



Additive manufacturing for the production of microoptics

Michael Thiel, Co-founder of Nanoscribe

Neuchâtel, 8th of October, 2019



Who is Nanoscribe?

Facts & Figures

Nanoscribe at a glance



The **NANOSCRIBE Group** is an international leader in the field of additive 3D microfabrication and maskless lithography. The company operates subsidiaries in the US and in China and is headquartered near Karlsruhe, Germany. Distributors are established in more than 10 countries.

Nanoscribe GmbH is privately owned and is partner company with ZEISS. The Group's products and services set standards in microfabrication since its **foundation in 2007**.

Products

- ▶ Microfabrication systems
- ▶ Resins & consumables
- ▶ Processes
- ▶ Software
- ▶ Technical consulting & services

Markets

- ▶ Industrial Microfabrication
- ▶ Scientific Instruments
- ▶ Micro-Optics
- ▶ Advanced Optical Packaging
- ▶ Wafer Level Optics
- ▶ Life Sciences



Recent Awards & Perception by the Media



LASER Innovation Award, 2019

First price among 1,300 exhibitors with 5,000 EUR

Landespreis für junge Unternehmen, 2018

First price, endowed with 40,000 EUR

DPG Technology Transfer Award, 2017/18

Transfer scientific research to commercial product

CTO of the year Europe, 2016

Category SME

World Technology Award, 2015

Category *Materials*, Jury: 3 Nobel prize laureates

Deutscher Gründerpreis, 2015

Finalist of the highest ranked entrepreneur award

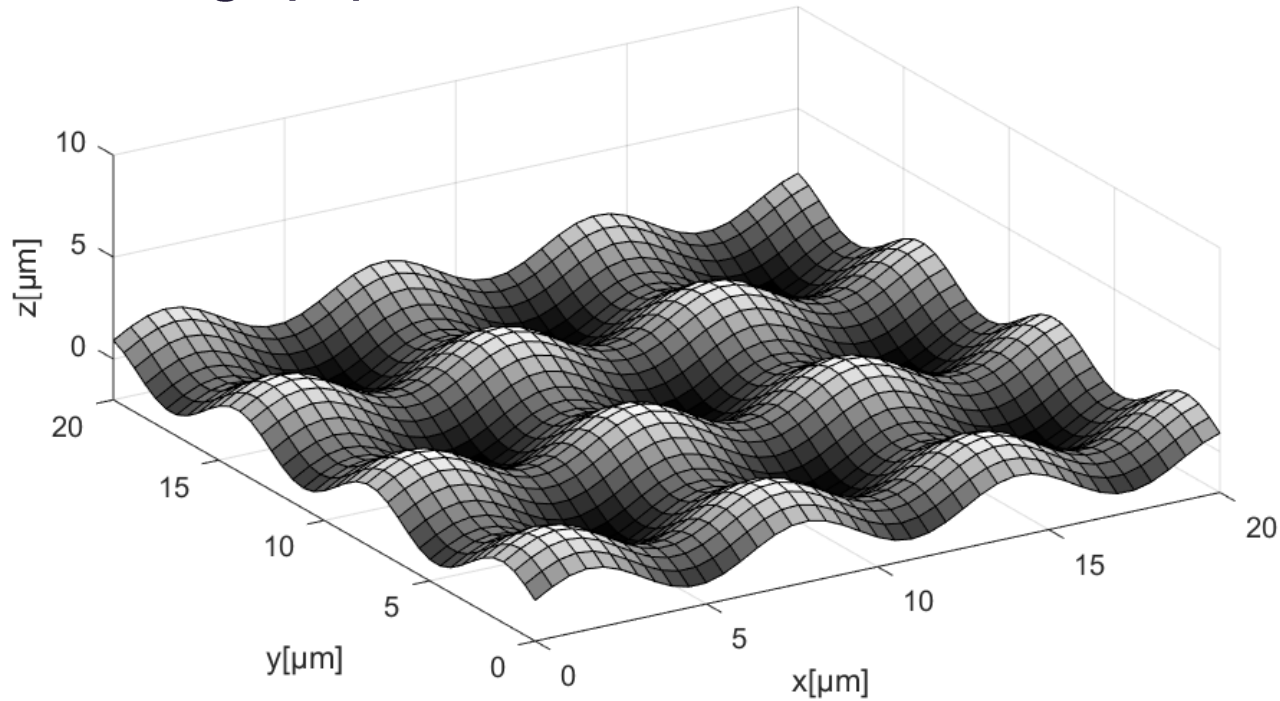




Nanoscribe's 2PP Technology

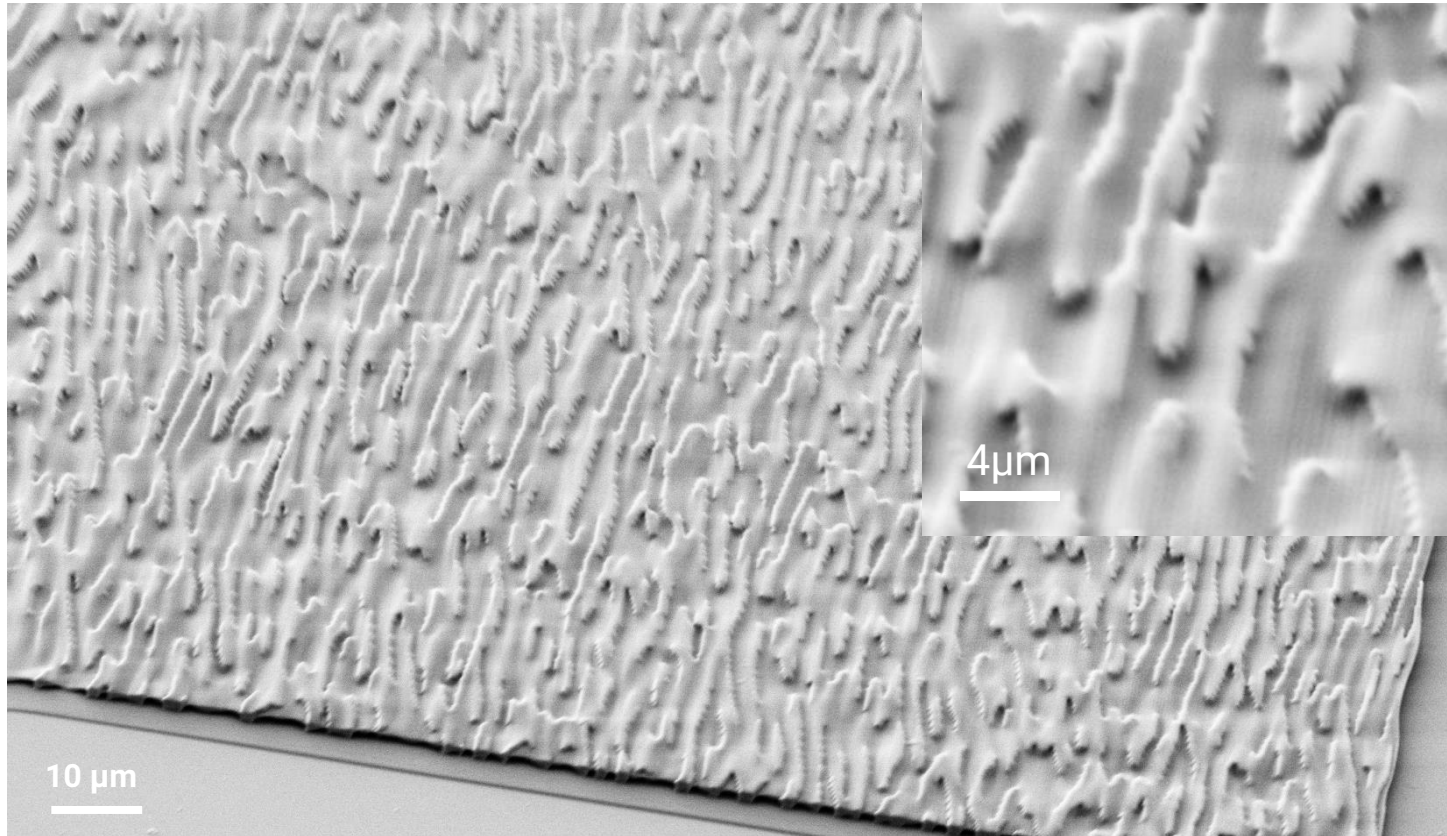
Changing the way refractive and diffractive microoptics are made

Grayscale Lithography

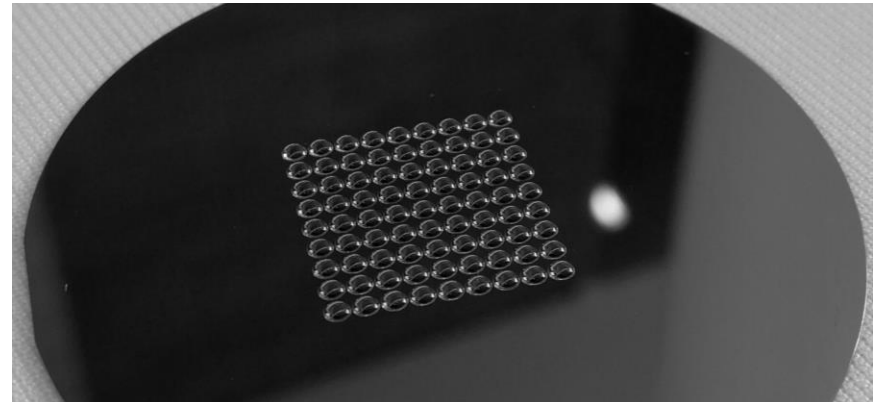
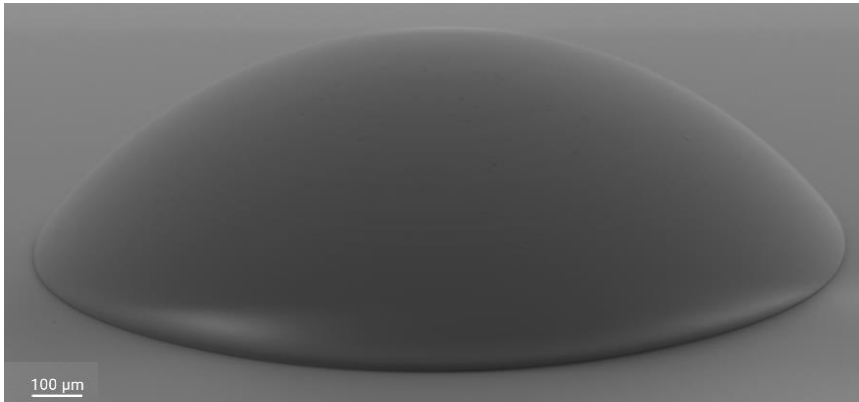
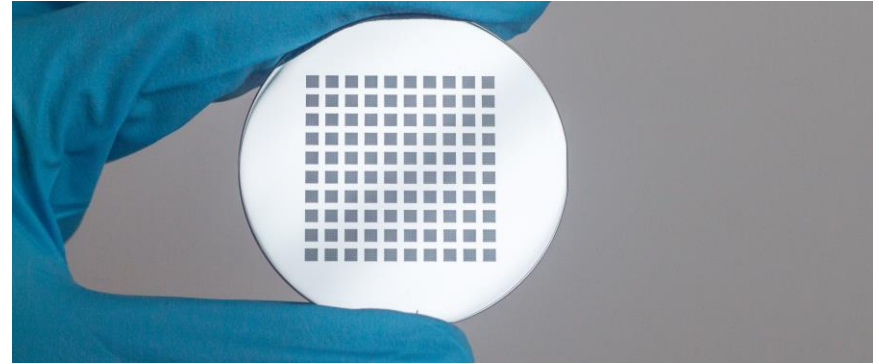
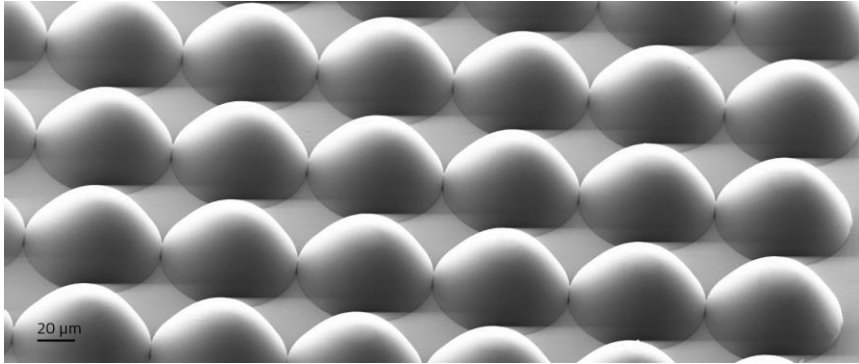


Modulated dose pattern is transferred into topography after development

Quasi-continuous DOE (4096 levels in 1 step)



Microoptics



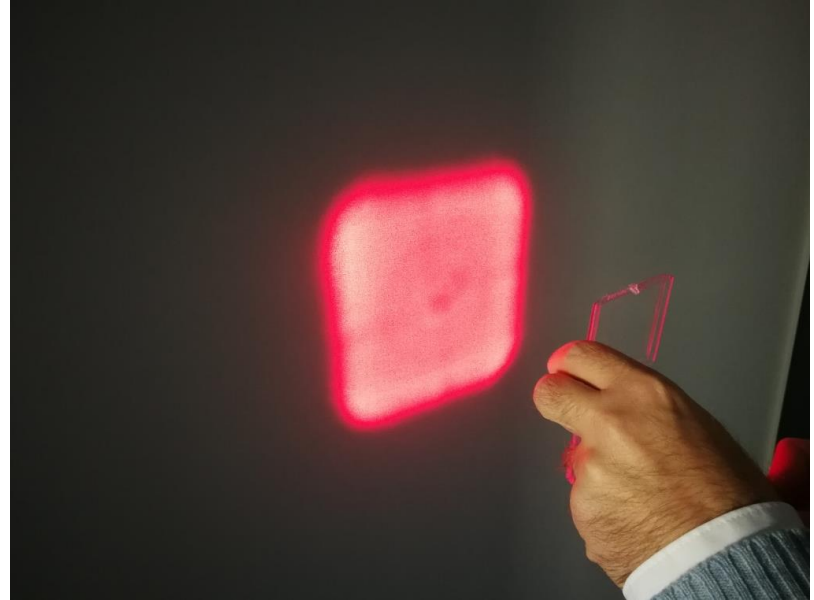
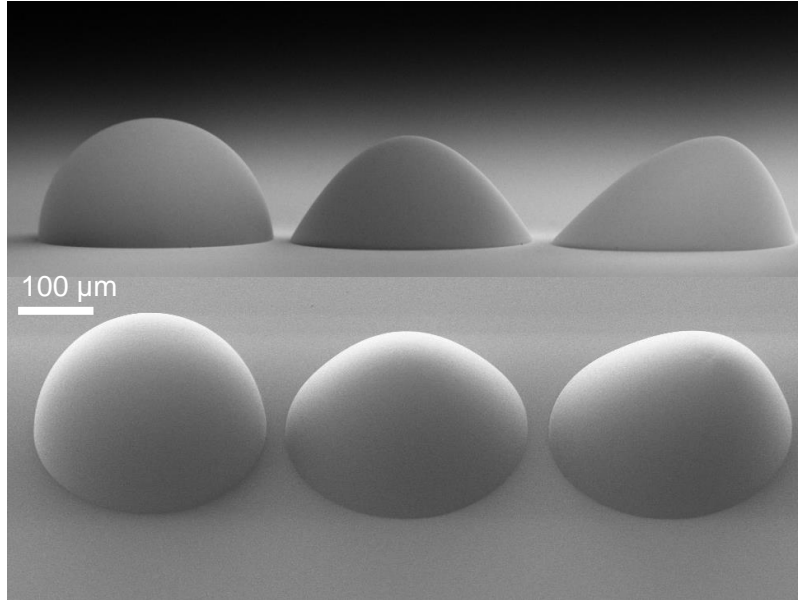


Additive manufacturing for the production of microoptics

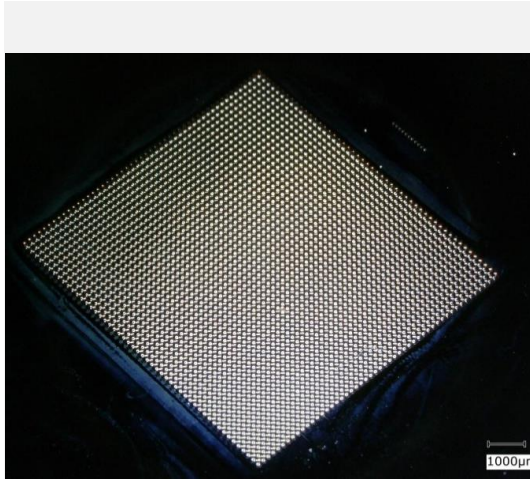


Example:
Microlenses &
UV-Molding /
Nanoimprint

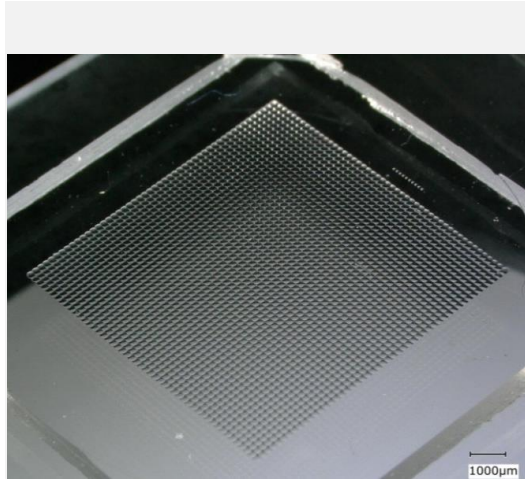
Additive manufacturing



Replication via UV Molding



1 cm² microlens polymer master



Silicone rubber (soft) stamp



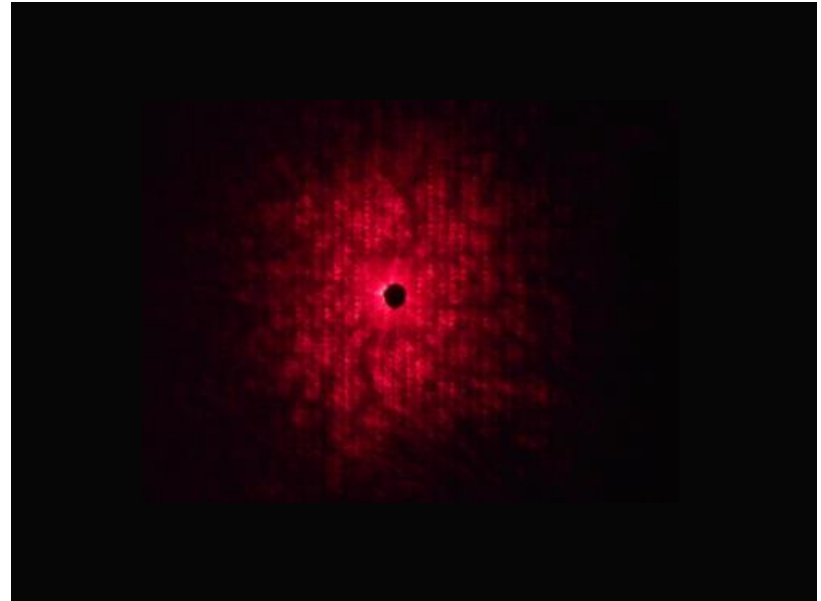
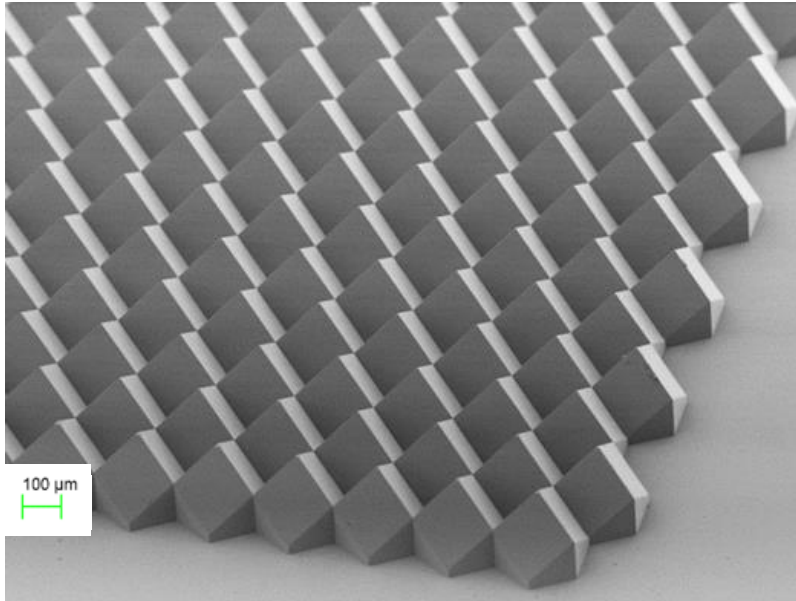
UV-molded part



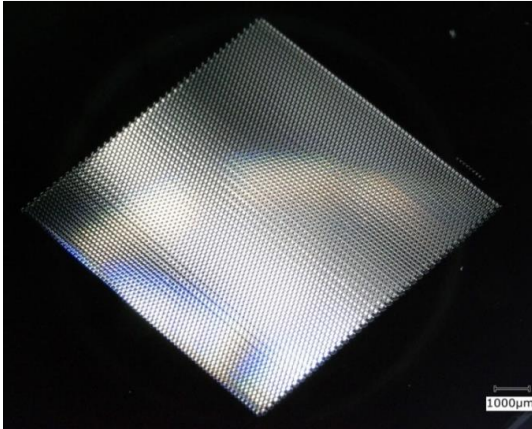
Example: Cornercube-Reflector / Lens Arrays & Injection-Molding

Injection molding technology reference:
V. Saile et al., Wiley-VCH, DOI 10.1002/9783527622573 (2009)

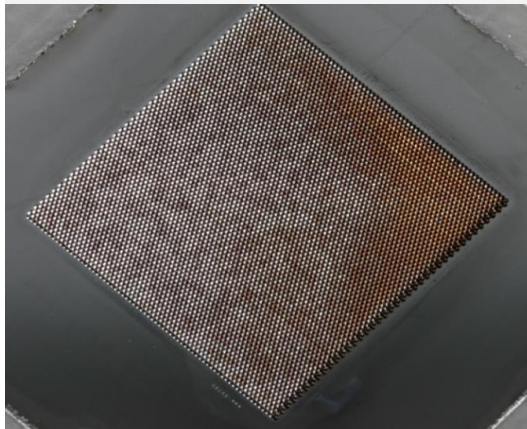
Additive manufacturing



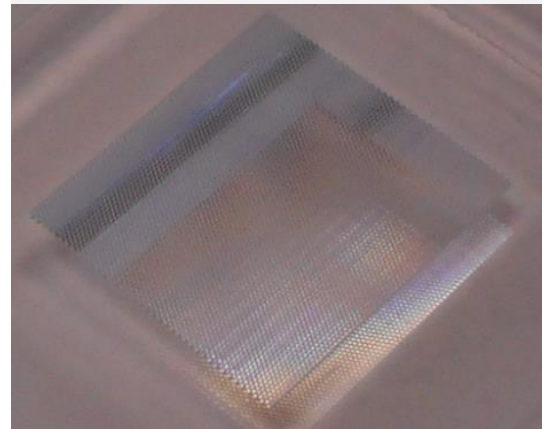
Replication via Injection-Molding



1 cm² retro-reflector polymer master



Ni-shim



Injection molded PMMA part

Replication via Injection-Molding

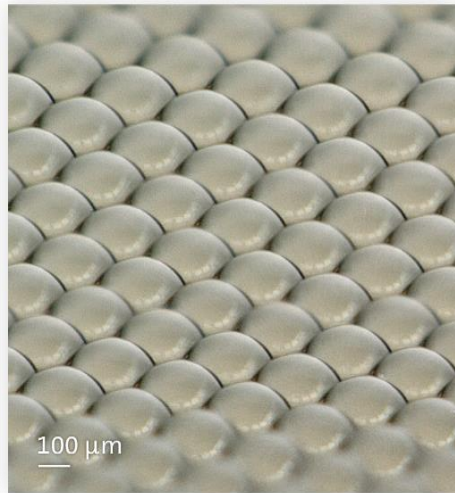


3D Printing

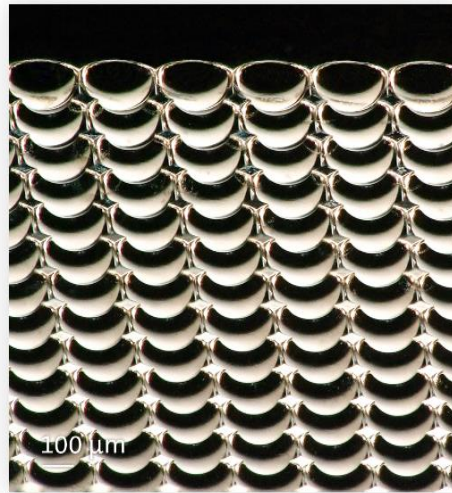
Electroforming

Injection Molding

Microlens Array (MLA)

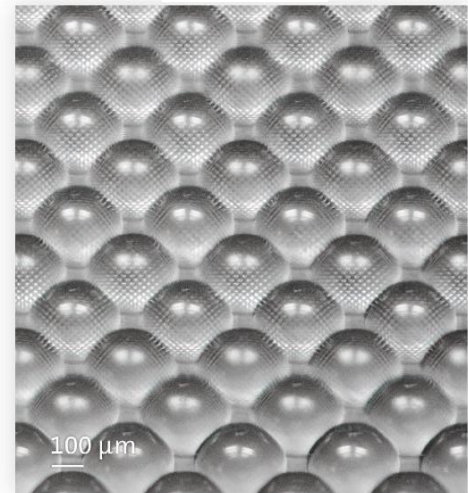


3D Printed
Polymer Master



Nickel Shim

References: **YNG** OPTICS  **MOVEON**
Empowering Light ...



MLA Replica

Complete ecosystem for grayscale lithography



The new
Quantum X



World's first Two-Photon Grayscale
Lithography system

Systems



Resins &
consumables



Processes



Software



Technical consulting &
services







Conclusions & Outlook



In December 2019 the new **ZEISS Innovation Hub** will become our headquarters with modern facilities and more than 4,300 m² space to further develop microfabrication solutions.



Thank you for your attention!

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