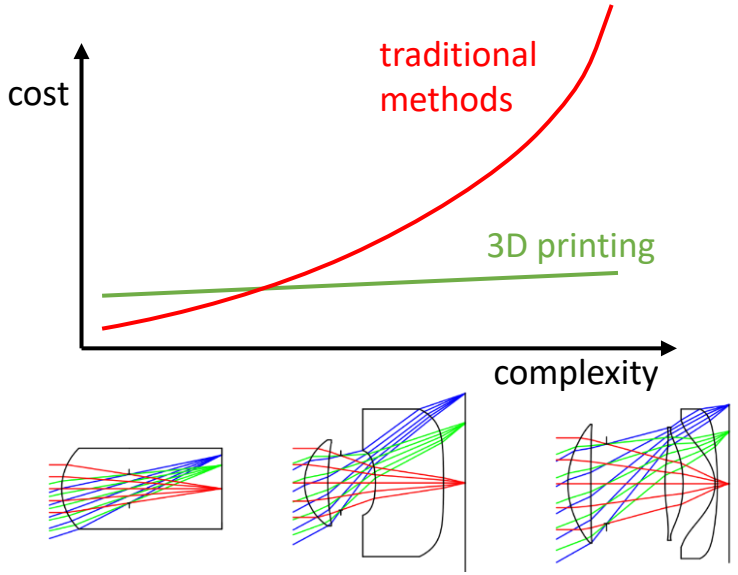
Two-photon polymerization



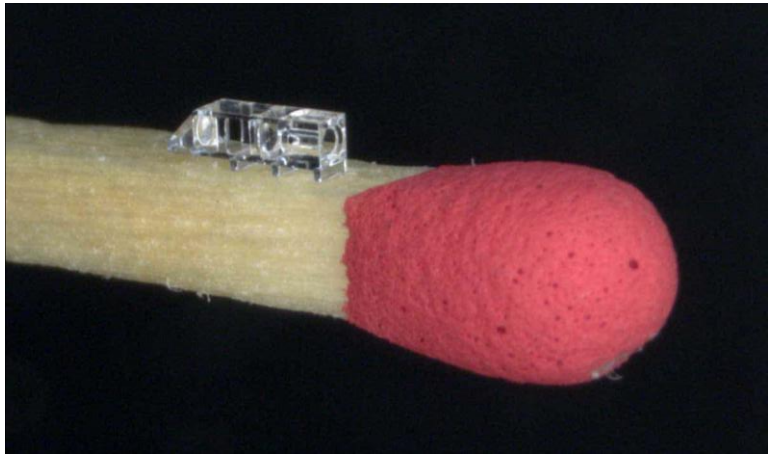
3D printing of Micro-Optics

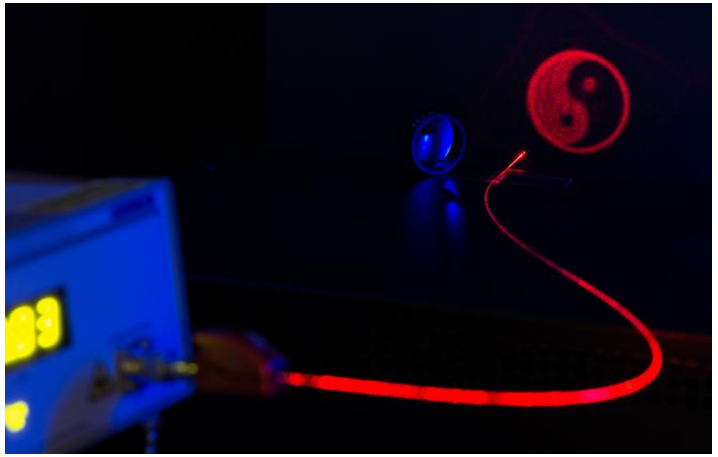


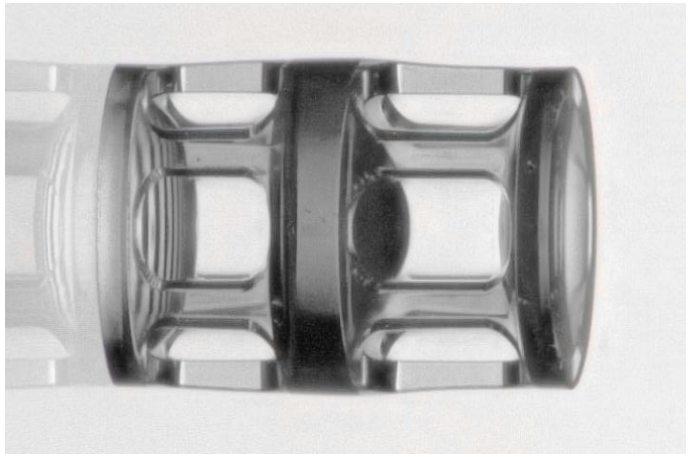
- fabrication of complex lens systems without assembly
- no lens alignment required
- complexity is a free resource in 3D printing

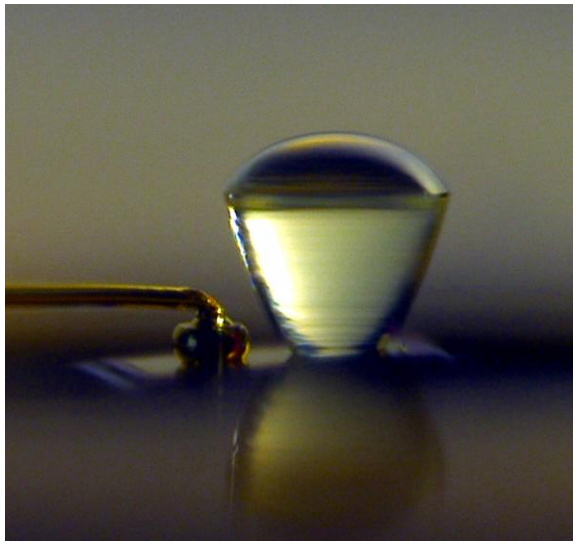


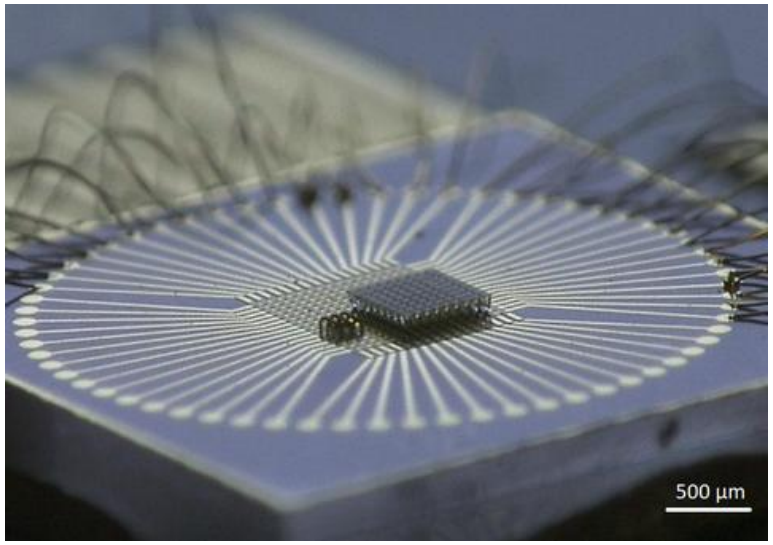
Unlimited Design Freedom





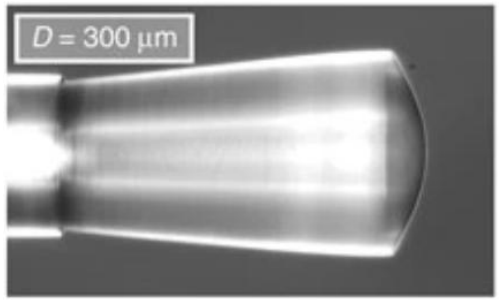






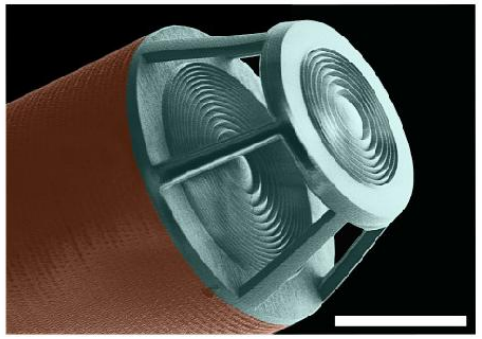
Modes of Light Manipulation

Refraction



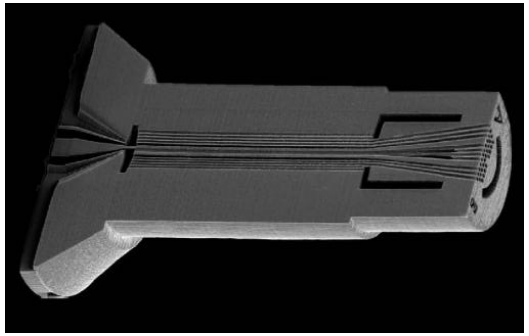
T. Gissibl et al., Nat. Comm. 7, 2016

Diffraction



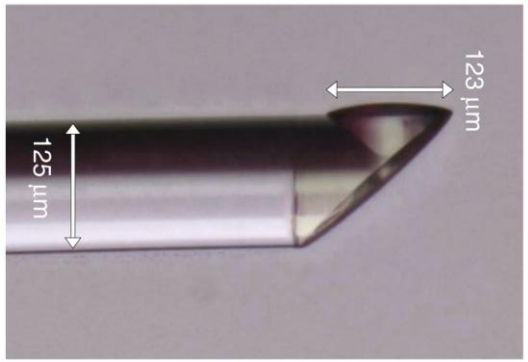
A. Asadollahbaik et al., ACS Phot. 7, 2019

Sub-λ effects (photonic band gaps, metalenses, effective medium)



A. Bertoncini et al., Optica 7, 2020

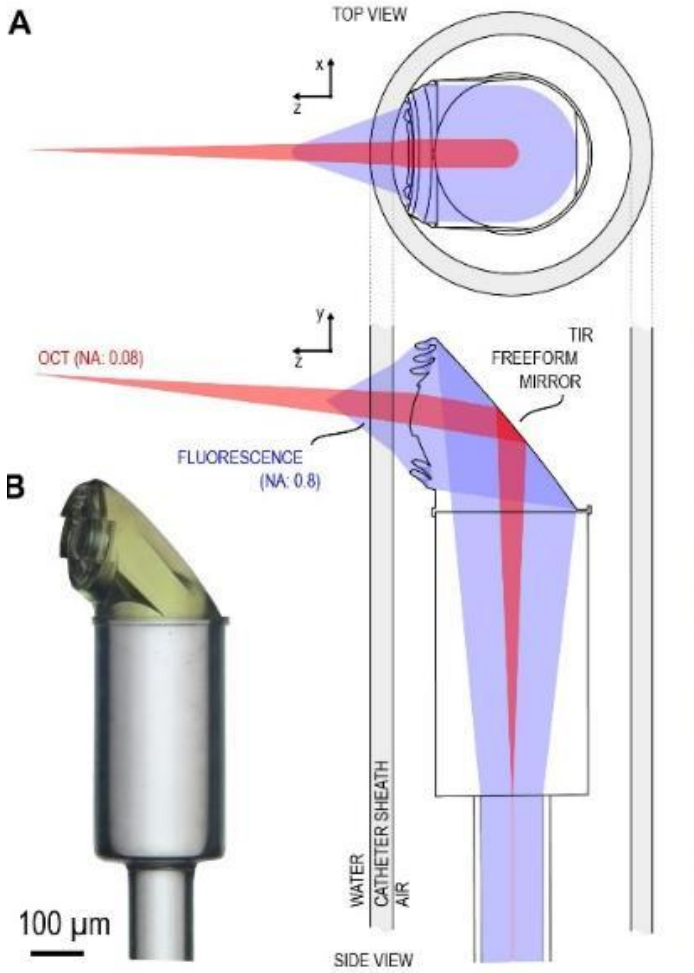
Reflection / TIR

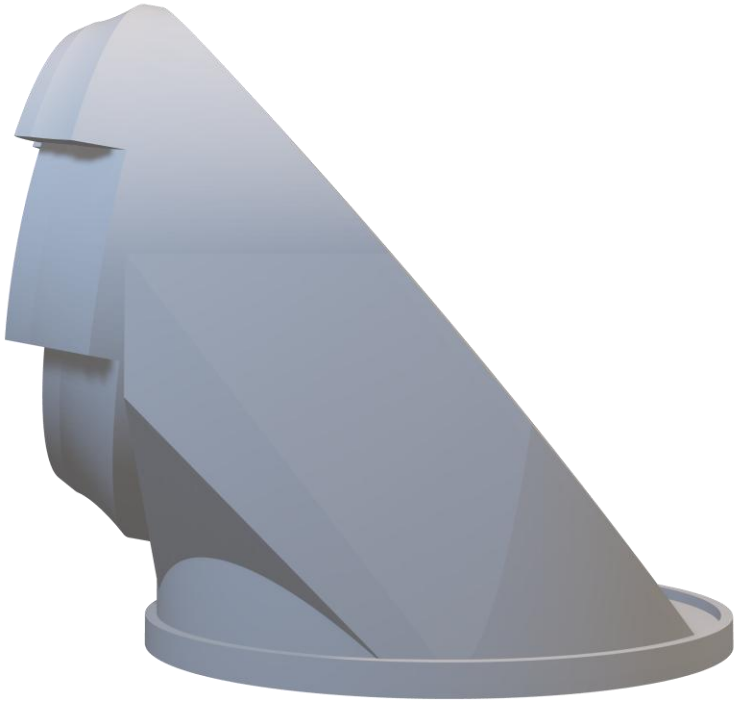


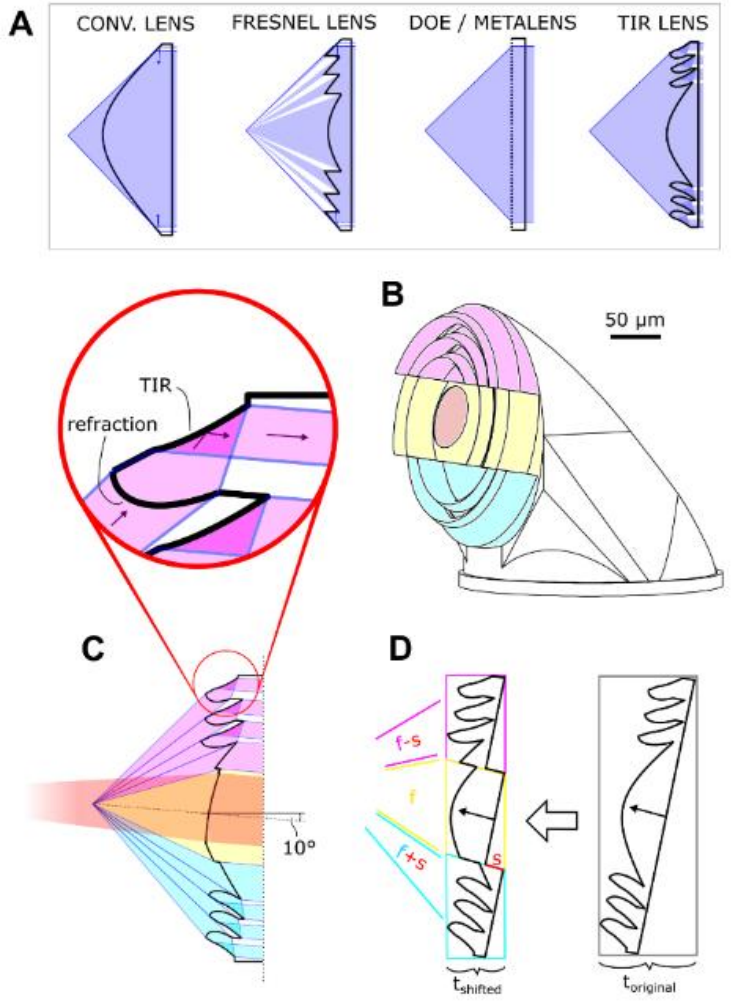
Absorption

Hybrid

TIR designs



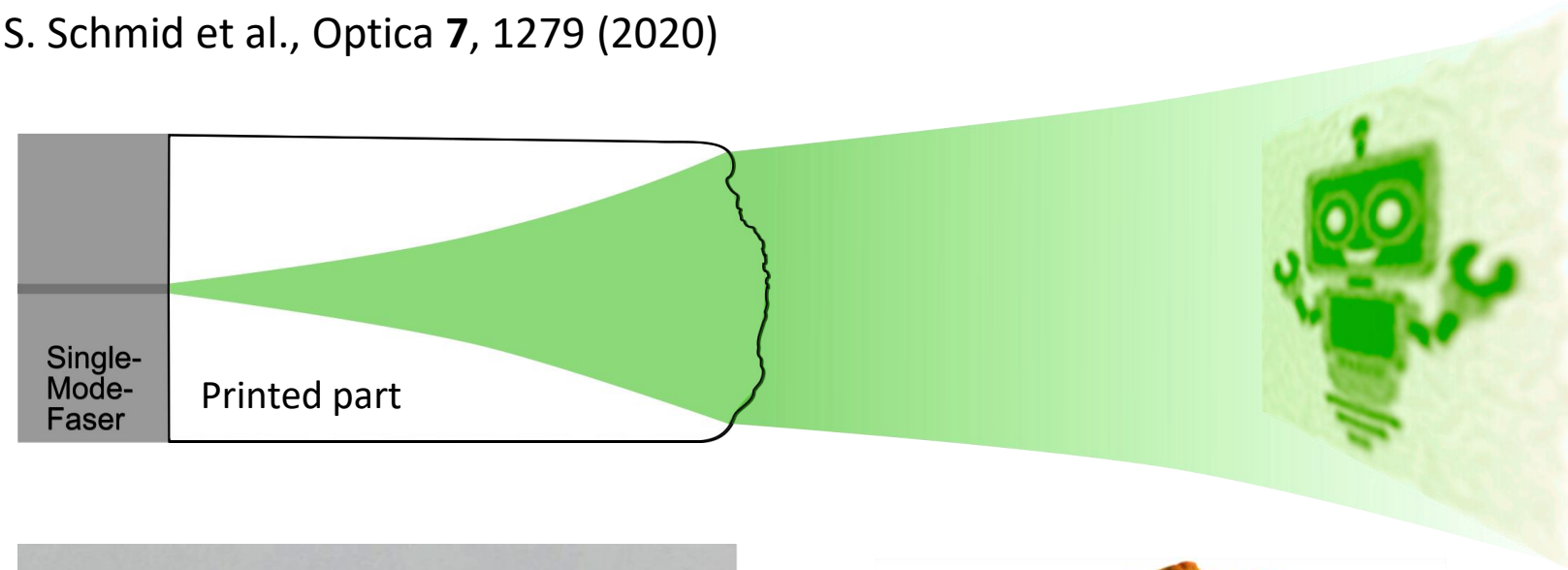


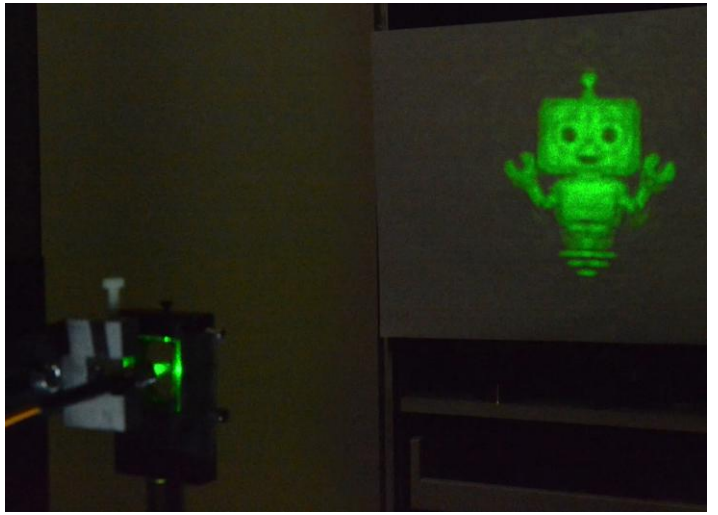


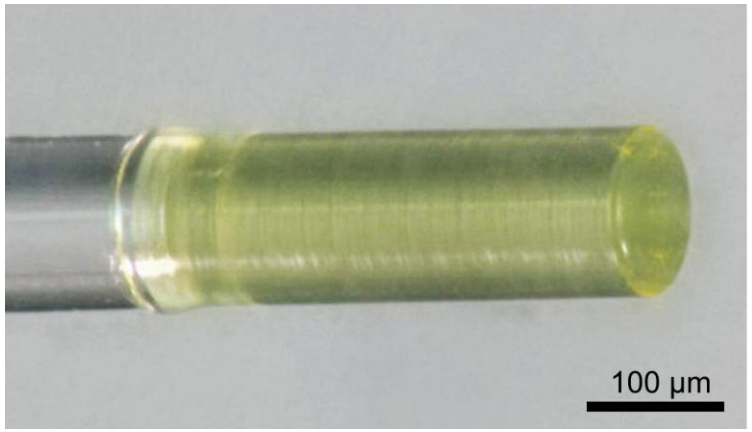
J. Li, S. Thiele et al., small 18 (17) 2022

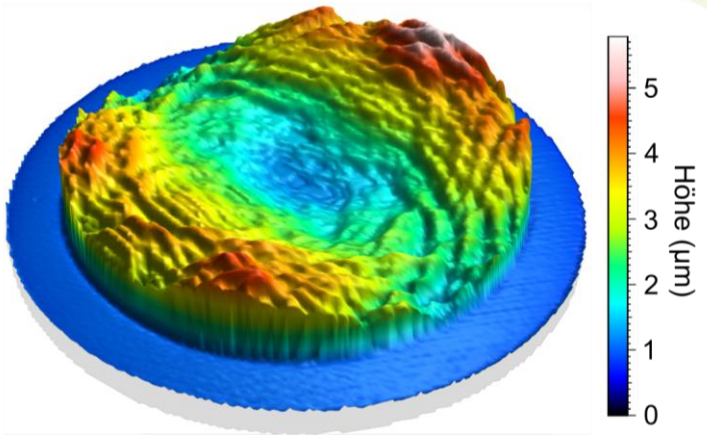
Laser Beam Shaping

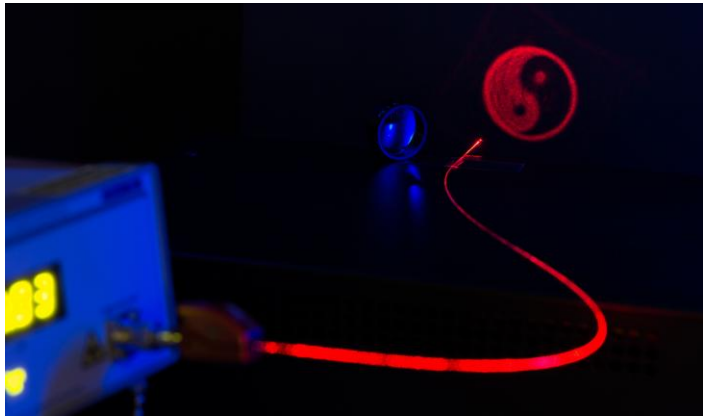
S. Schmid et al., Optica **7**, 1279 (2020)







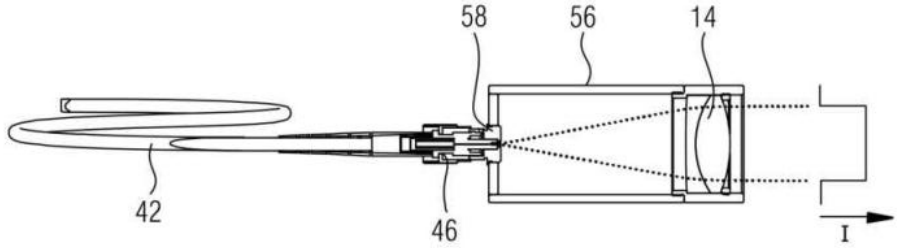


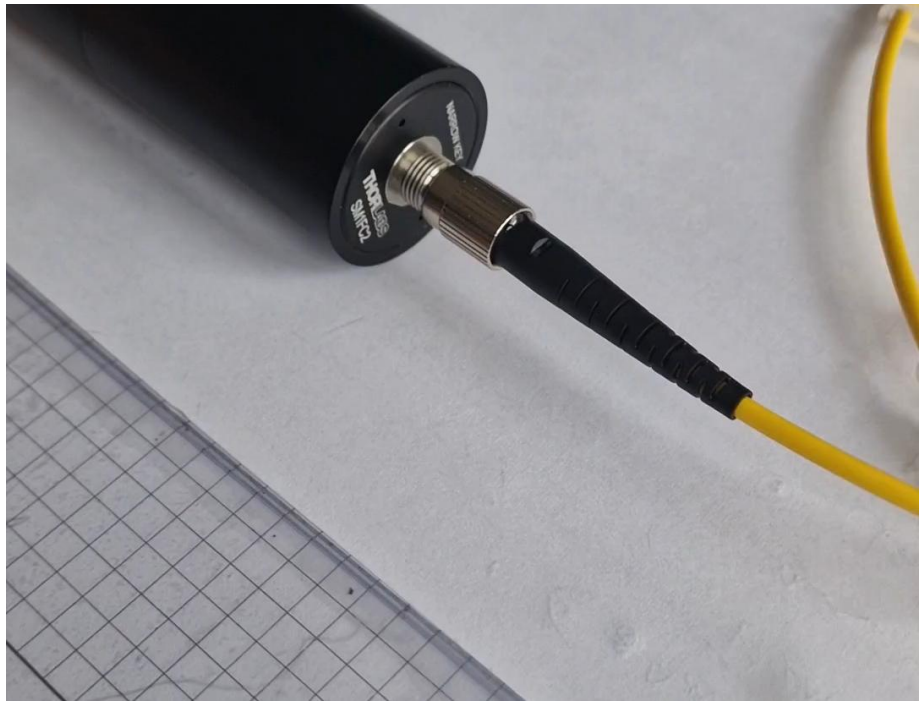


Cooperation with Sören Schmid, Carl Zeiss AG

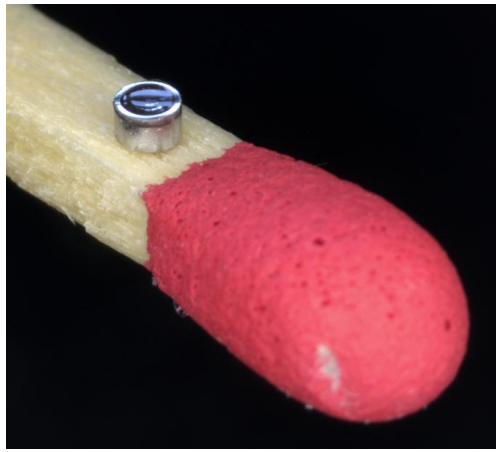
Laser Beam Shaping

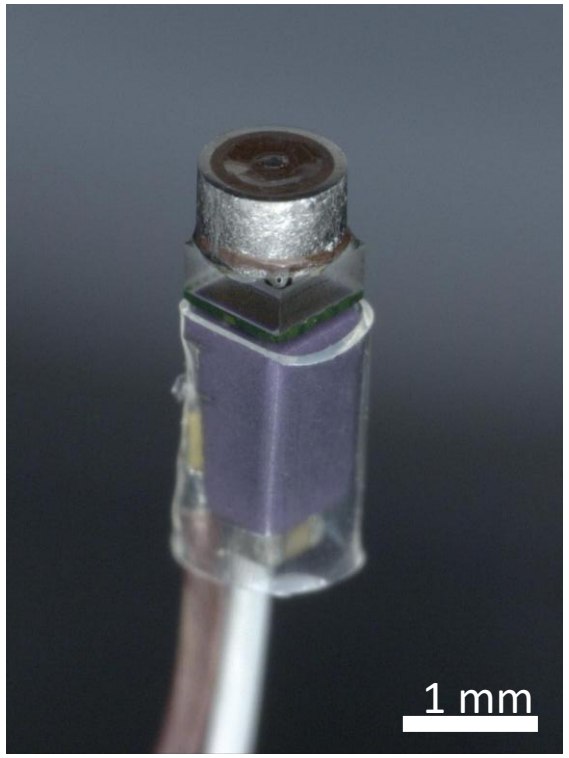
Patch cable integration



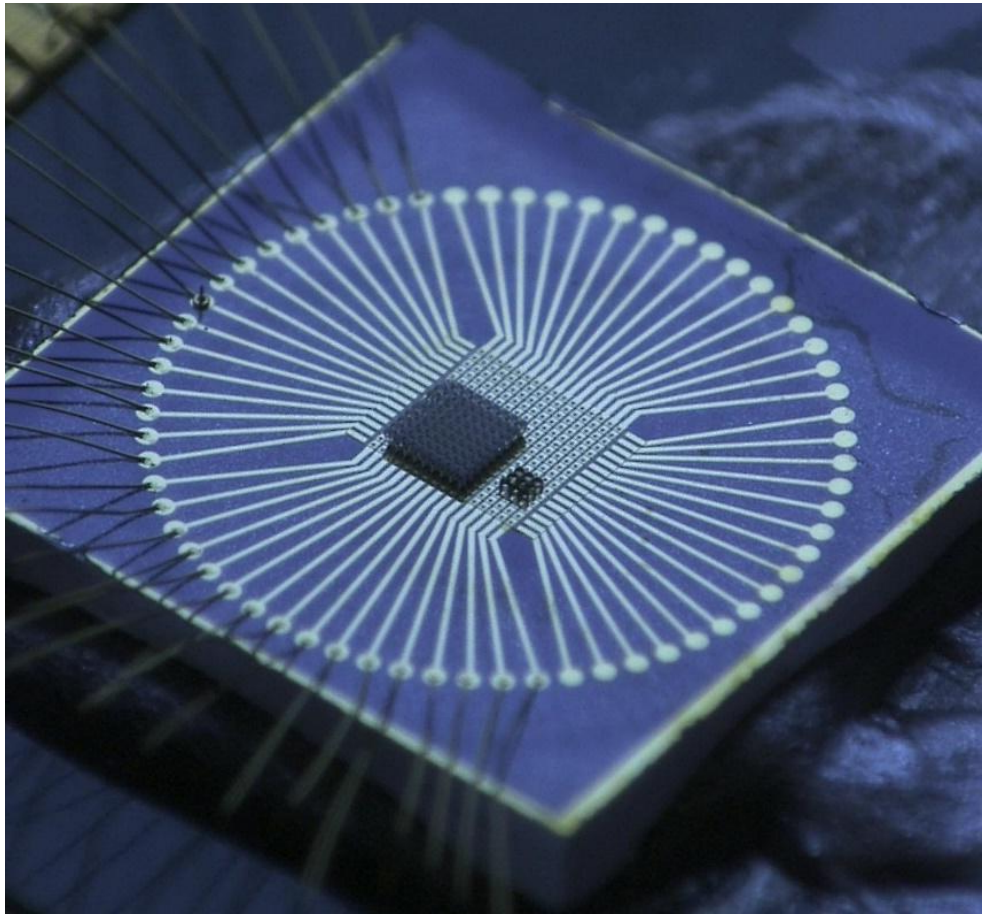


Imaging Objectives

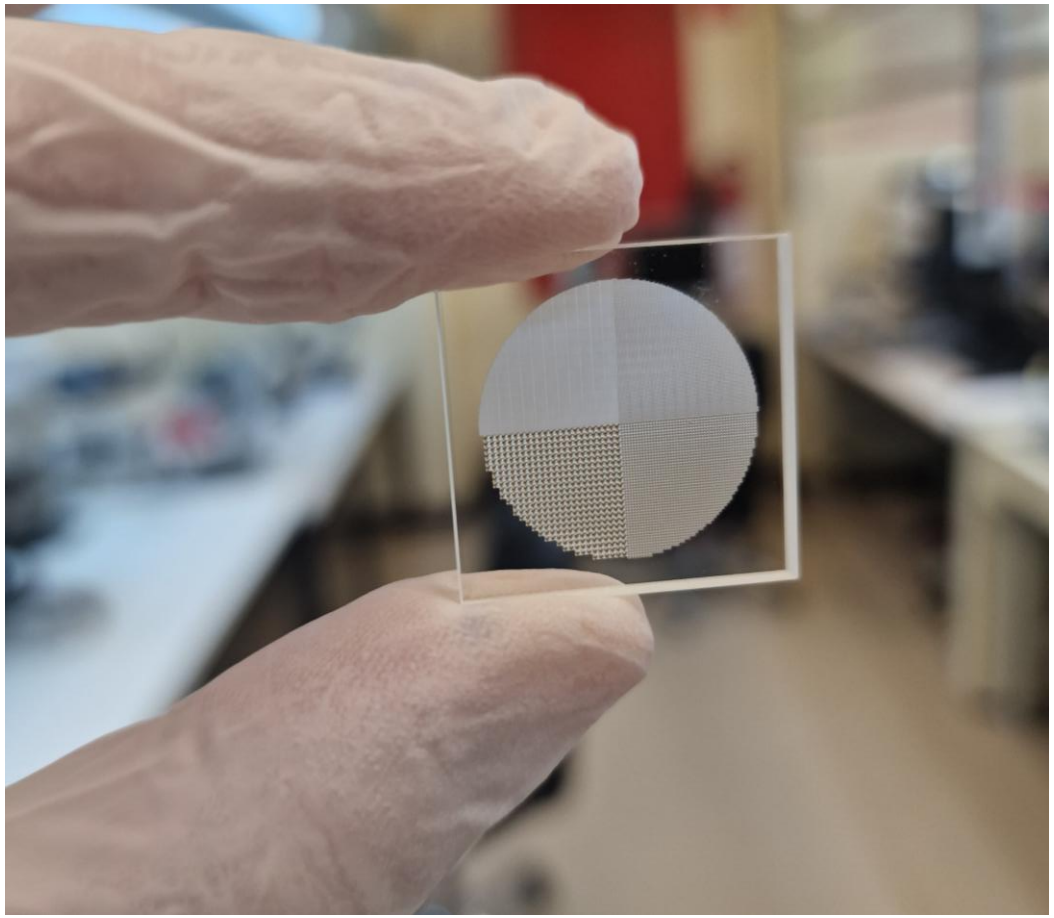




Array Optics



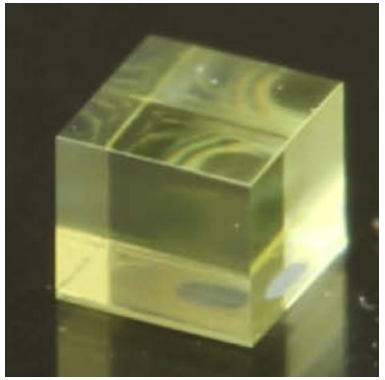
Collimator Array on a Micro-LED Array, 700 x 700 µm²



4 Different Arrays on One Shared Substrate

Optical engineer

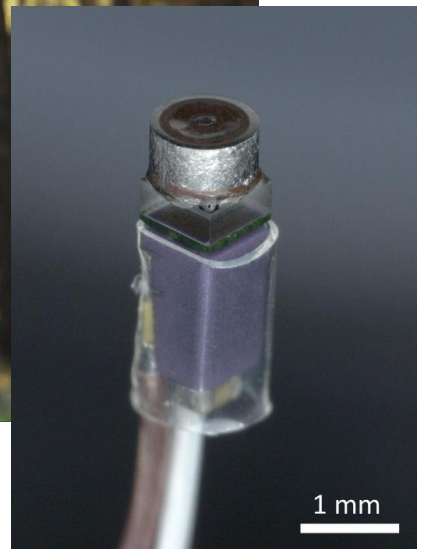
Polymers



Challenges and future applications

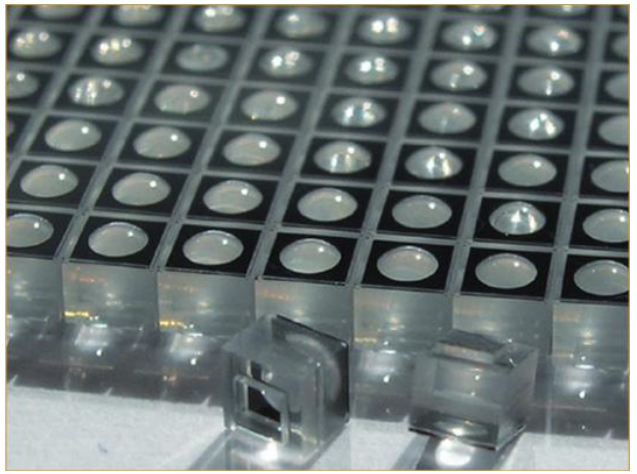
AR/VR

Image: Dmitry Ganin



Tilted optical axis

Printing glass

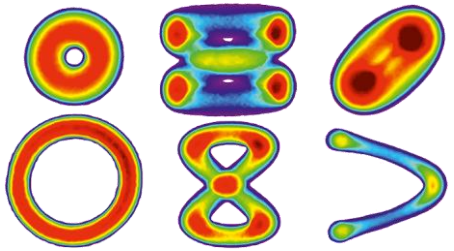


micro resist technology, OrmoComp® and OrmoClear®, 2025

High power applications

Radiolex®, 2025

Beam shaping



C. Gopphold et al., Photonics Spectra, 2017

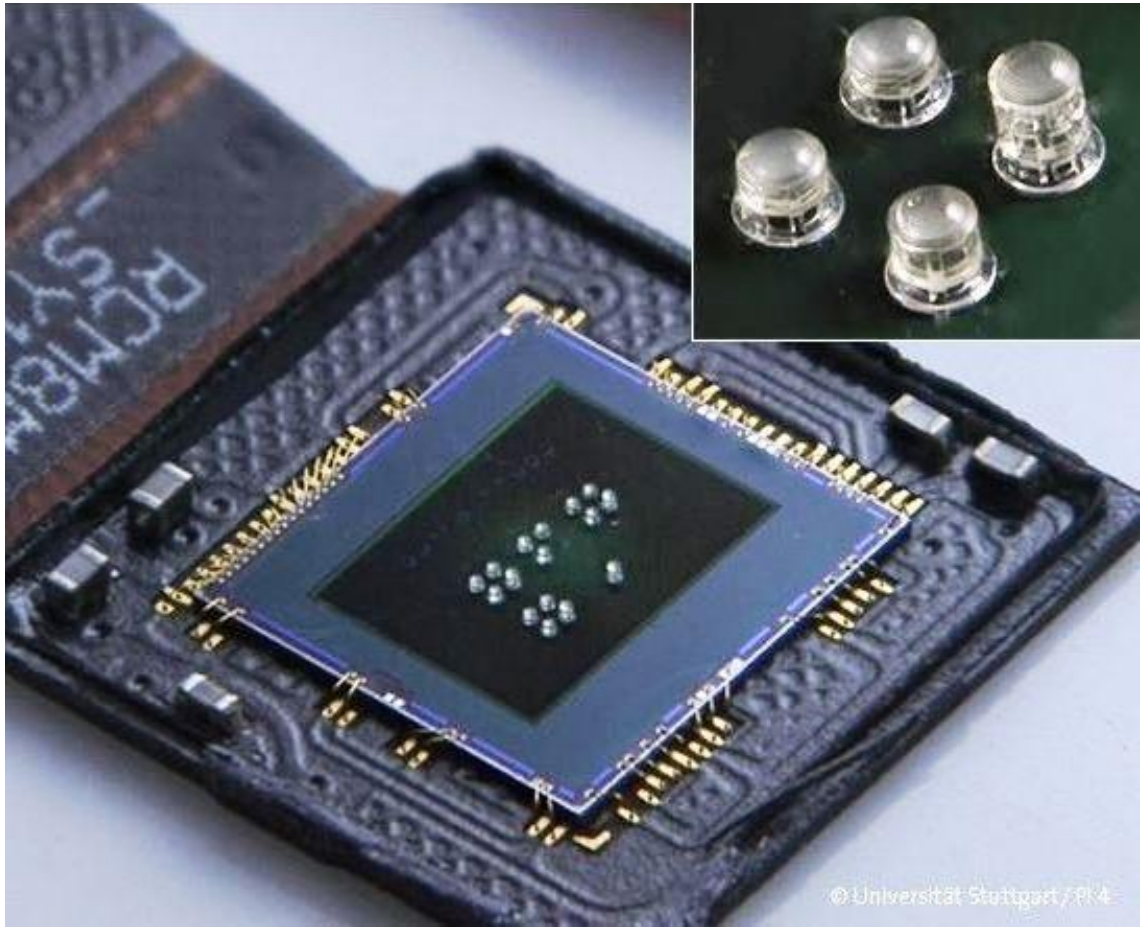
Thank You!

Questions?

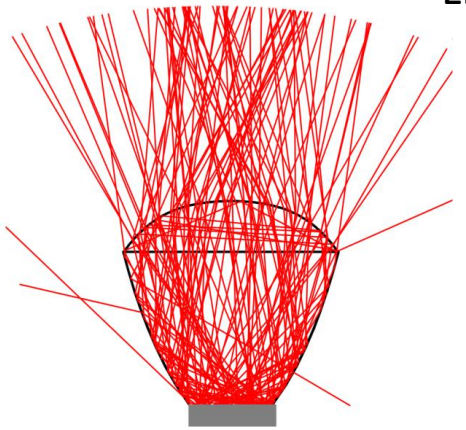
Simon Hartlieb
s.hartlieb@printoptix.com
+49 151 42014836

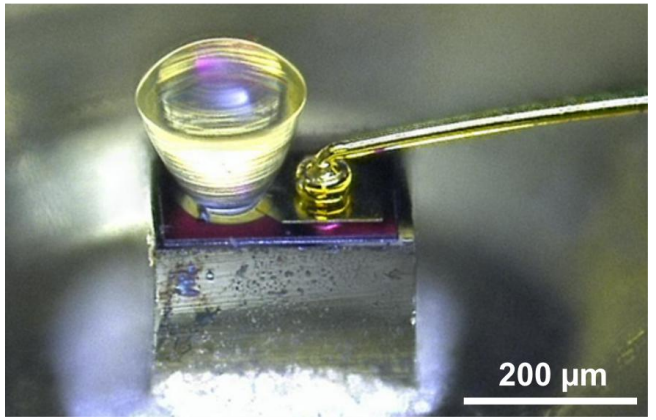
Printing on Semiconductors

Image sensor

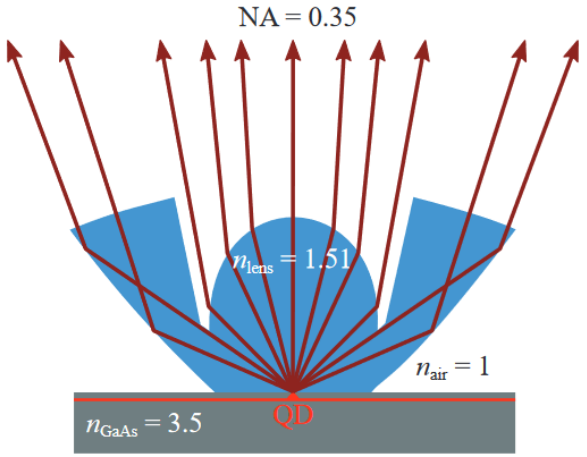


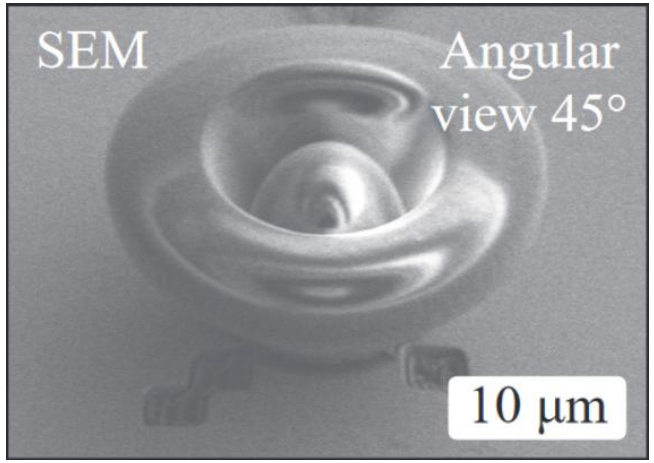
LED





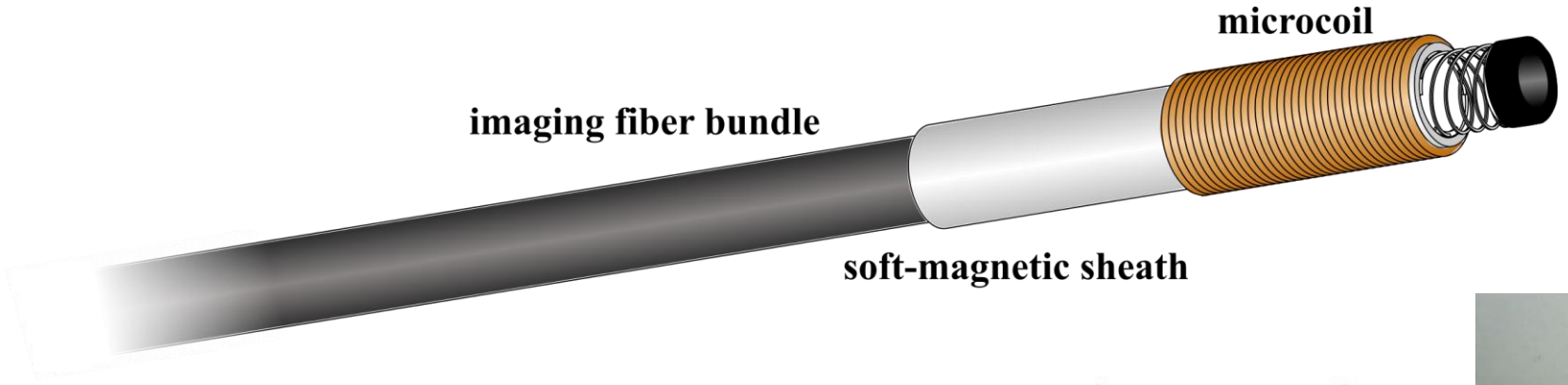
Quantum dots

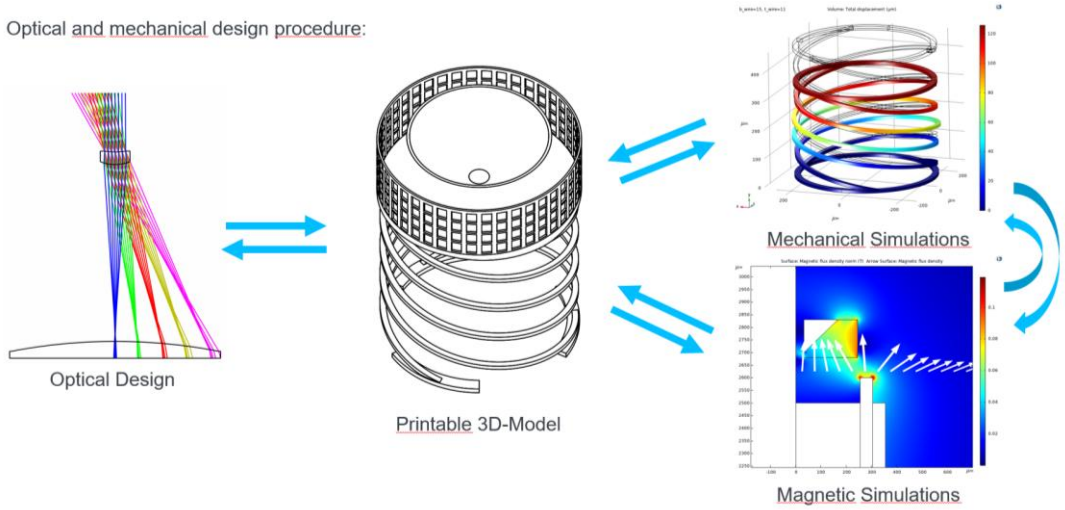


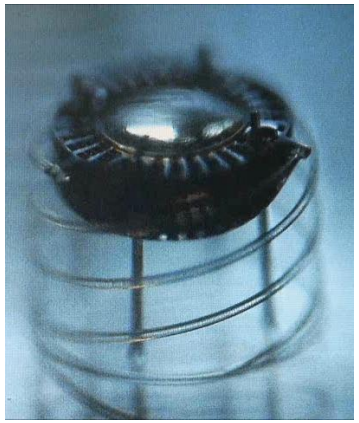


M. Sartison, K. Weber et al., Light: Advanced Manufacturing 2 (6), 2021

Active Optics

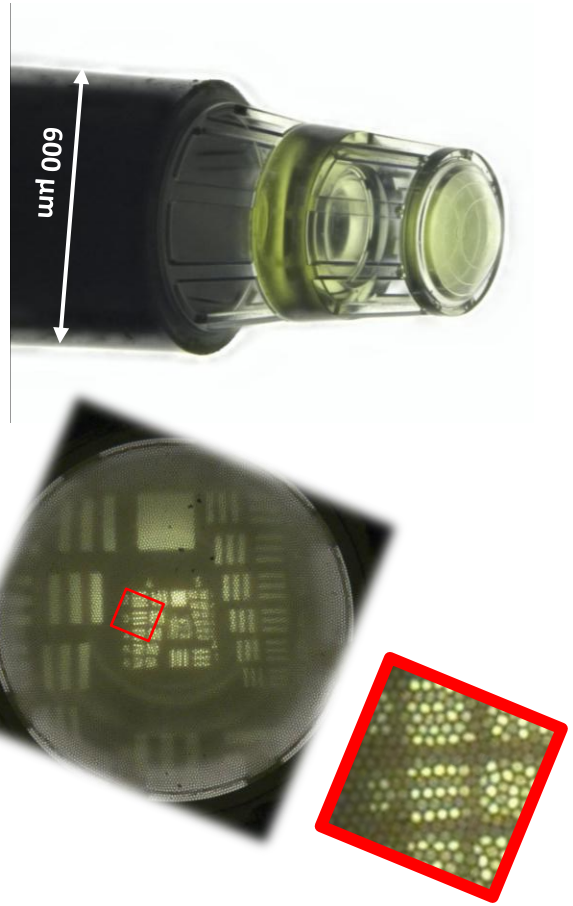




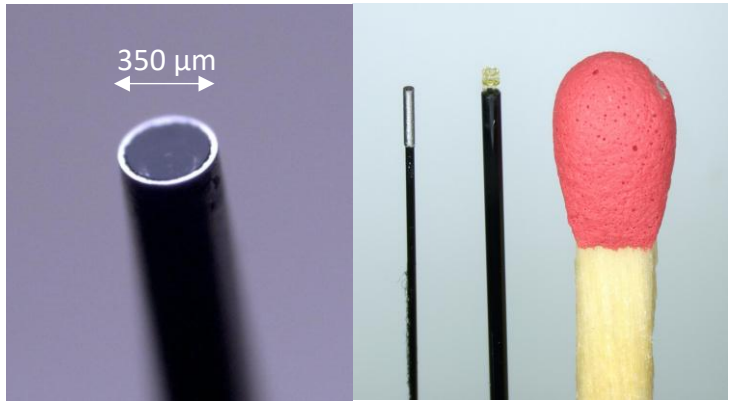


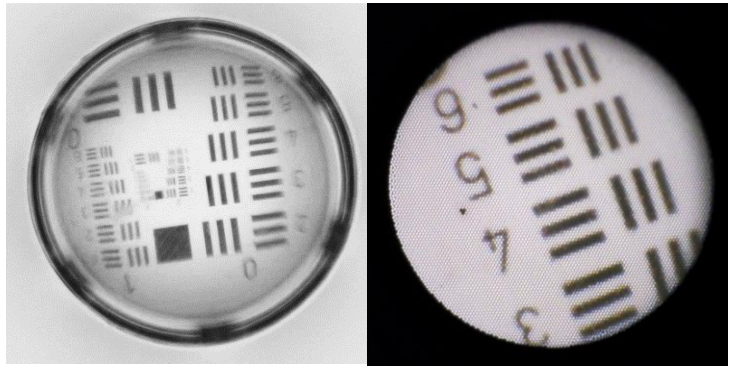
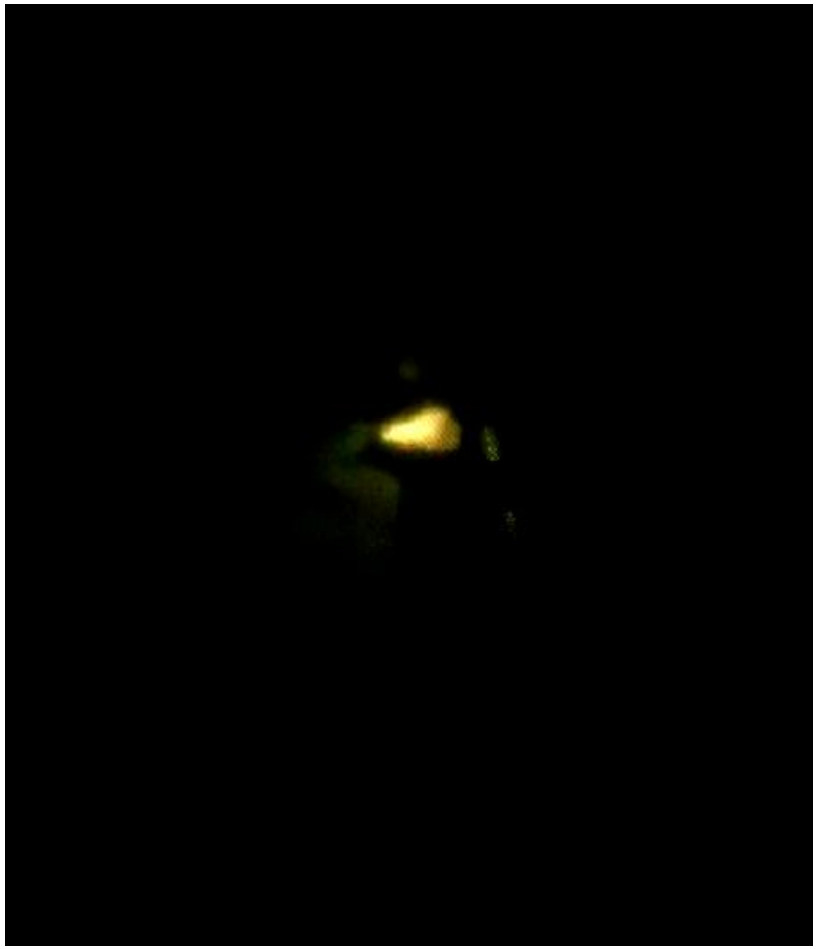
Work by Florian Rothermel, Institute of Applied Optics, University of Stuttgart

Fiber Endoscopes



First approach





First medically usable prototype
(mechanically and chemically protected)