nano scribe
A BICO COMPANY

Think big.
Print nano.

双光子对准光刻及其在光电子封装中的应用

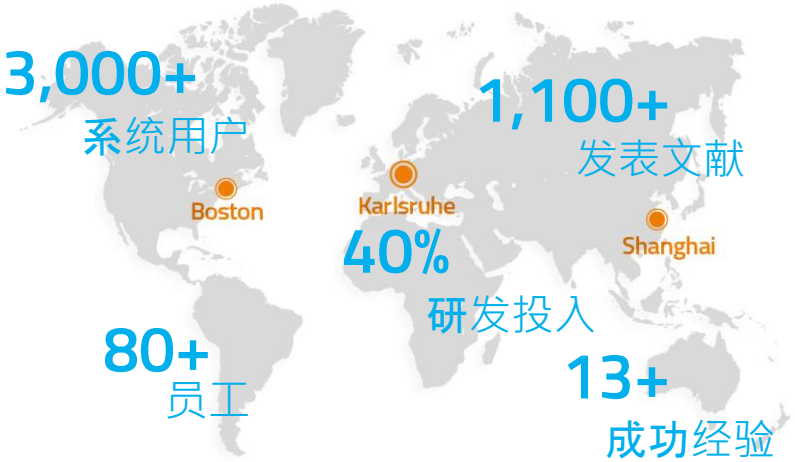
Nanoscribe GmbH & Co. KG
崔万银

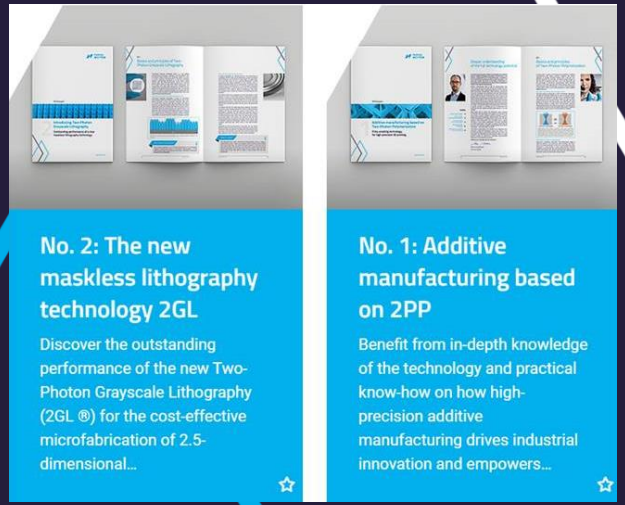
Sept. 8th, 2021

EPIC TechWatch at CIOE

on Optical Components, Materials and Innovative Applications

Nanoscribe 简介





技术内核

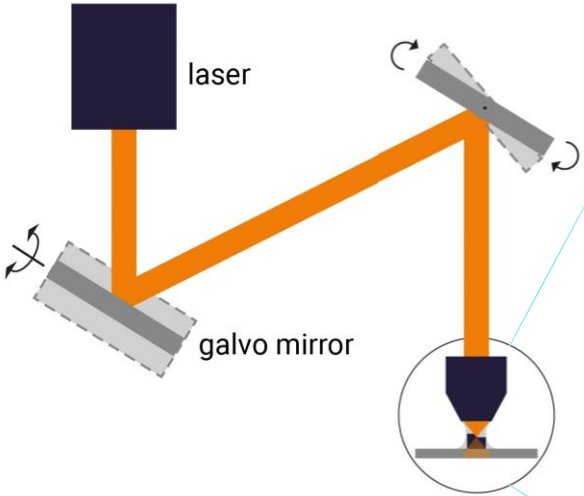
白皮书下载

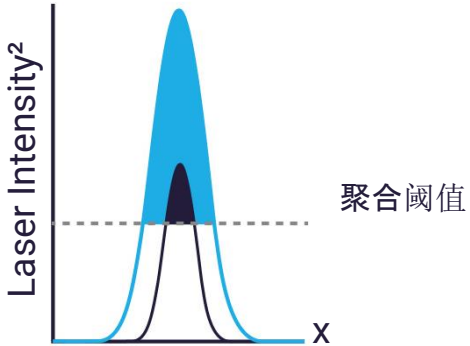
双光子聚合光刻(2PP)

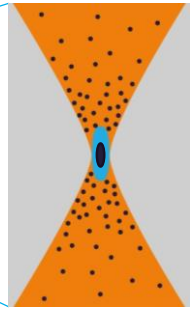
双光子灰度光刻(2GL®)

基本原理

双光子聚合光刻 &
双光子灰度光刻 (2GL®)

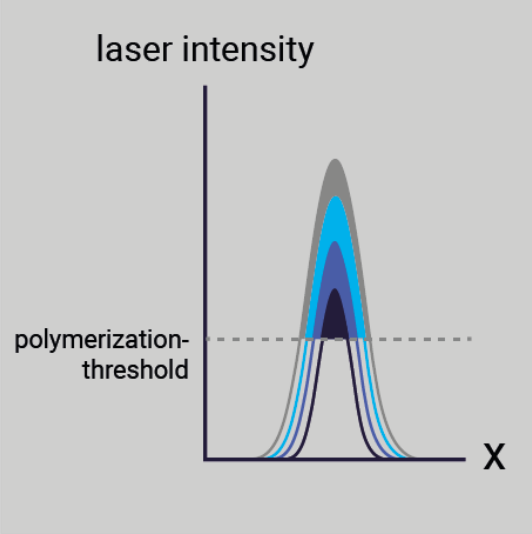


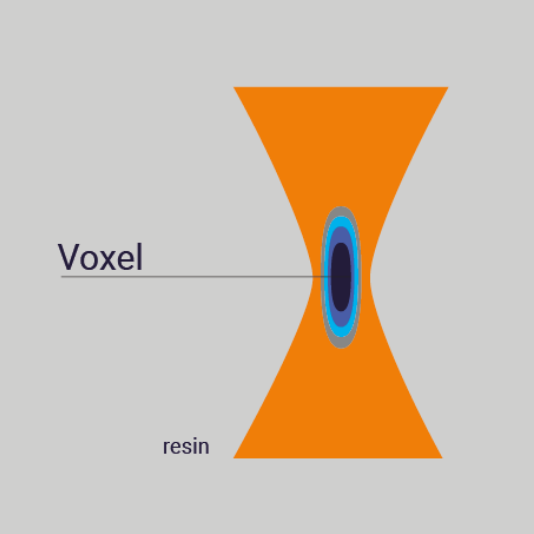


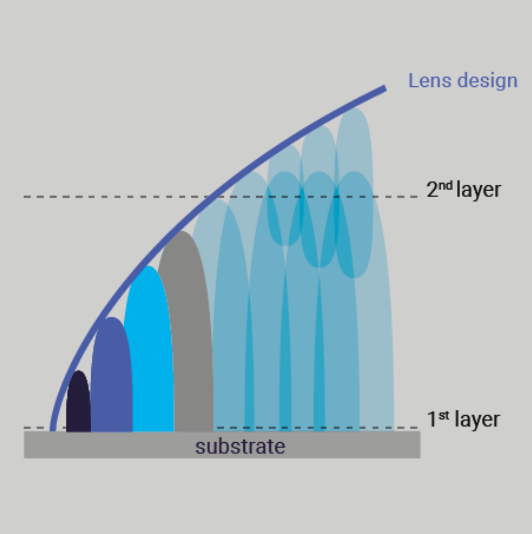


自适应光斑

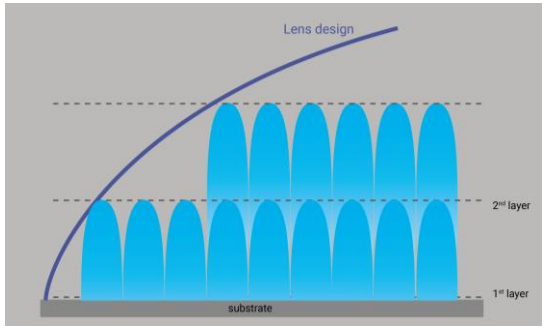
自适应光斑

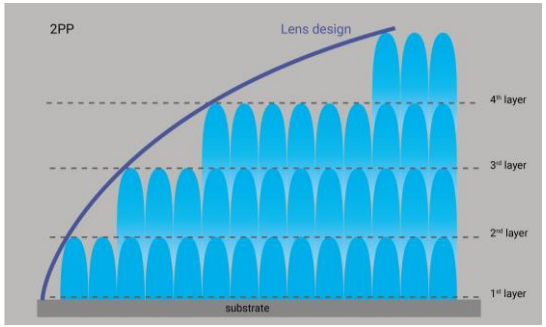

laser intensity
polymerization-
threshold
X

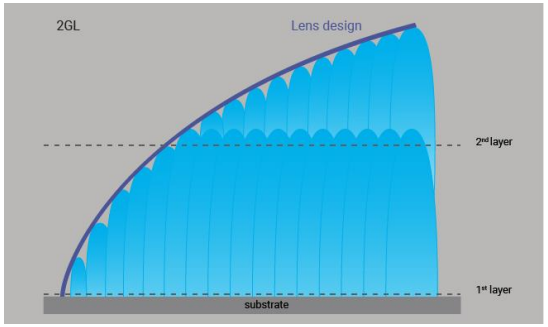

Voxel
resin

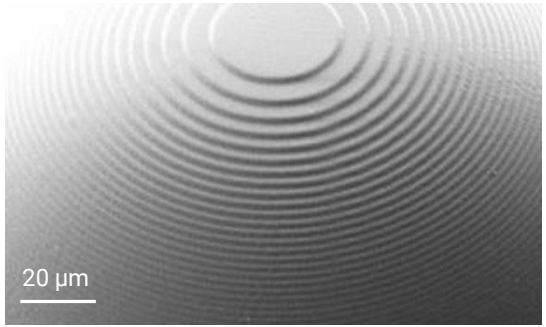

Lens design
2nd layer
1st layer
substrate

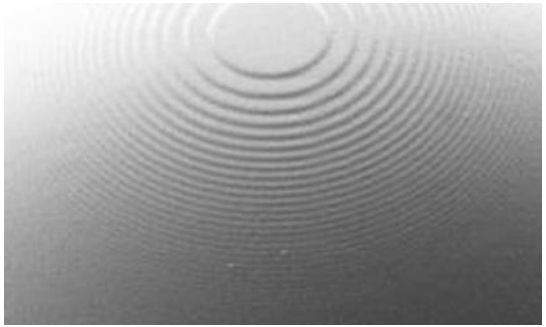
高精度3D打印的挑战
阶梯形貌 vs. 打印速度

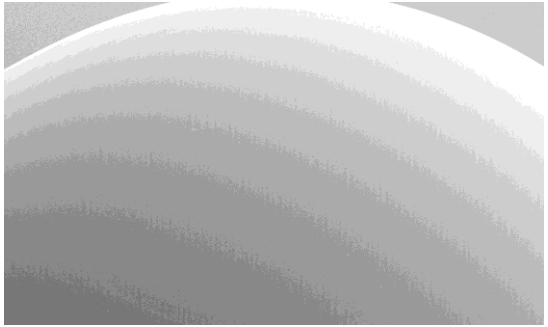








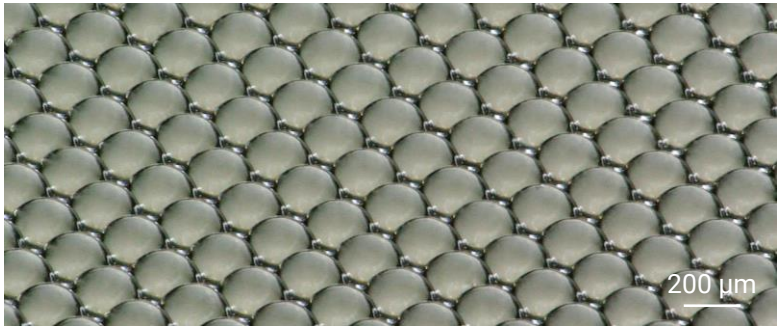


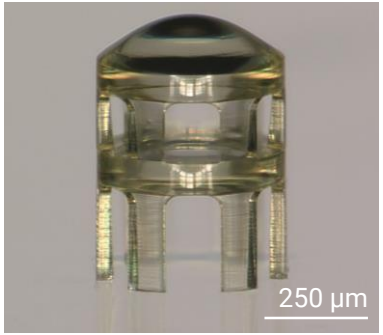


微纳光学模具的制备

Best in class microoptical devices
increasing performance

3D打印微光学器件

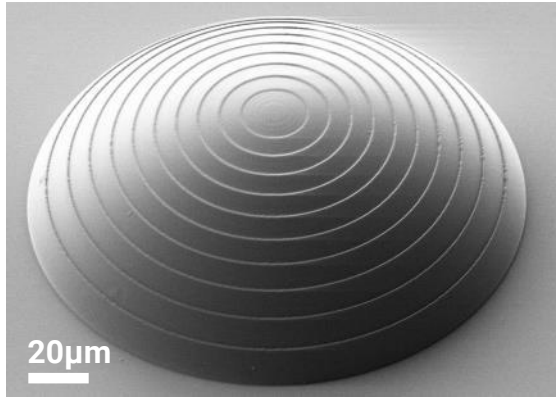




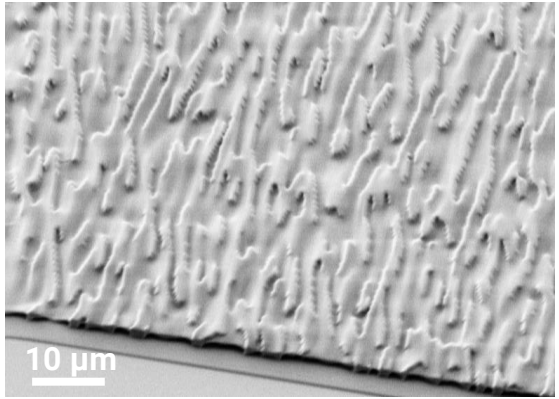
Compound microlens with diffractive structures,TTI GmbH TGU Printoptics

- 设计自由
  - 2.5D 适合于模具加工
  - 3D 复杂形状
  - 高填充比
  - 边缘尖锐
  - 混合光学元件
- 预结构化表面上的对准打印在集成光子学中的应用
  - 光纤头上的微纳光学器件加工
  - 硅片上的微纳光学器件加工
  - 芯片上的微纳光学器件加工
- 快速成型与迭代
- 减少加工步骤

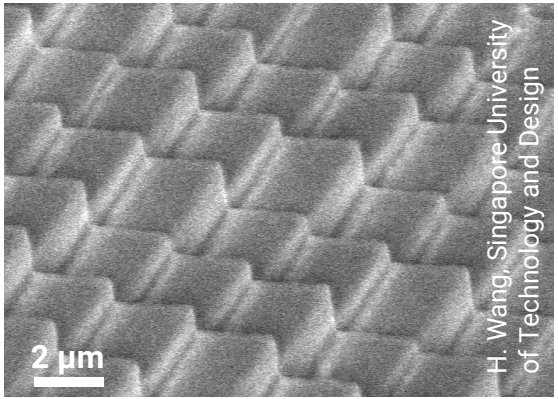
2GL®: 降低复杂结构的加工难度



集成于折射光器件表面的衍射光器件



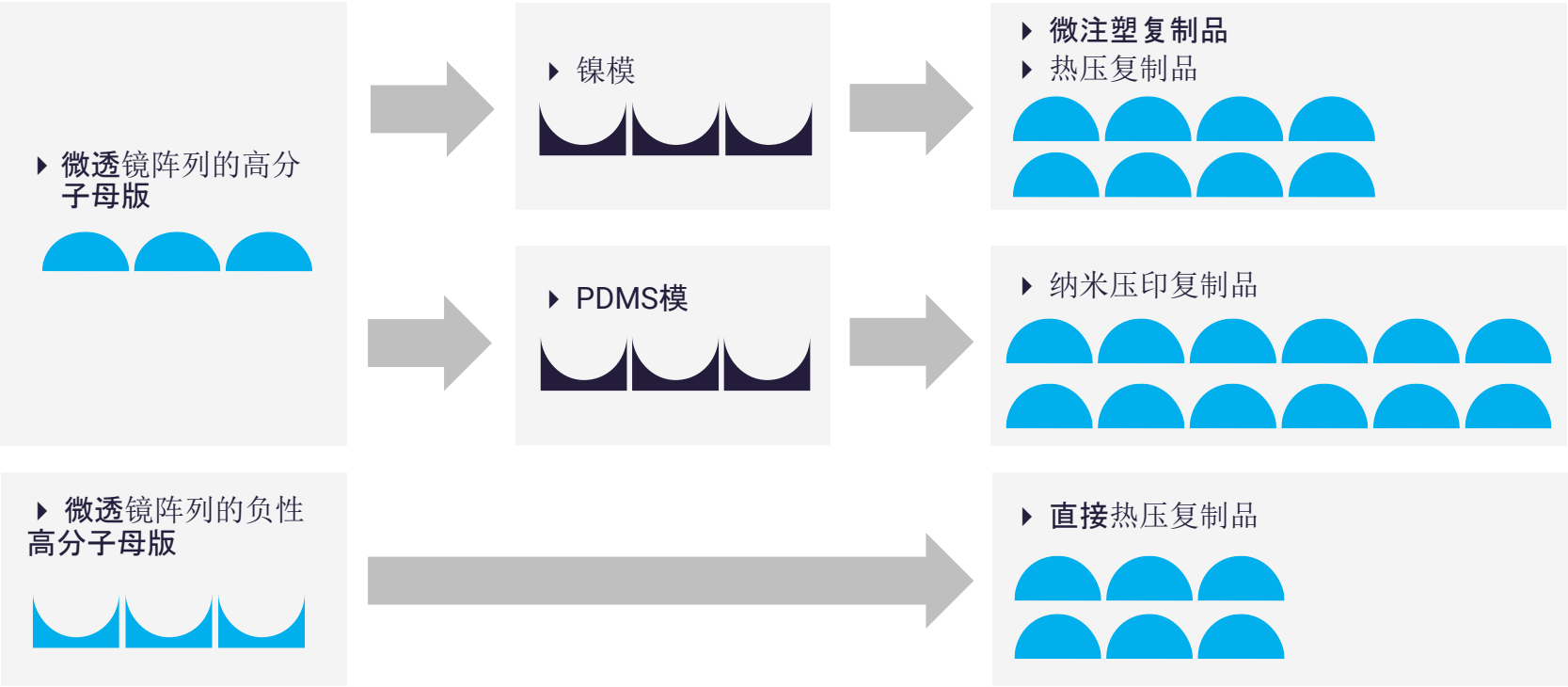
准连续的衍射光器件 (4096 阶)



倾斜结构的3D打印如闪耀光栅和闪耀衍射光器件

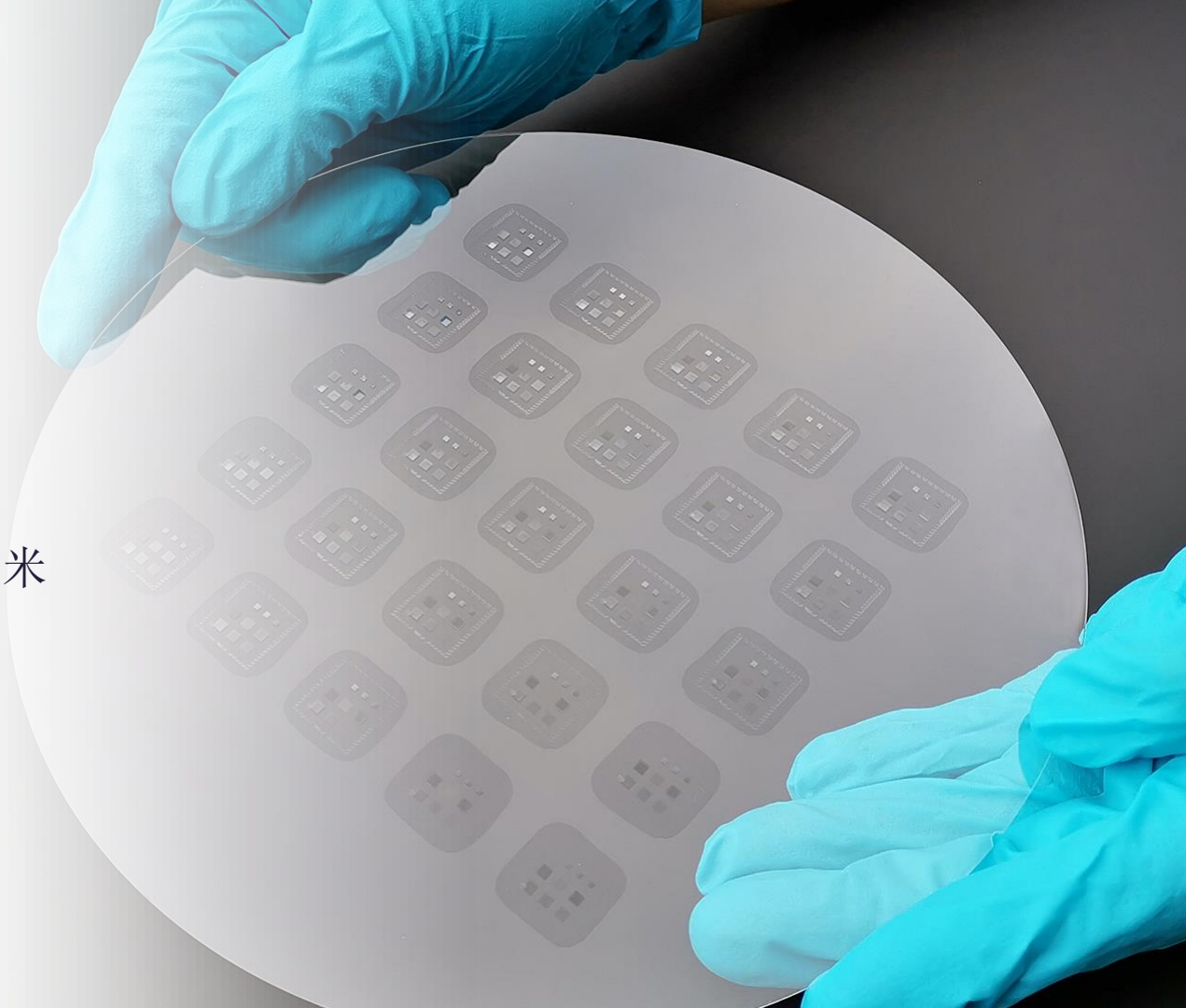
DOI: 10.1002/adom.201900068

翻模流程
从高分子模具到批量生产



翻模流程
纳米压印

- 8” 硅片
- 纳米压印复制品
- 合作伙伴EV Group的纳米压印技术



集成光子学

Disrupting Photonic Packaging by
Aligned Maskless Lithography

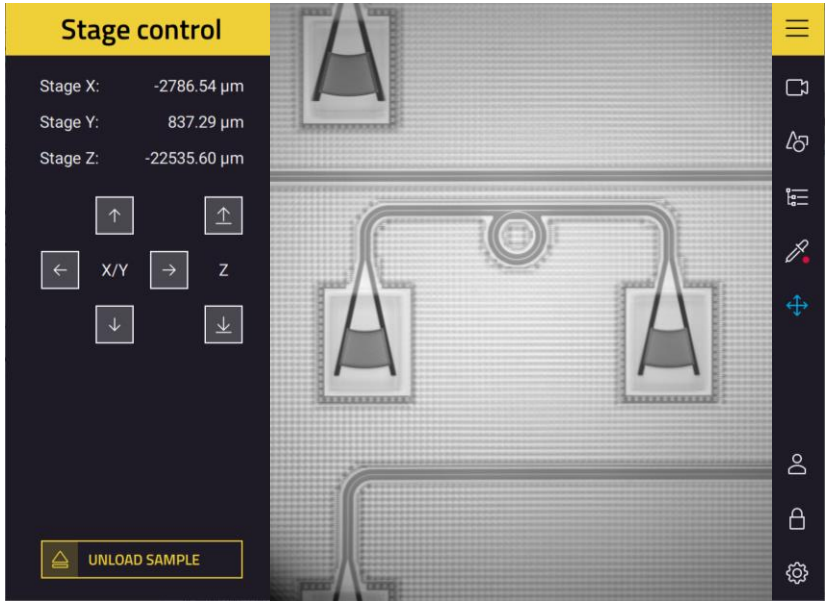
光电封装

- Nanoscribe 光互连
  - 光机械
  - 光学
    - 边缘耦合器
    - 表面耦合器

光电封装的微纳增材制造手段

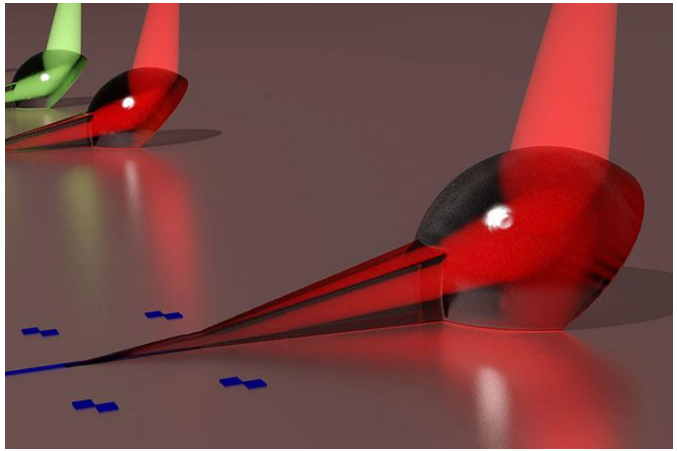
- 完全校准和匹配的光刻系统 – 实时视图.
- 100 nm 对准精度.

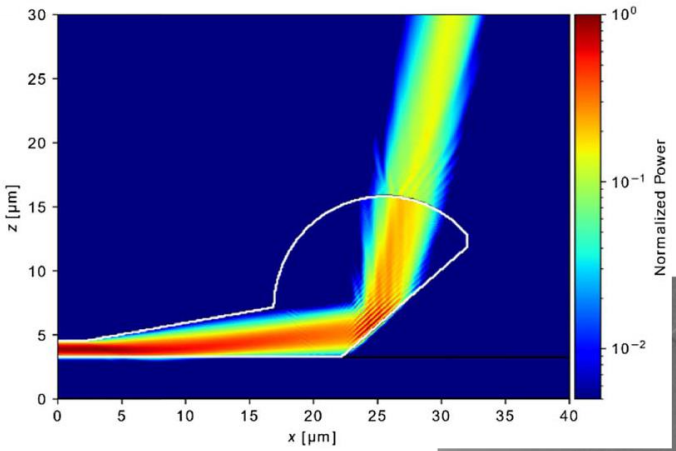
High resolution lithography system provides the perfect basis for automated packaging processes

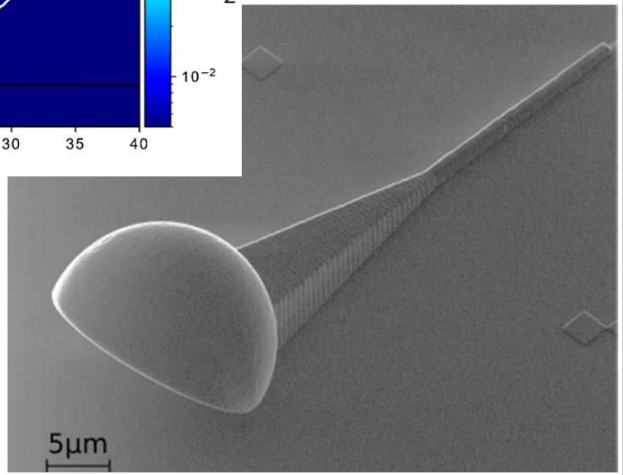


Quantum X中的硅光芯片视图

可见光波段的平面外耦合器



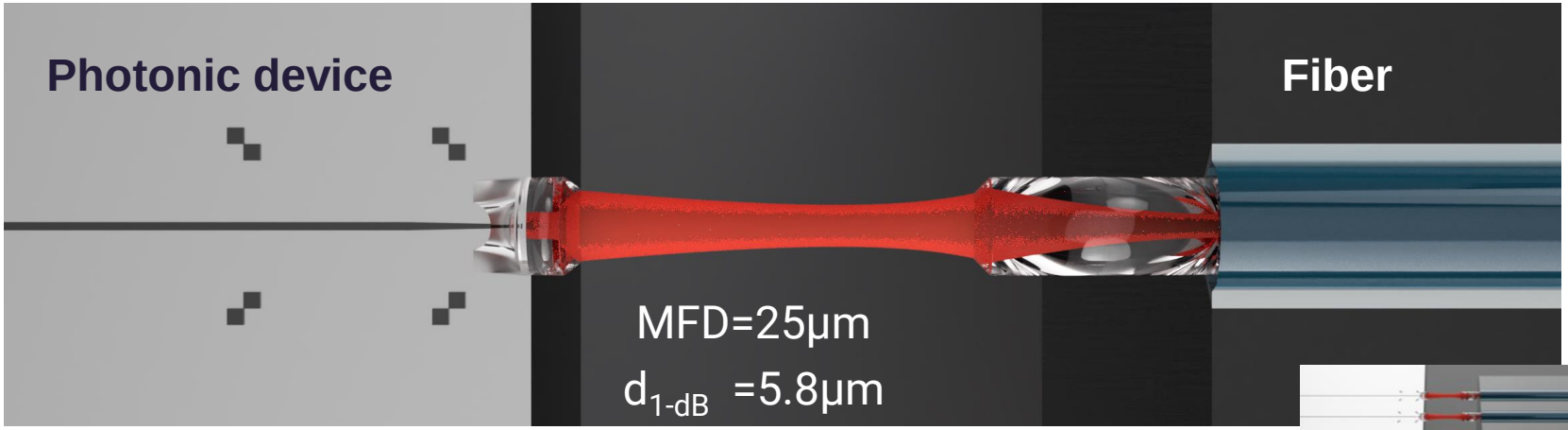




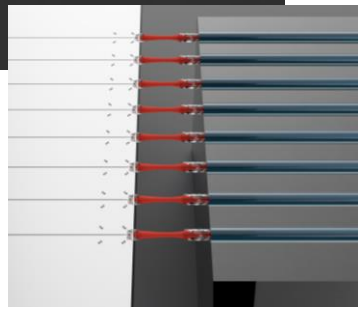
- 光纤和芯片间的耦合
  - 近绝热模式转换器
  - 全反射表面
  - 用作聚焦透镜的球体
- 宽带可见光波段的平面外耦合器

Gehring, Helge et al., "Broadband out-of-plane coupling at visible wavelengths", *Optics Letters*, 44.20 (2019)

通过器件表面微光元件的光互连



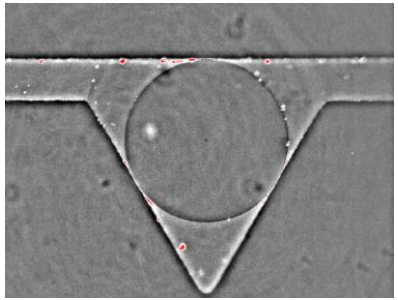
Effective large
beam component



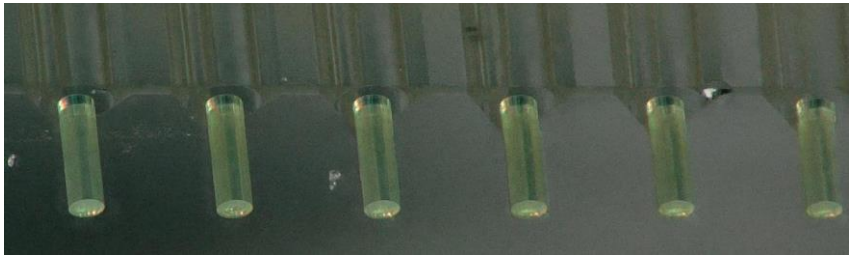
Dietrich, P-I., Blaicher, M. et al. "In situ 3D nanoprinting of free-form coupling elements for hybrid photonic integration." *Nature Photonics* 12.4 (2018): 241-247.

全自动的光纤端面微透镜加工

- V型槽阵列中的规则间隔光纤
- 单模光纤芯的自动检测
- 光纤阵列扩束微透镜的制作



Lithography view of a fiber inside a V-groove



3D printed lensed fiber array

Summary

双光子微纳增材制造 & 优势

微纳光学模具的制备:

- 设计自由度的提高 -> 更好的性能
- 快速迭代周期和光学级材料 -> 微纳期间的快速成型
- 加工步骤的减少 -> 更可靠，成本更低
- 与纳米压印光刻和微注塑兼容的工作流程 -> 批量生产

光电封装:

- 高质量微光器件的打印 -> 表面和边缘的耦合
- 模场直径5-100 μm可调 -> 降低的对准的要求 (several μm @ 1dB loss)
- 在预结构化表面（光纤尖端、晶片、芯片上）对准打印 -> 多功能，降成本
- 光刻工具直接对准可以大大简化装配流程 -> 省时
- 将机械耦合器打印到光电器件上 -> 用途广泛