

HETEROMERGE
FUNCTIONAL 3D MICRO-PRINTING

Functional two-photon 3D printing of micro-optics using *in situ* print material exchange

Robert Kirchner

HETEROMERGE GmbH, 01217 Dresden, Germany

4-5 June 2024. Berlin, Germany

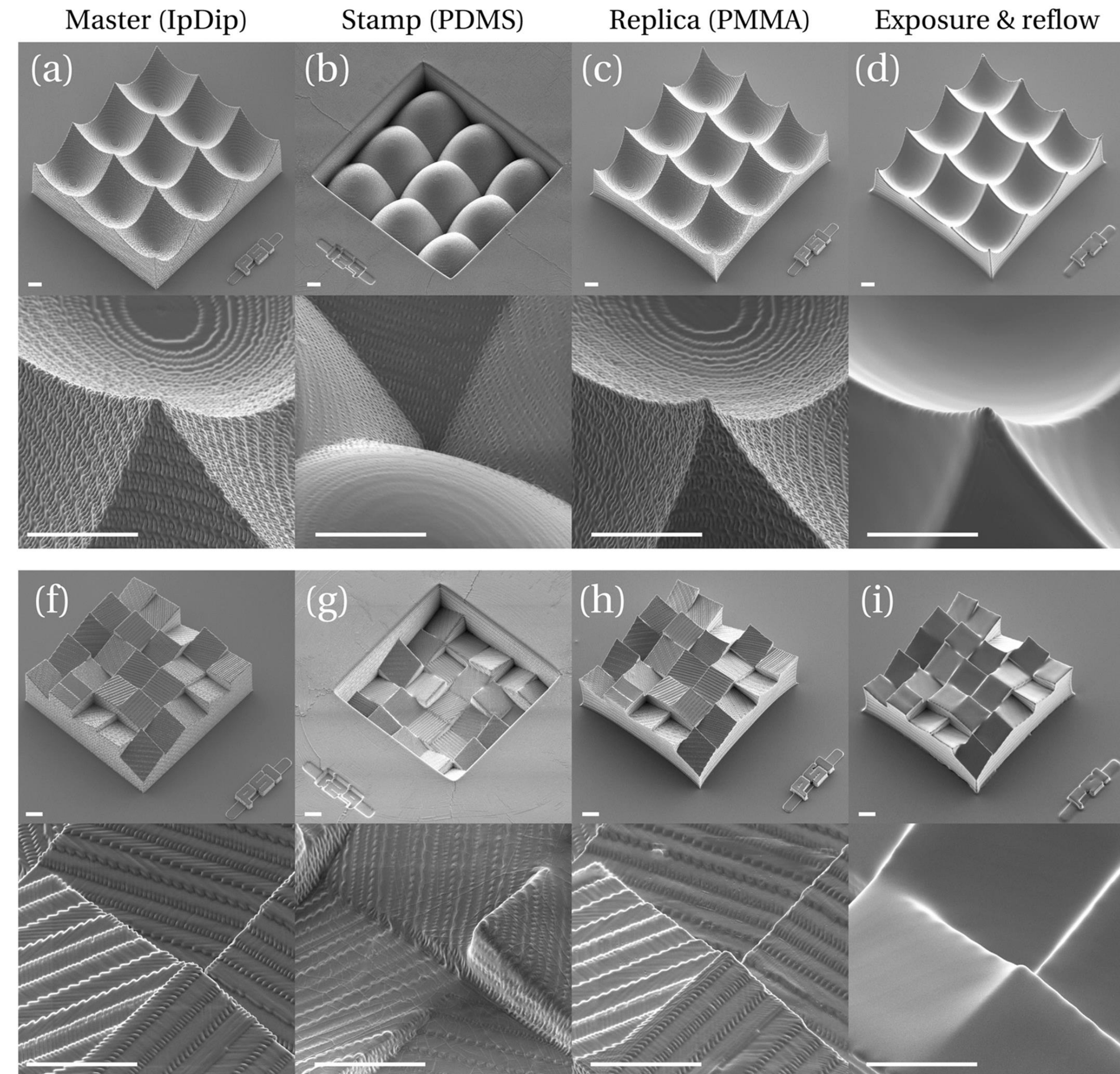
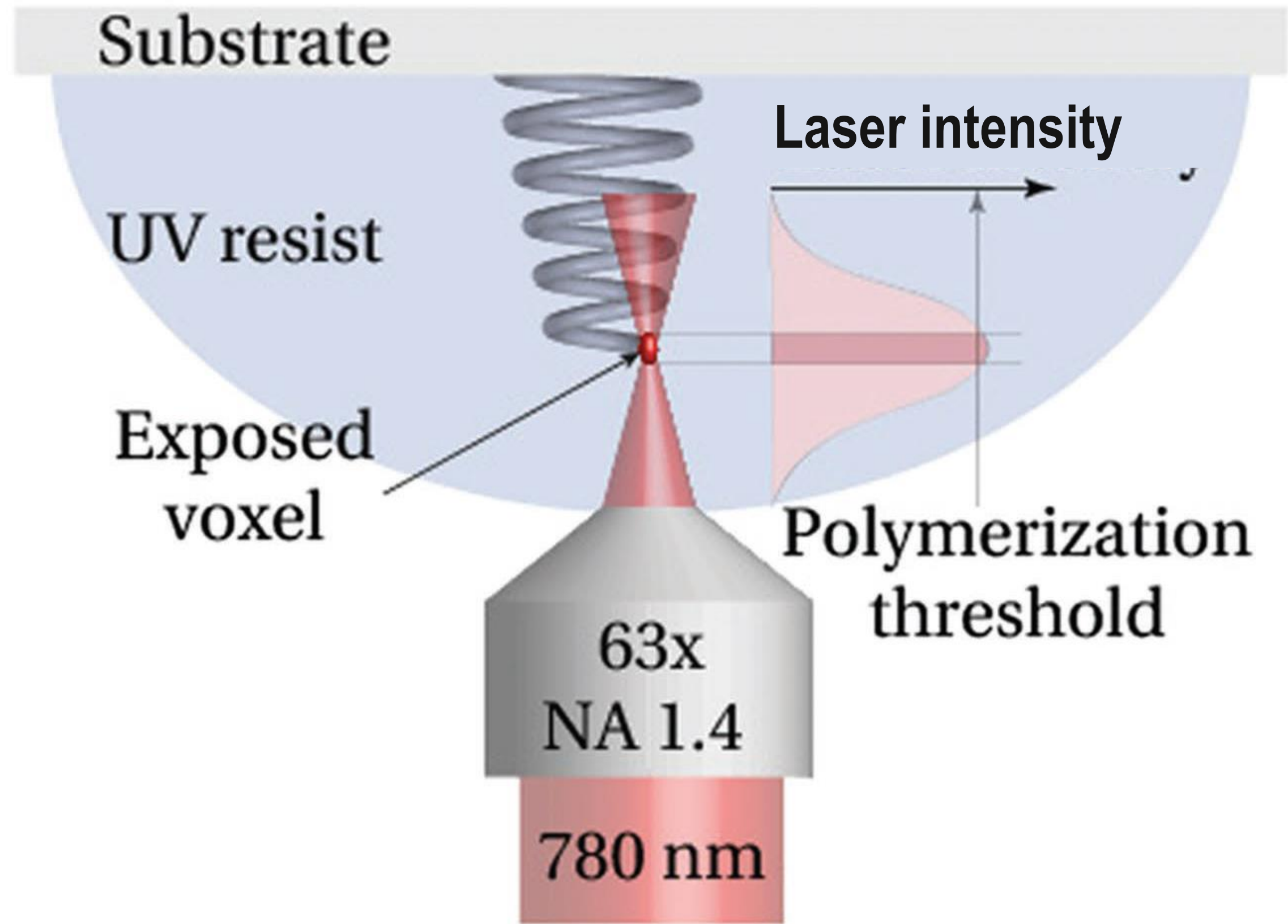
EPIC Technology Meeting on
Photonic Integration and Packaging at Fraunhofer IZM



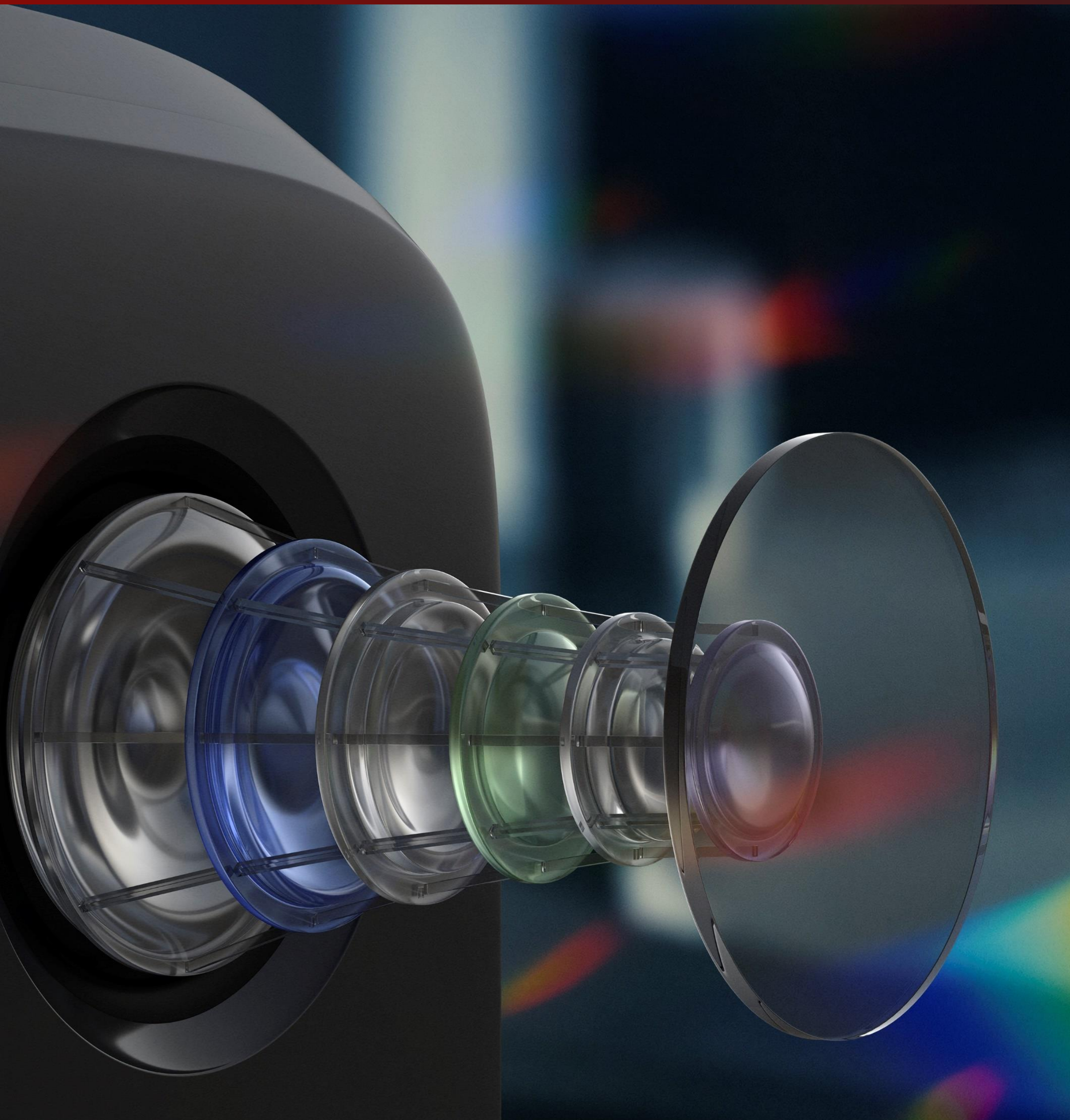
- Spin-off TU Dresden
Center for Advancing Electronics
EXIST Transfer of Research
- Incorporated 2023
Revenue 2023 59 k€
Pre-Seed 640 k€
Employees 8
- Pilot customers 5
Systems planned 2 (Q2/2024)



2PP: high resolution 3D printing



N. Chidambaram and R. Kirchner et al. Adv. Mater. Technol. 2017, 1700018 | N. Chidambaram and R. Kirchner et al. J. Vac. Sci. Technol. B 34(6), Nov/Dec 2016.



Problem



Low optical quality

HETEROMERGE

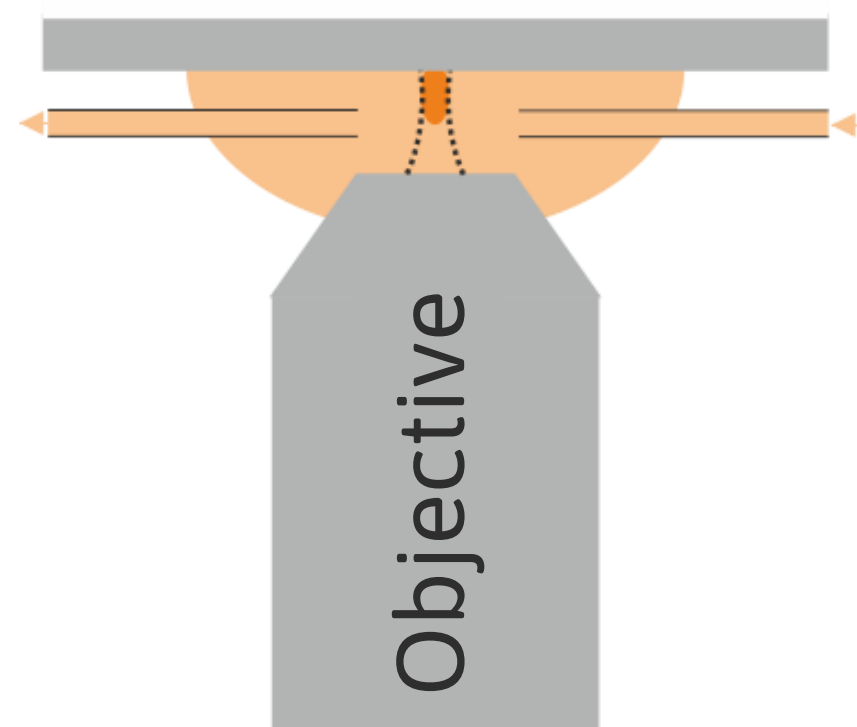


250 μ m



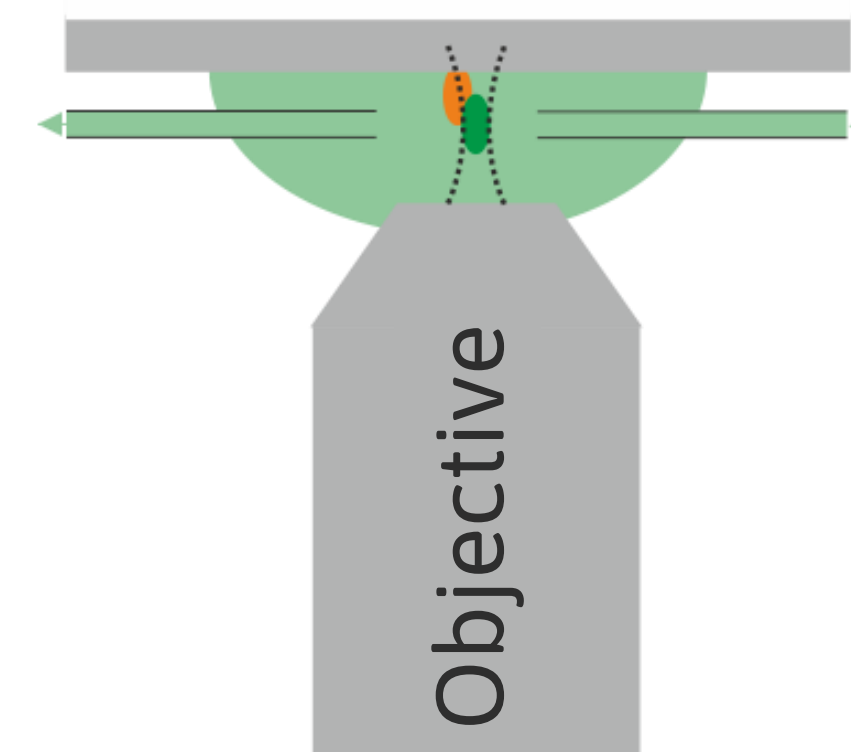
High optical quality

Printing Material A



Material exchange

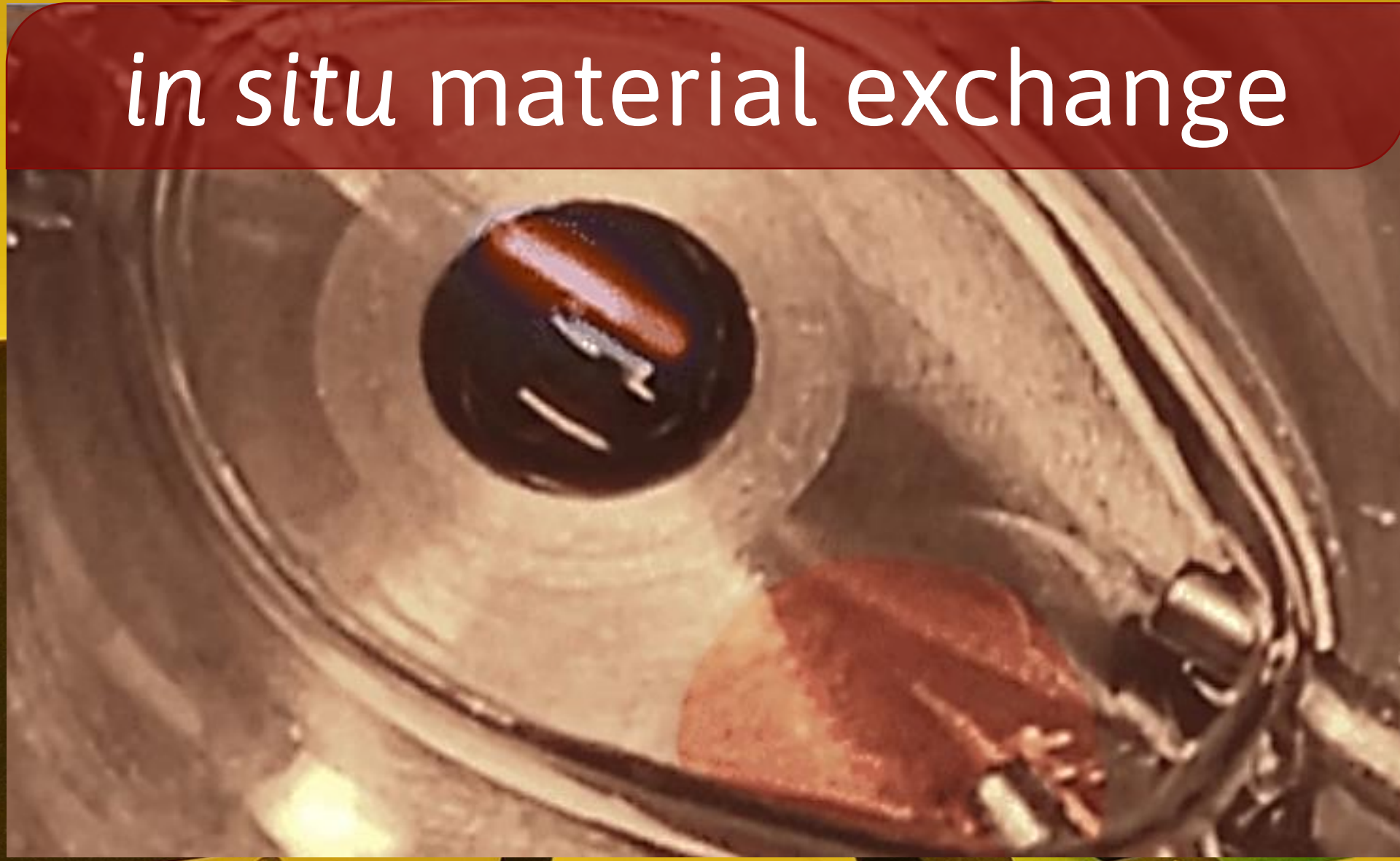
Printing Material B



Start over



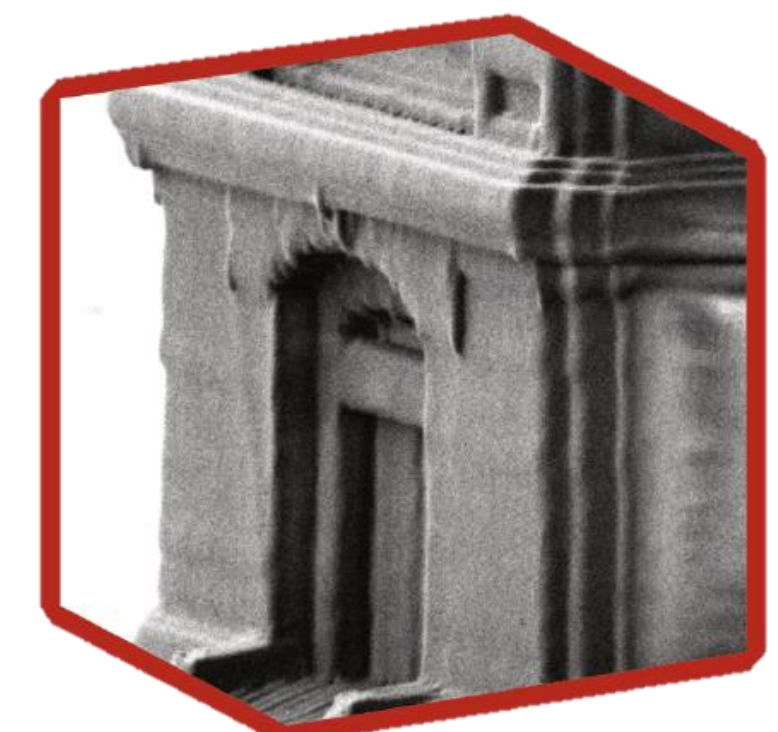
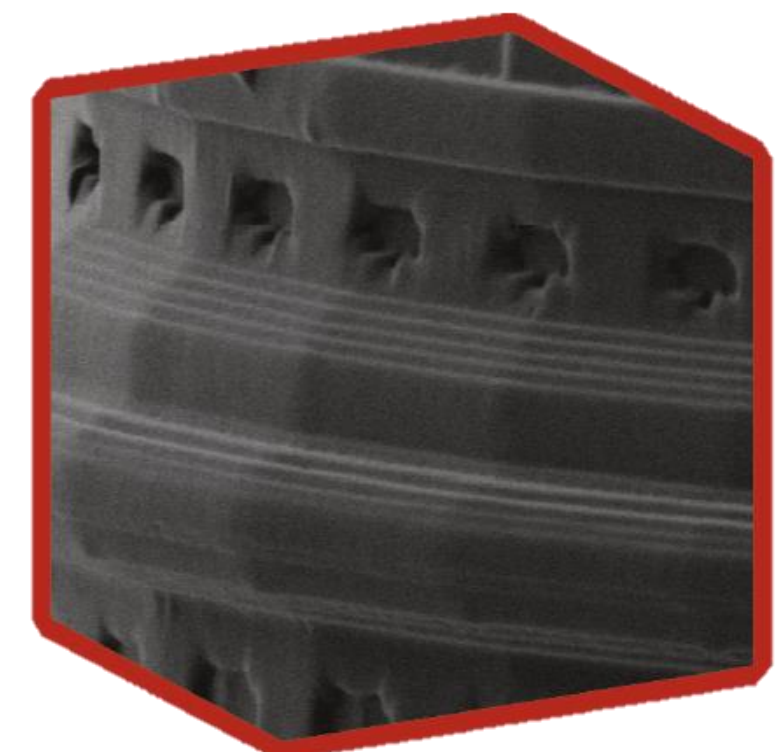
in situ material exchange



Patented solution

Add-on

Plug-n-Play integration



100 μm 

10x

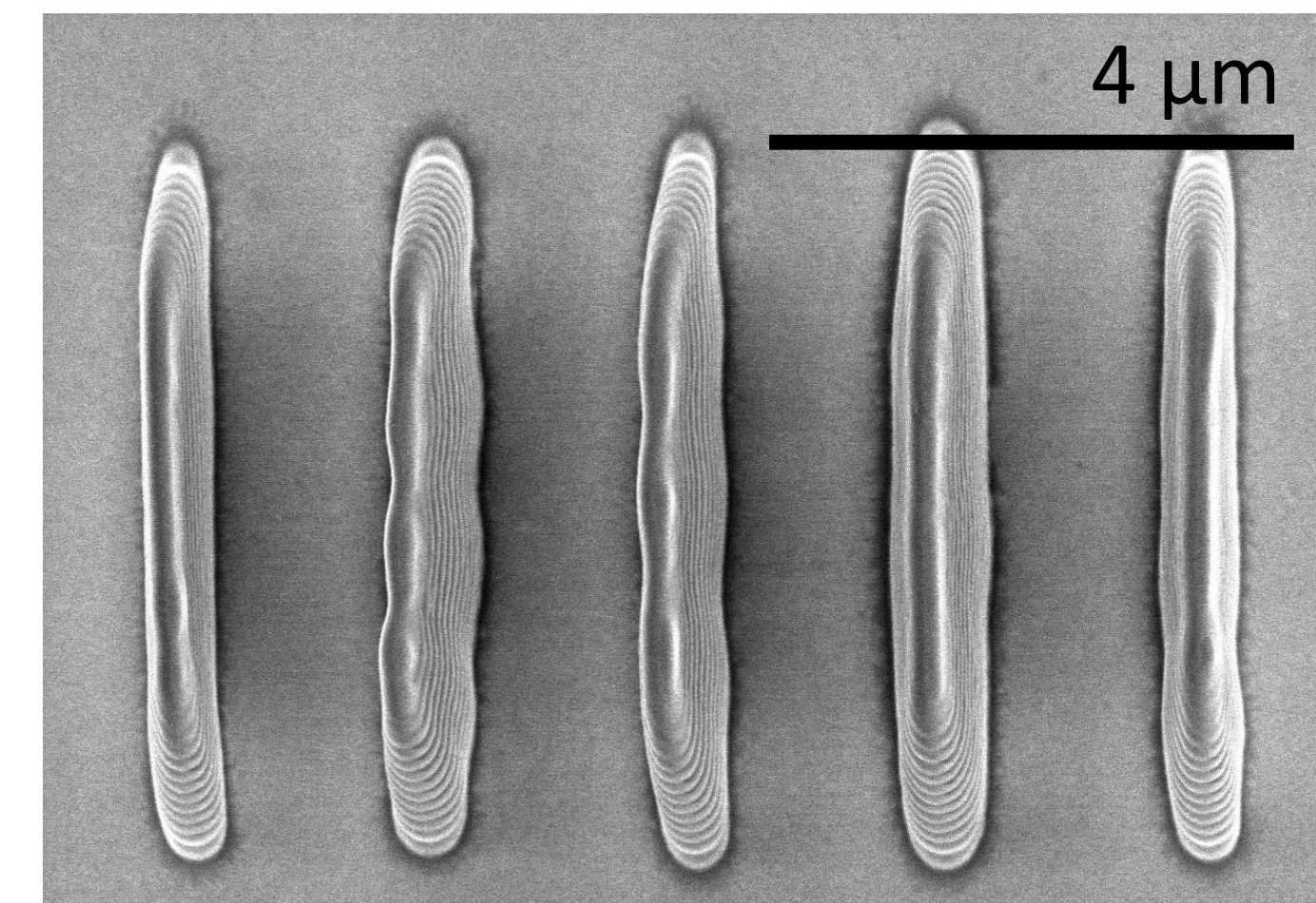
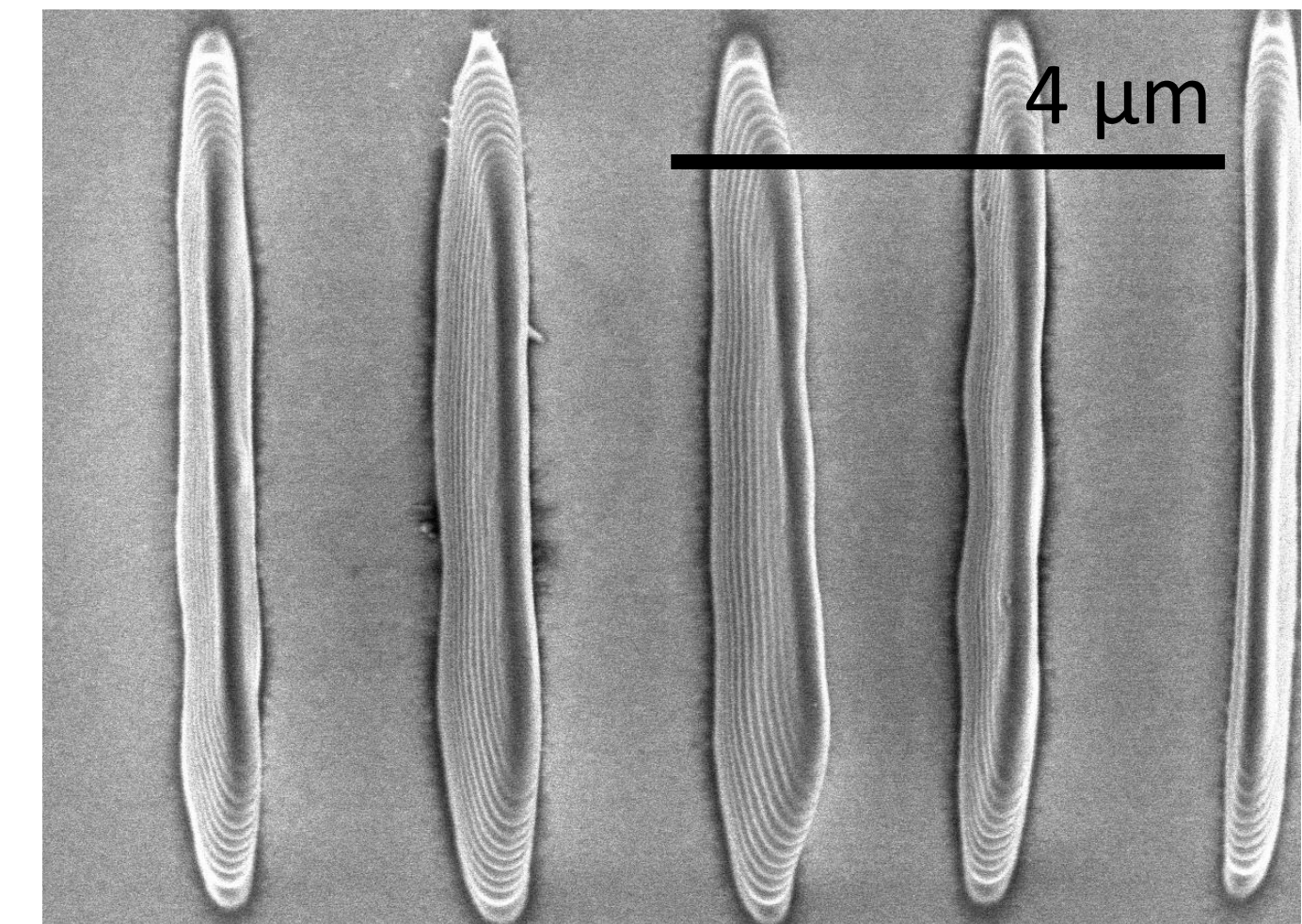
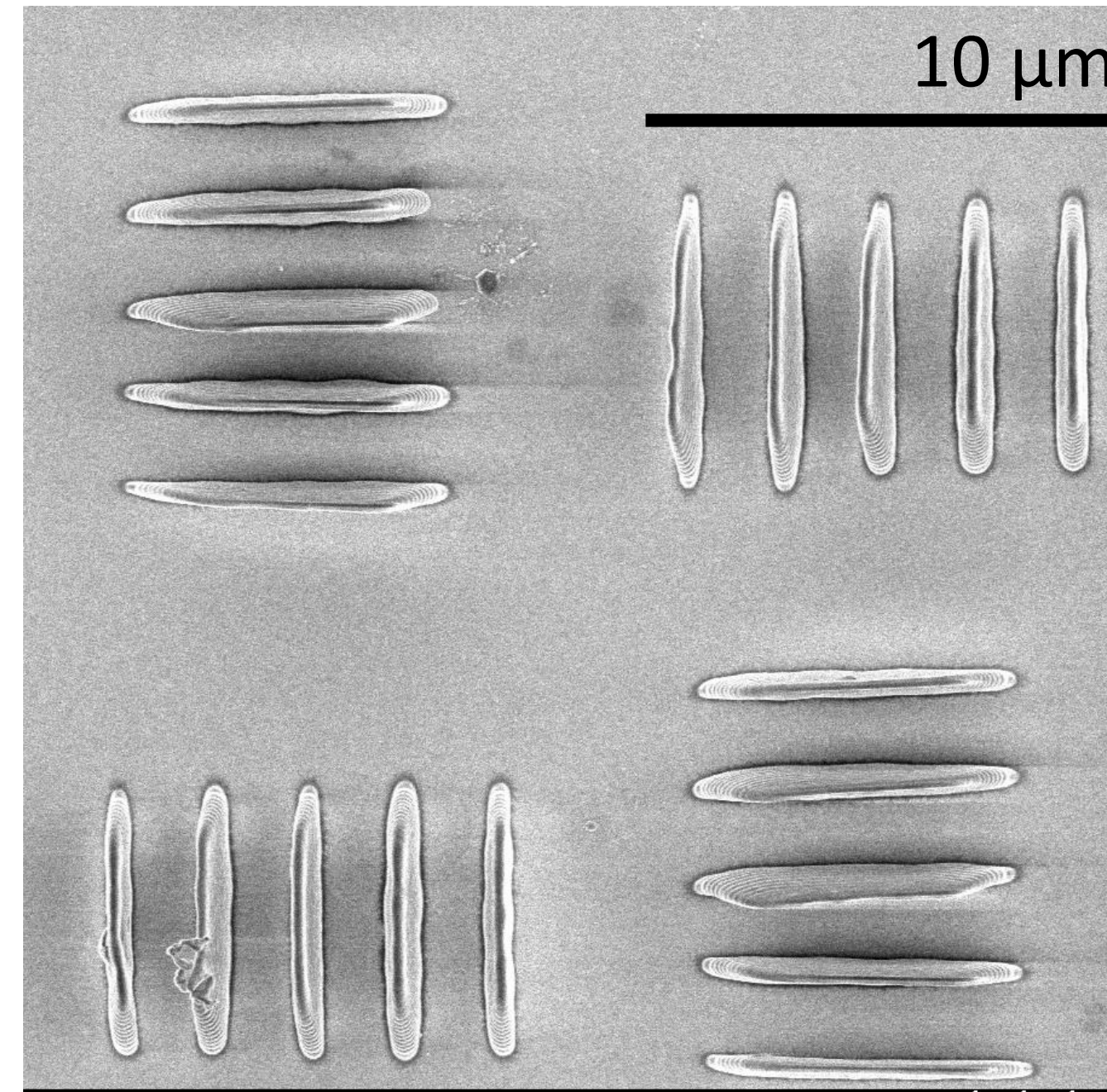
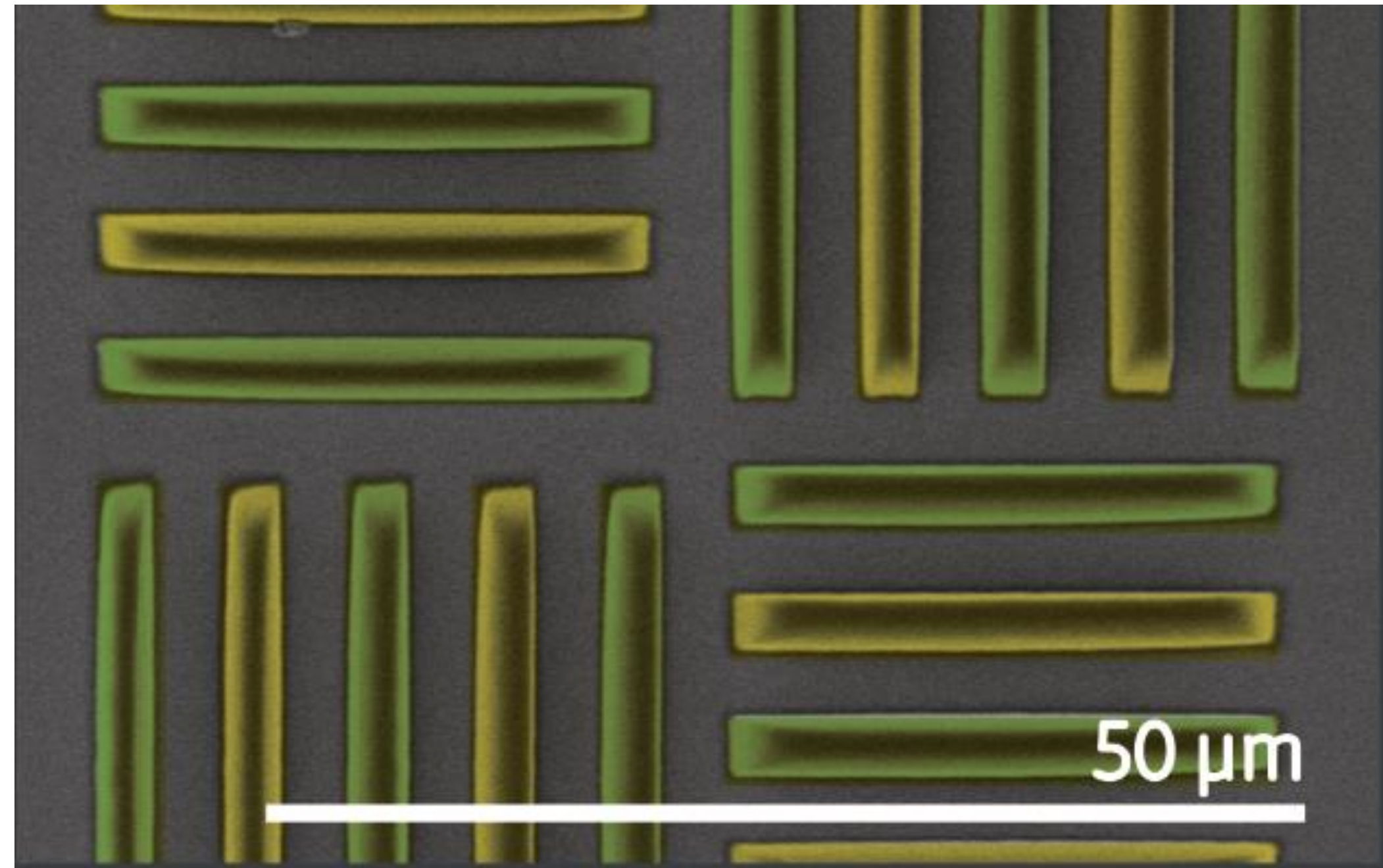
automated and fast material exchange

20x

Perfect placement of smallest structures (~ 100 nm practical)

∞

Substrate independent on active devices till wafer-level



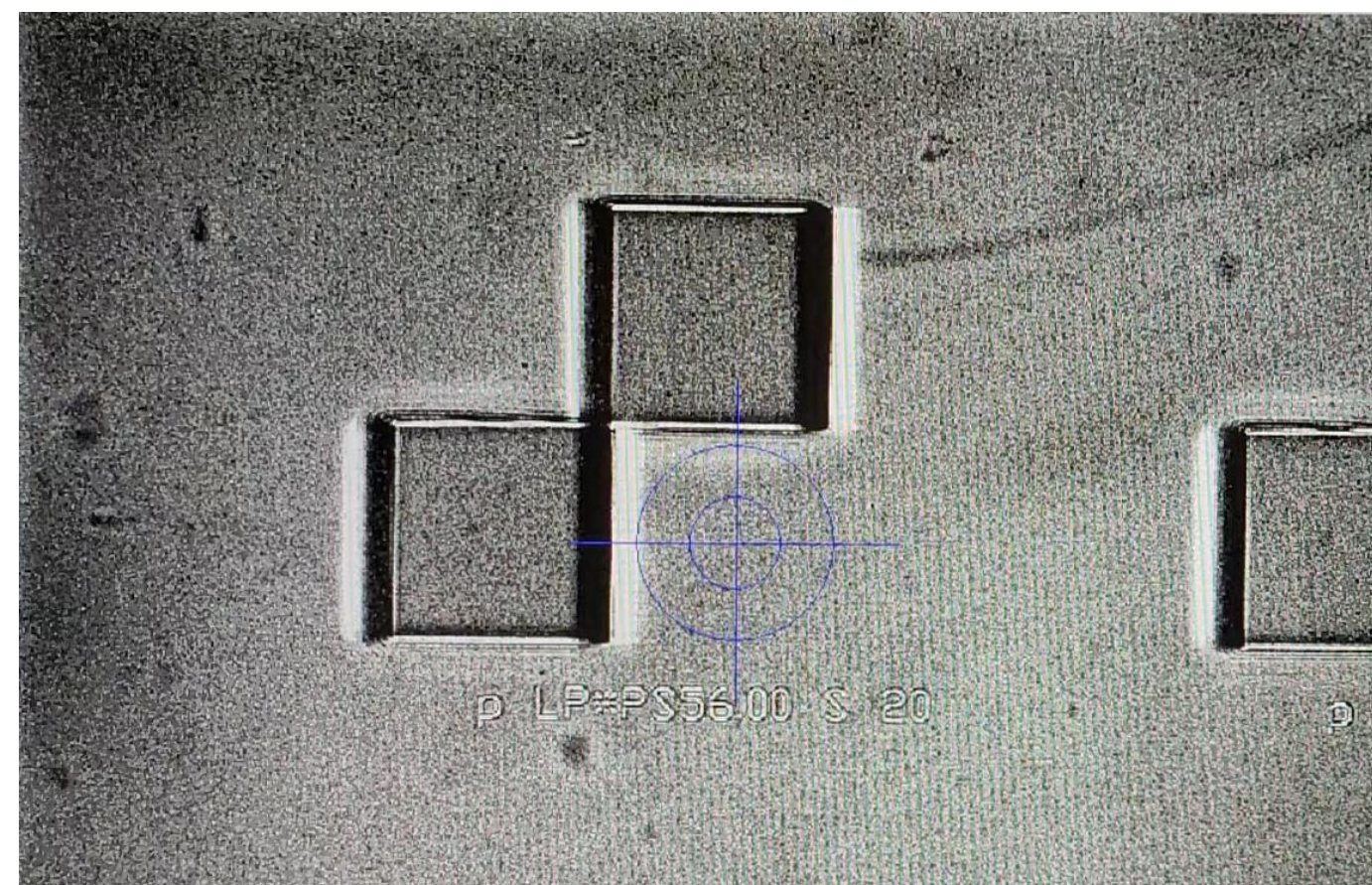
visual marker alignment
about 1000 nm - 1500 nm

only stage movement
about 500 nm - 600 nm

advanced marker alignment
100 nm - 250 nm

in situ exchange
below 50 nm
(5 +/- 28) nm

IPDip to MXpure



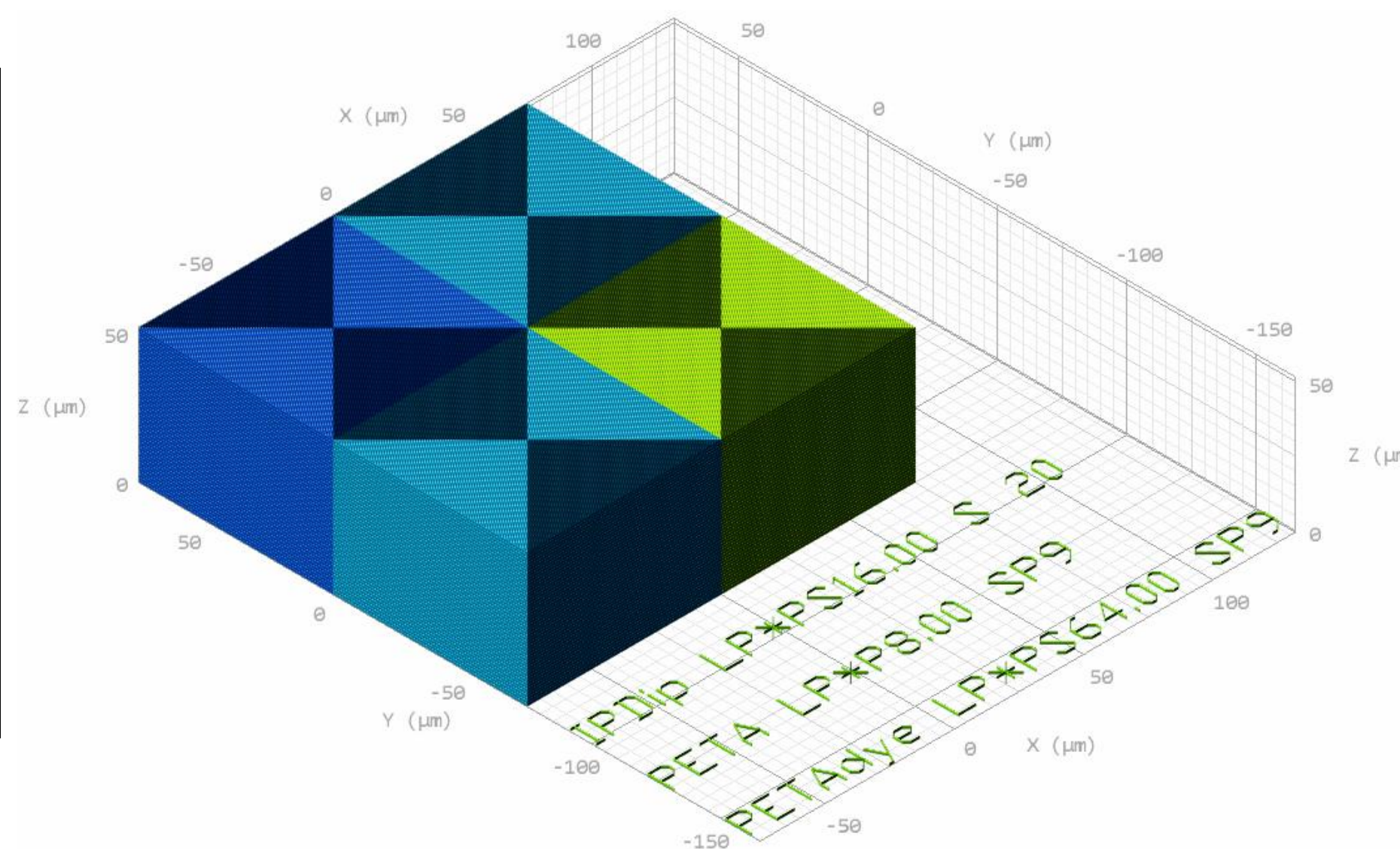
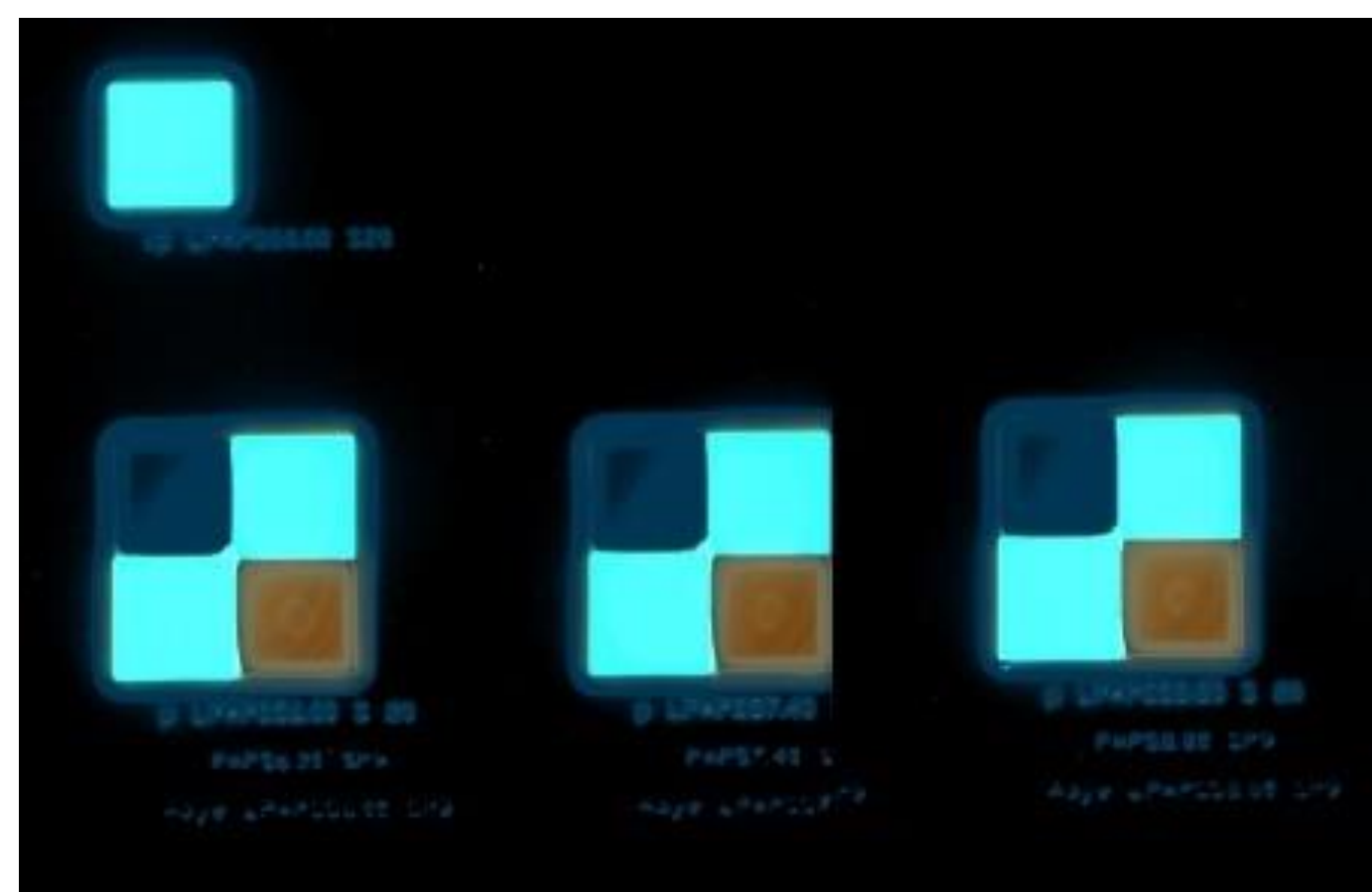
MXpure to MX535



IPS to new material



Fluorescence



Demonstrated materials

homogeneous systems

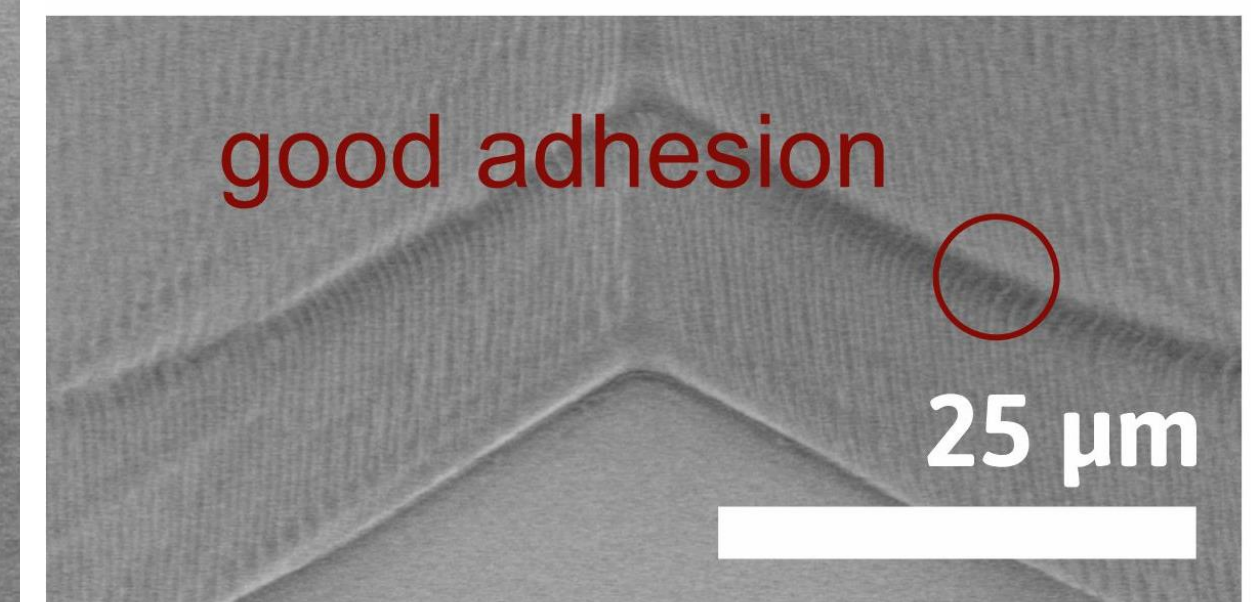
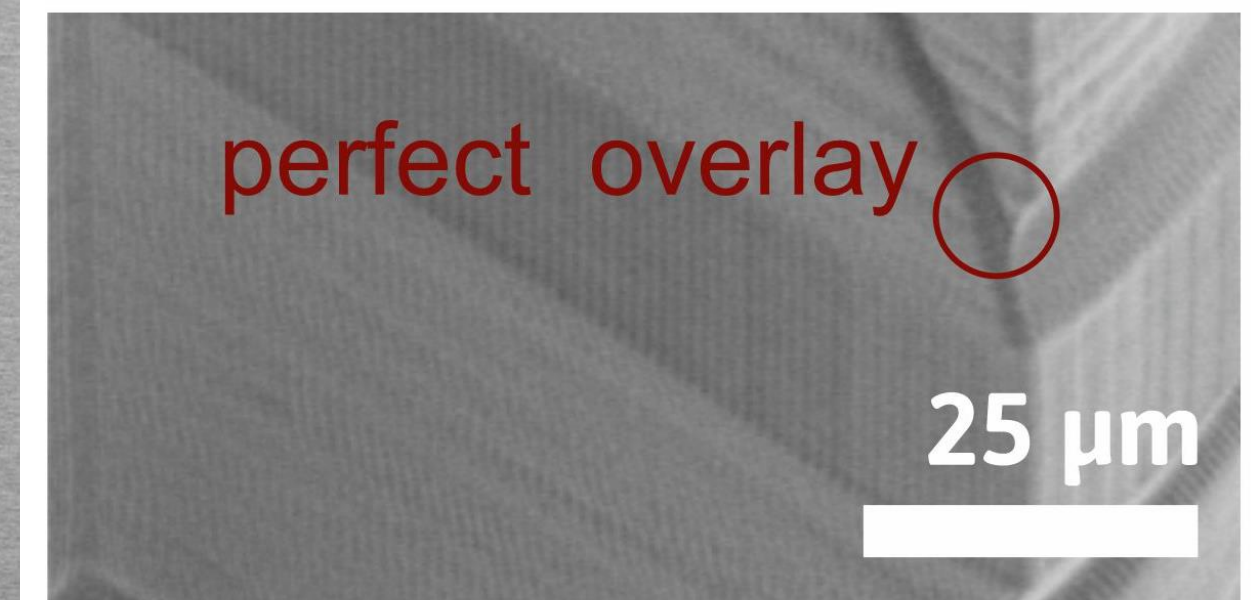
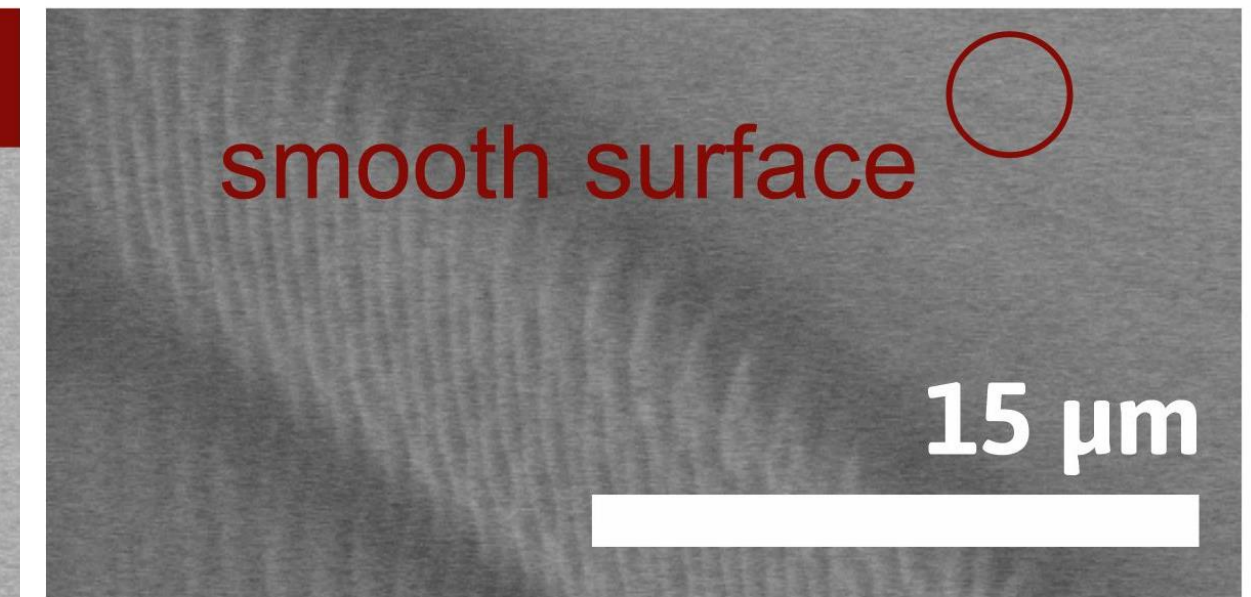
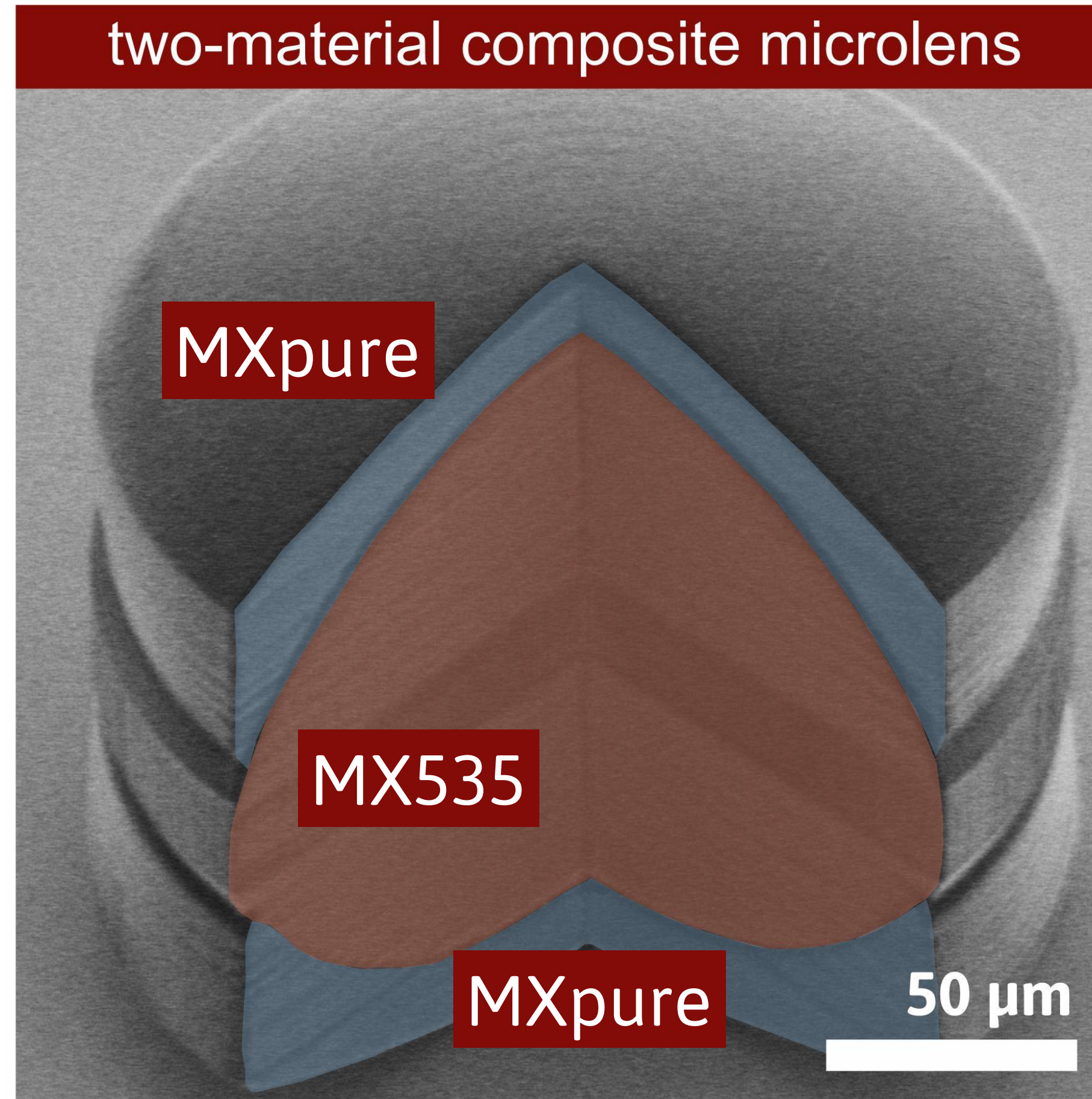
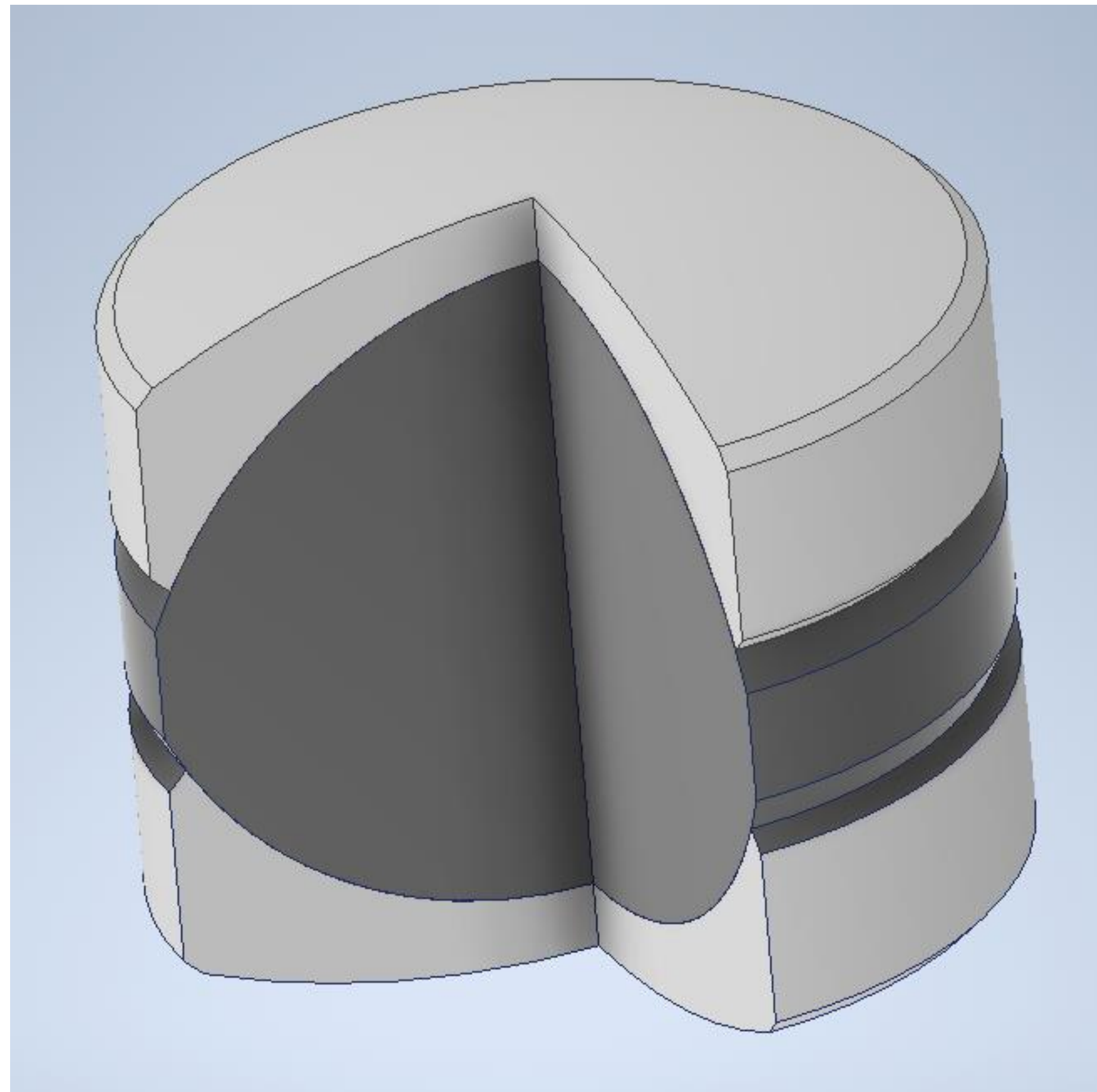
Low viscosity (1-3 Pas)

Medium viscosity (20-30 Pas)

High viscosity (> 30 Pas)

heterogeneous systems

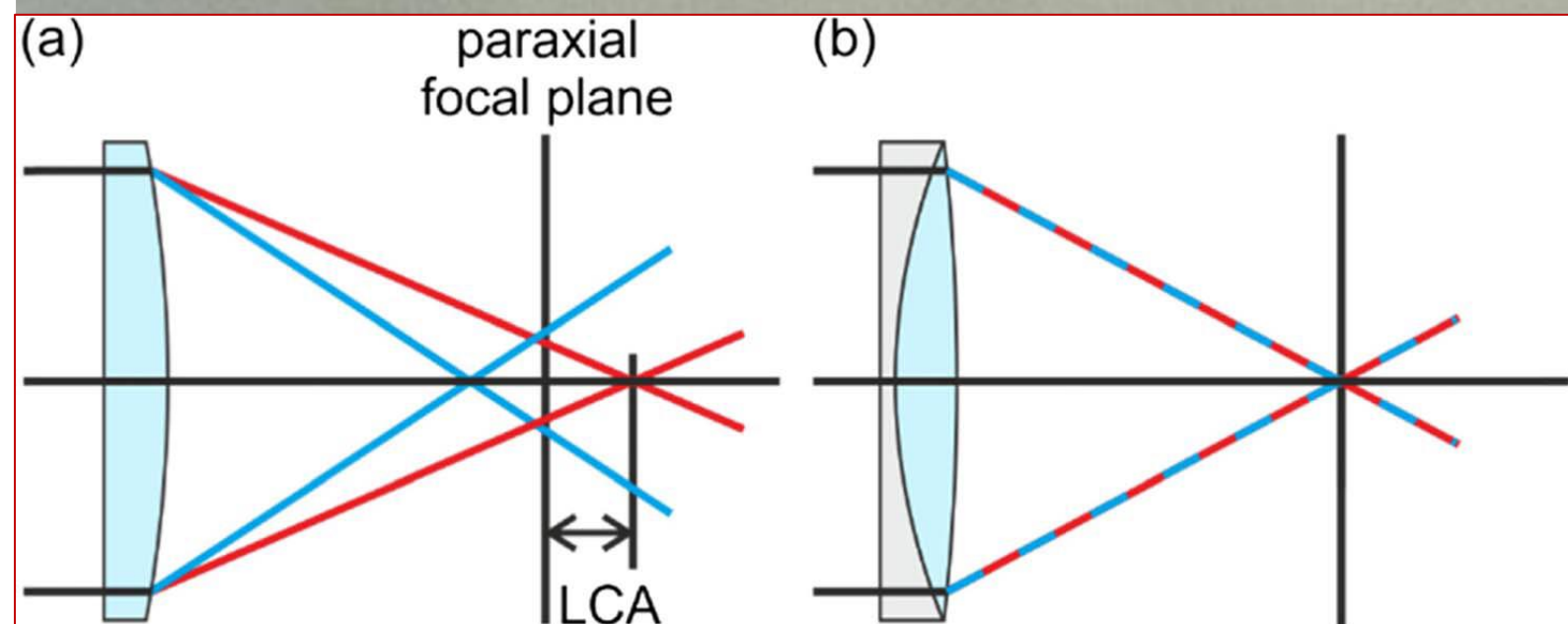
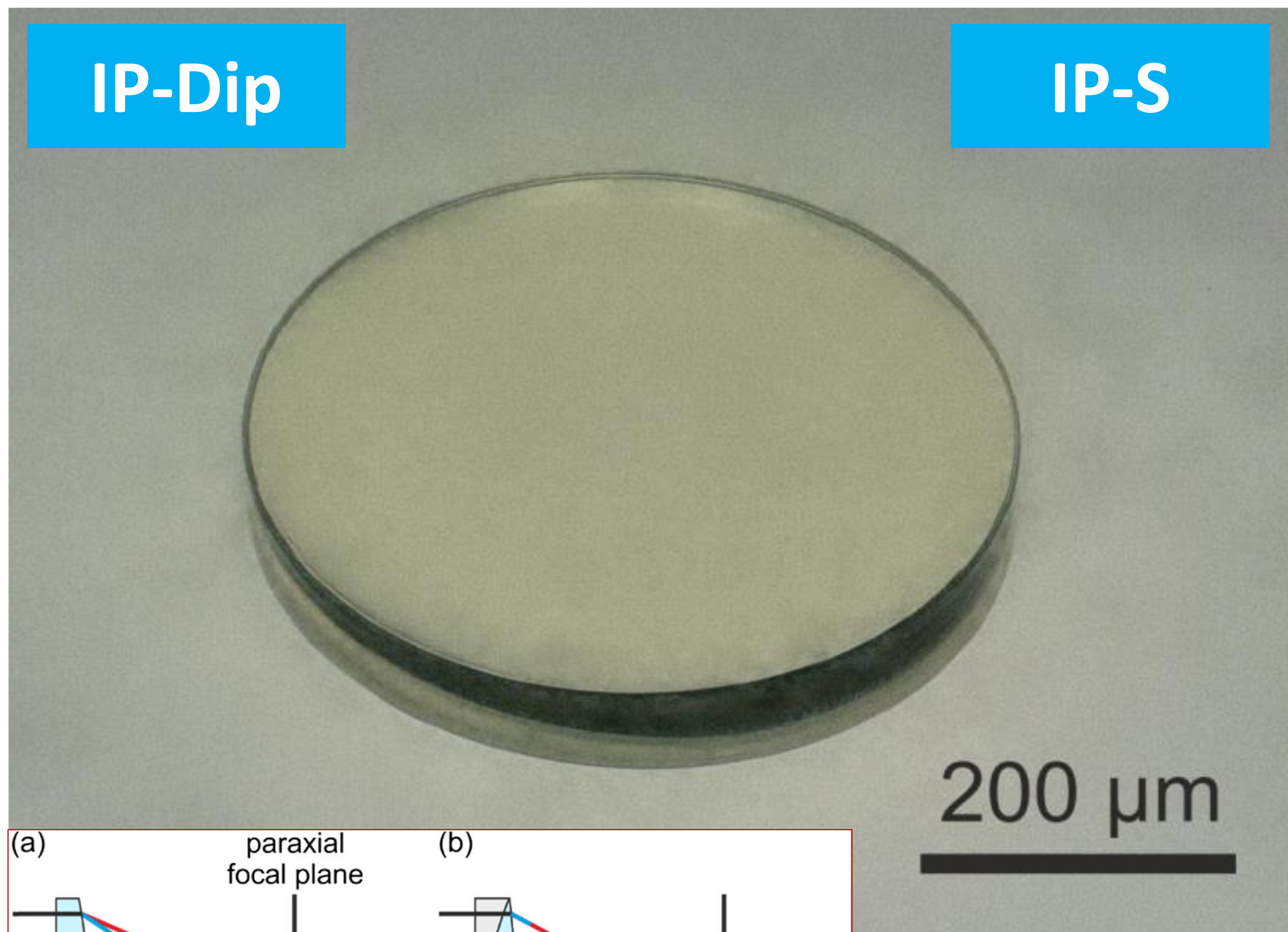
Extreme: < 1 Pas vs. > 20 Pas



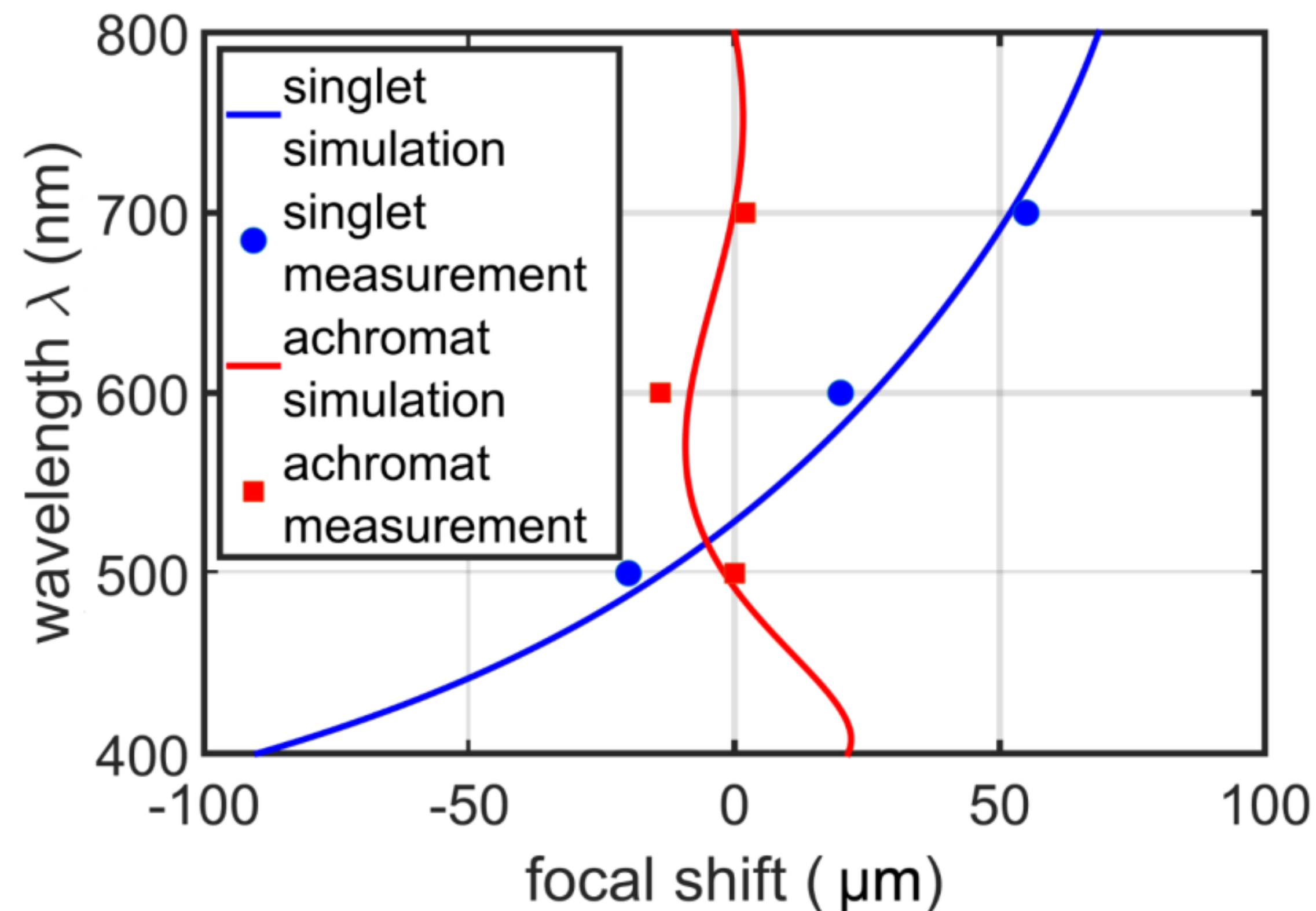
■ MXpure (printed 1st)

■ MX535 (printed 2nd)

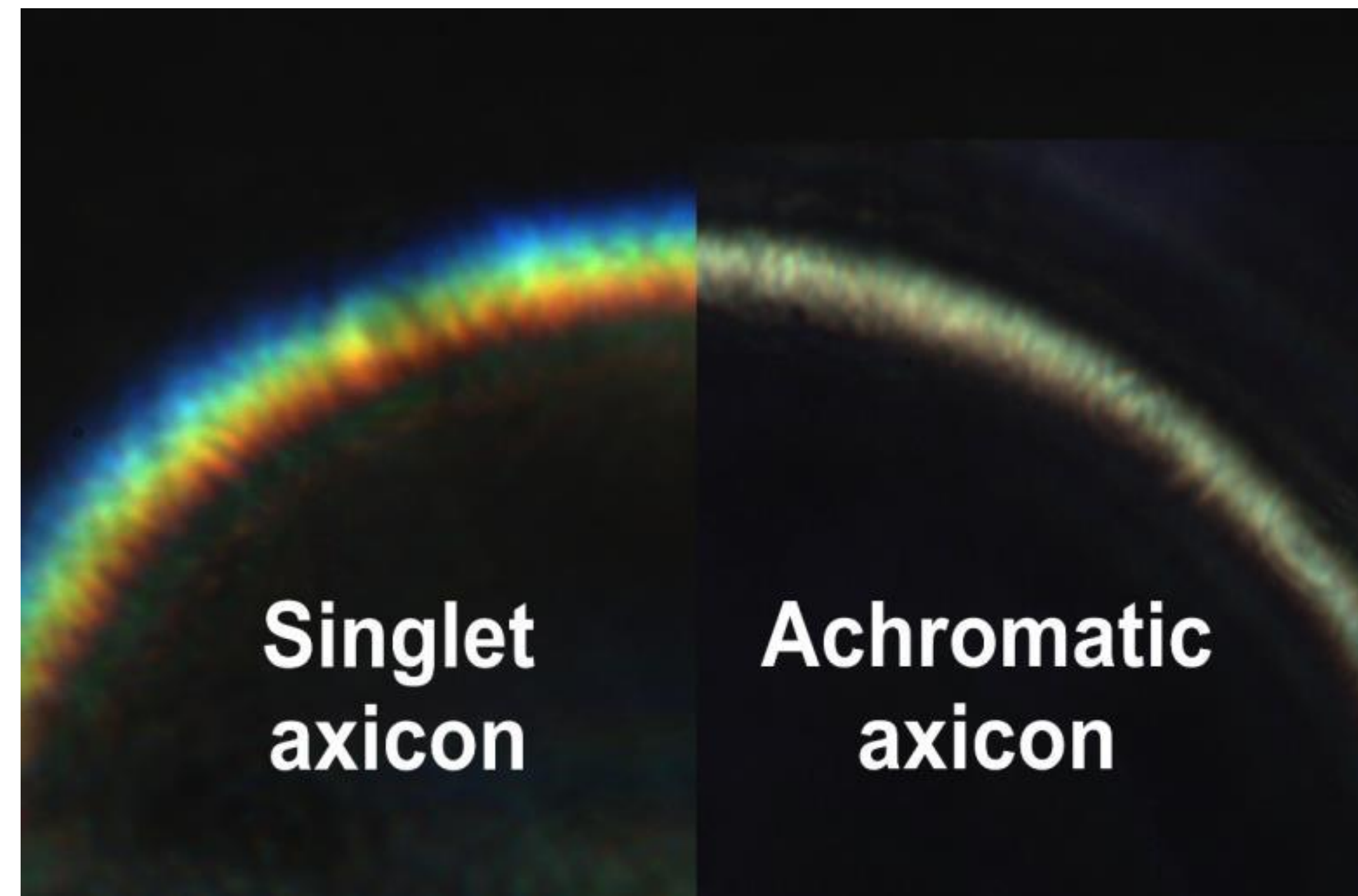
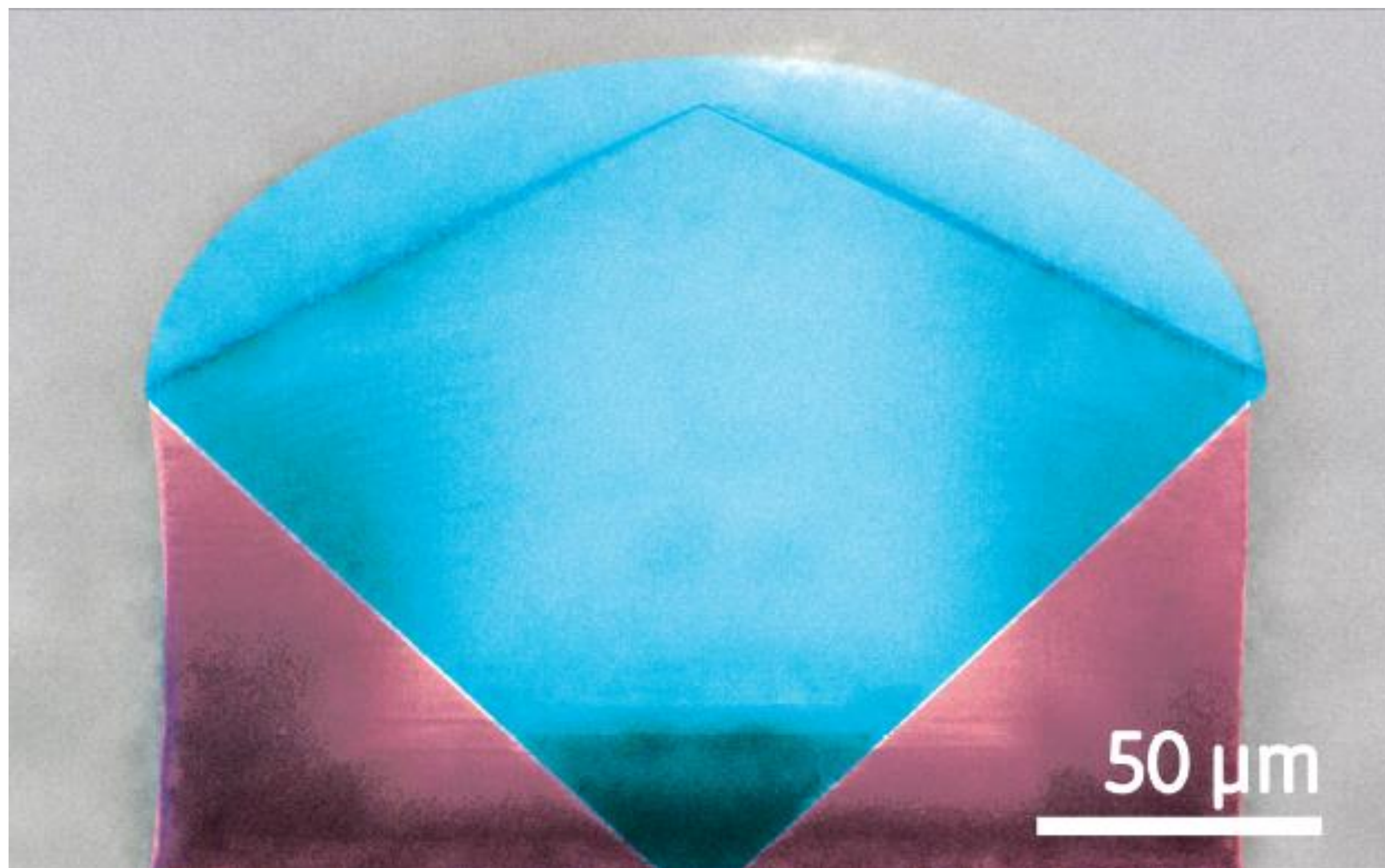
■ MXpure (printed 3rd)



M. Schmid, S. Thiele, A. Herkommer, and H. Giessen, *Opt. Lett.* 43, 5837-5840 (2018)



printed with MergeOne

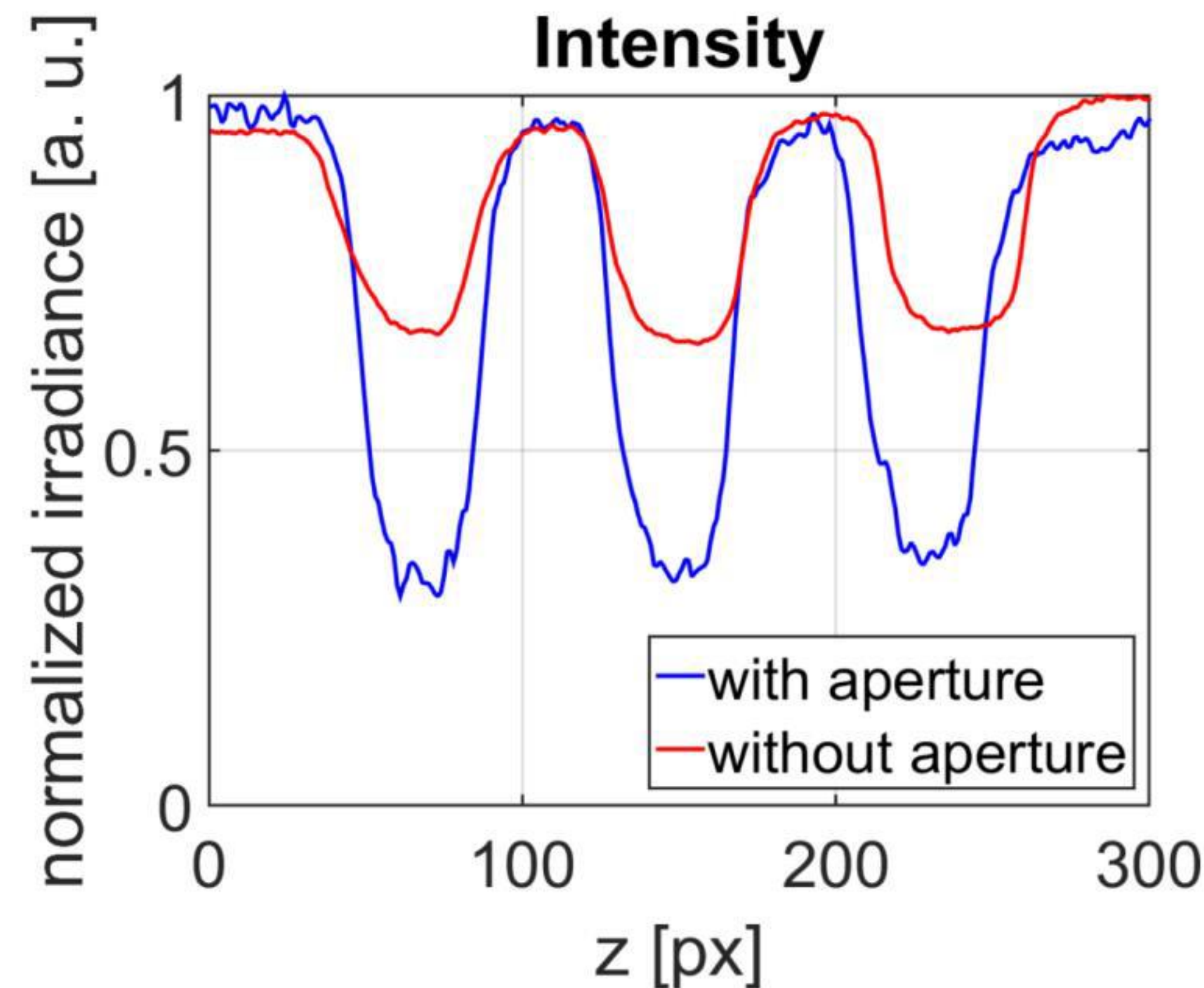
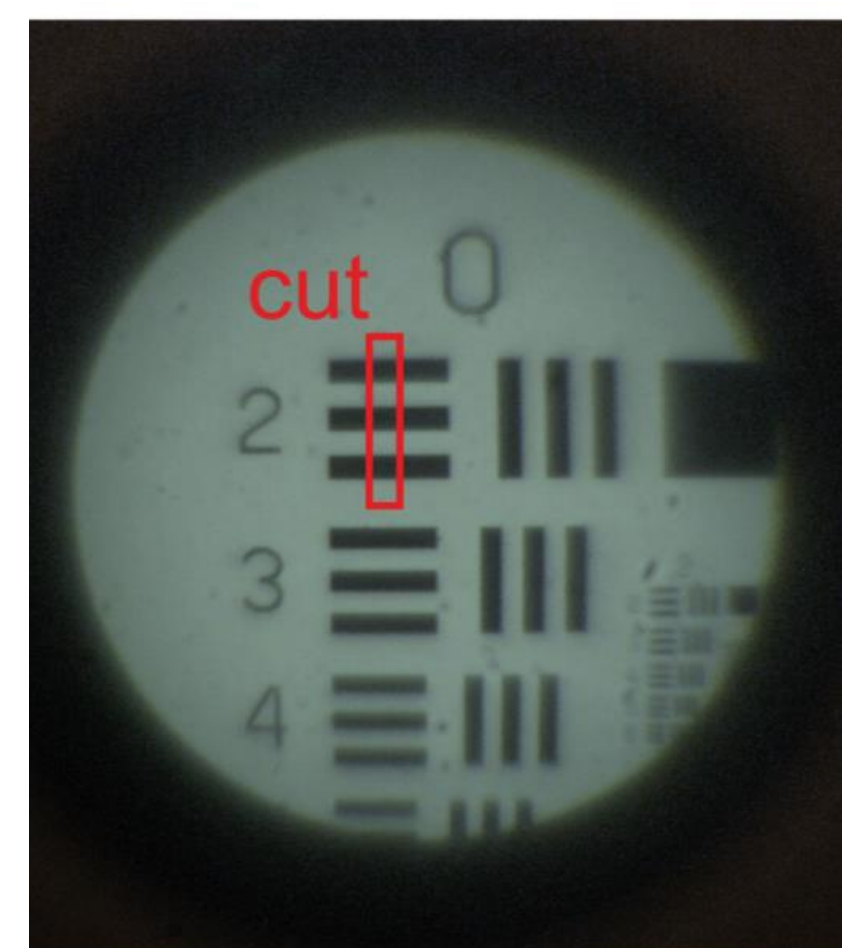
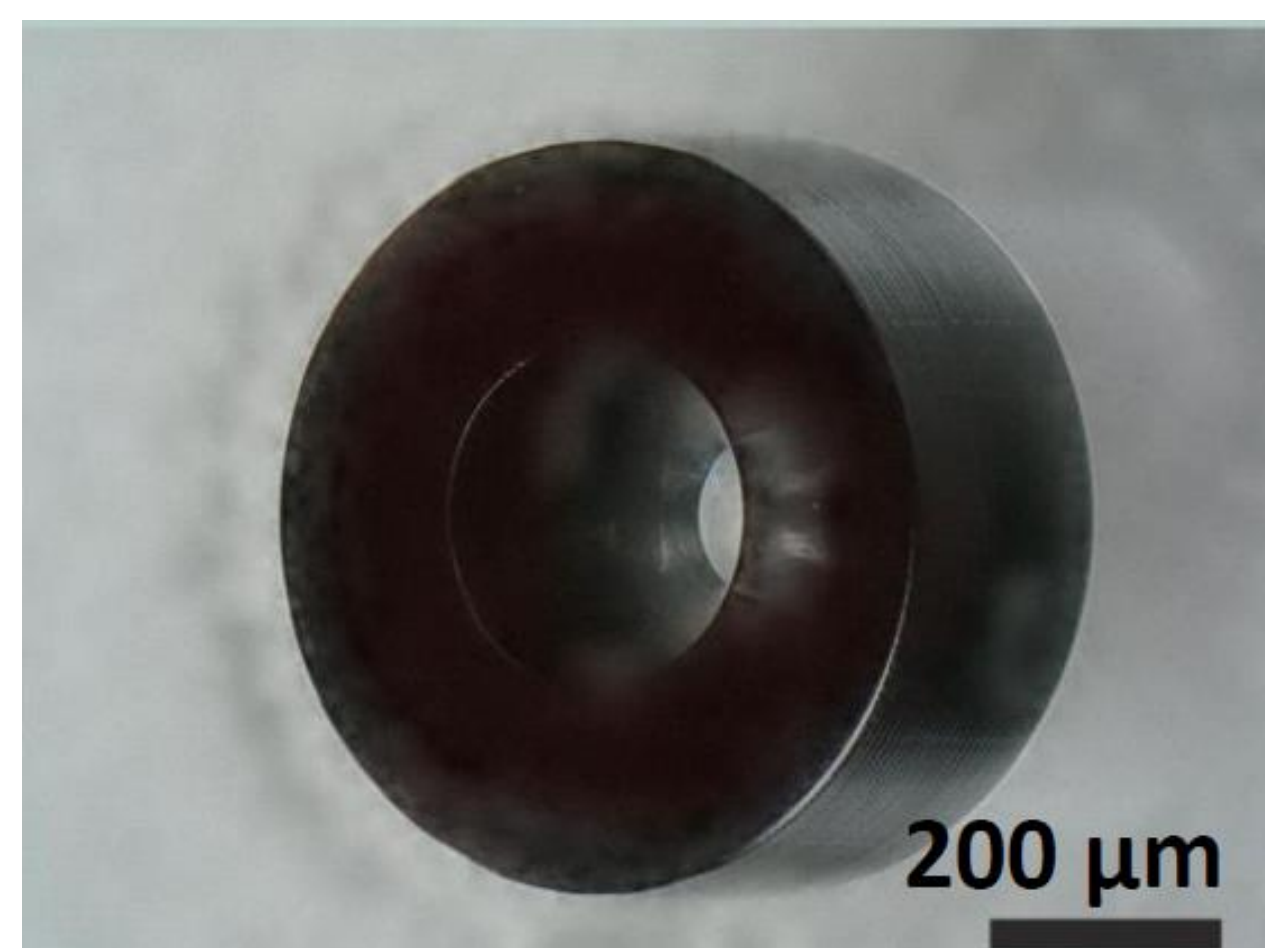
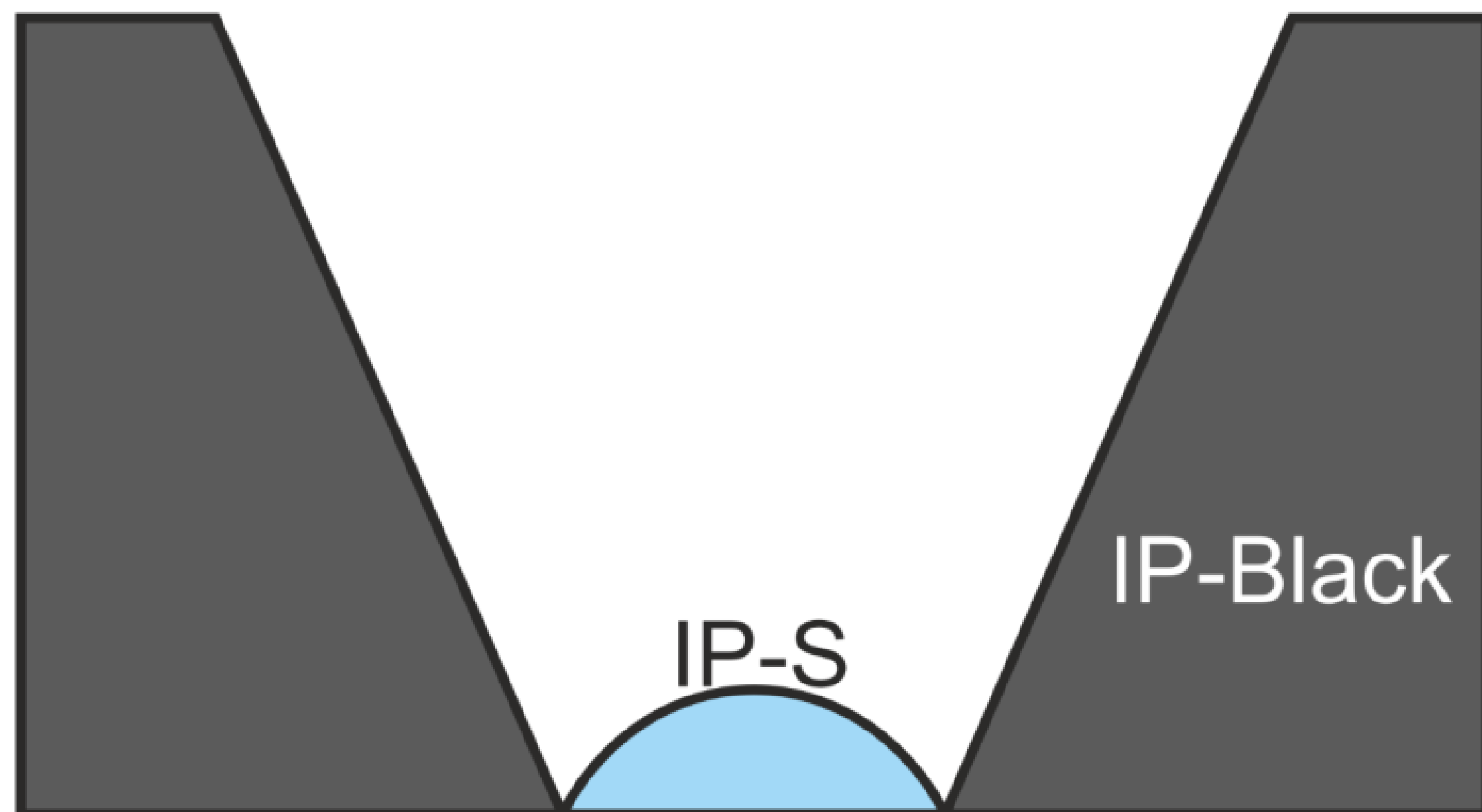


IP-Dip

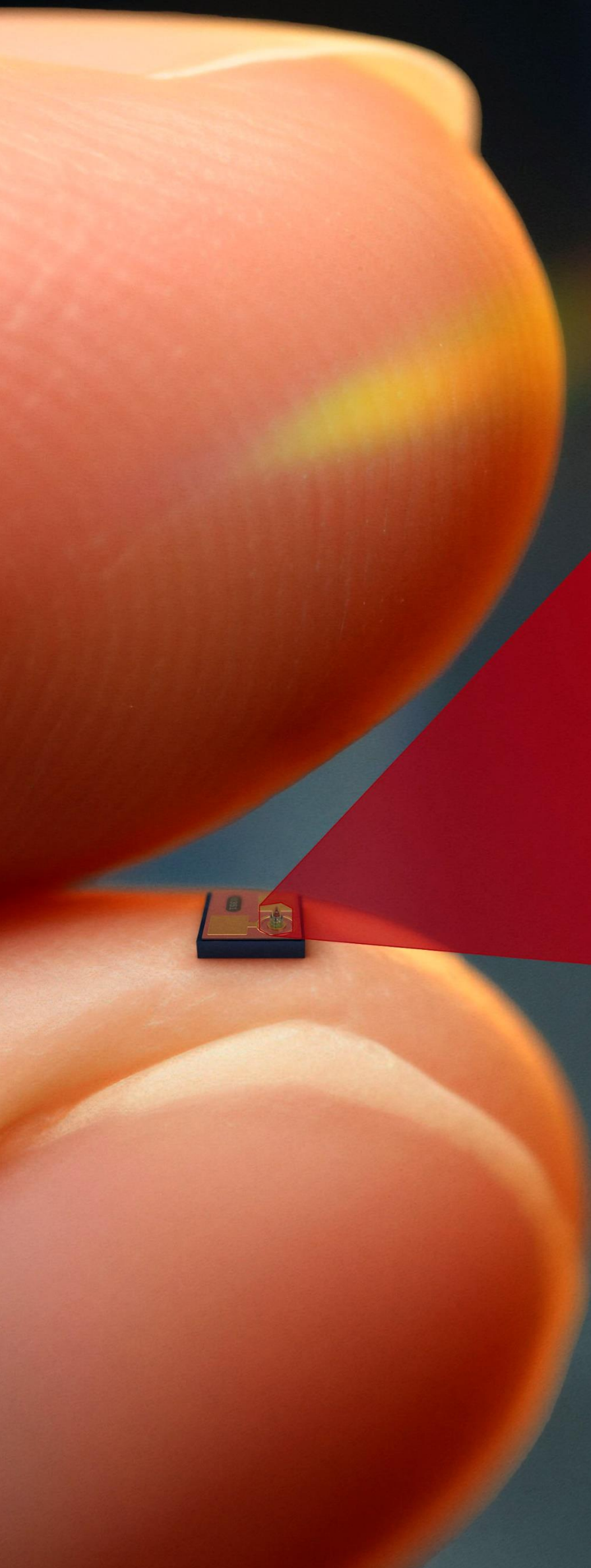
IP-S

printed with MergeOne

University of Stuttgart | 4th Physics Institute | Prof. Harald Giessen



printed with MergeOne



HETEROMERGE GmbH

Gostritzer Straße 61
01217 Dresden

Tel.: +49 351 463 43966
info@heteromerge.com

WWW.HETEROMERGE.COM