



# Nanoscribe and Quantum Technology

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07th February 2022

# Main challenges in optical coupling

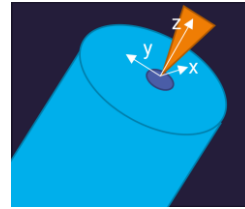


- ▶ Reduce coupling losses from/to fibers, edge couplers, grating coupler, emitting facets.
- ▶ Steer and form beams from
  - From small to large or large to small Mode Field Diameters (MFD)
  - In different directions ( $0^\circ, 45^\circ, 90^\circ, \dots$ )
- ▶ Relax alignment tolerances
- ▶ Flexible use with any material platform

# Quantum X align – Dedicated tool for improved optical coupling

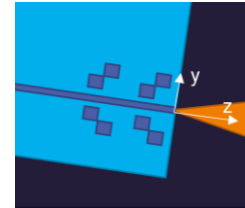


- ▶ Up to 100 nm precise alignment
- ▶ Automatic printing on fiber arrays & chips
- ▶ Web offer with Partner PHIX for Lensed Fiber Arrays (LFA)



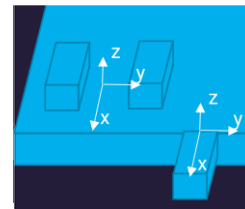
## Printing on fibers

3D alignment to fiber core and emission direction



## Printing on photonic chips

3D alignment to on-chip markers, waveguides etc.



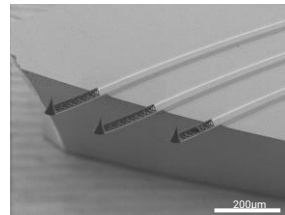
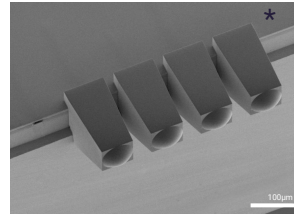
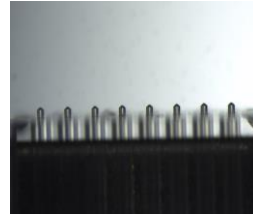
## Printing on 3D topographies

3D alignment to topographical features

# Quantum X align – Dedicated tool for improved optical coupling



- ▶ Up to 100 nm precise alignment to waveguides
- ▶ Automatic printing on fiber arrays & chips
- ▶ Web offer with Partner PHIX for Lensed Fiber Arrays (LFA)



## Printing on fibers

3D alignment to fiber core and emission direction

## Printing on photonic chips

3D alignment to on-chip markers, waveguides etc.

## Printing on 3D topographies

3D alignment to topographical features

# Quantum X- align

## Aligned multiphoton lithography for high precision

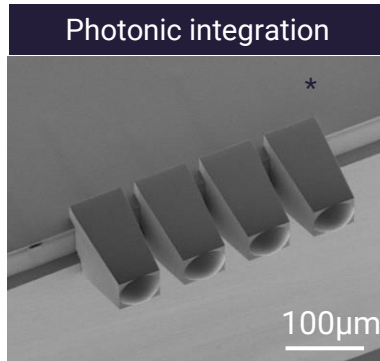


### ► Requirements for Photonic Integrated Circuits (PIC)

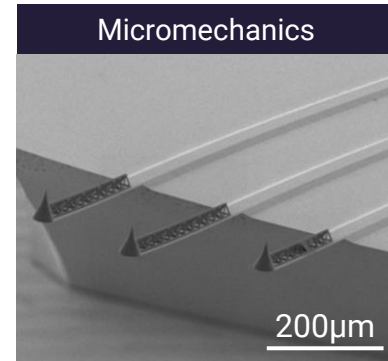
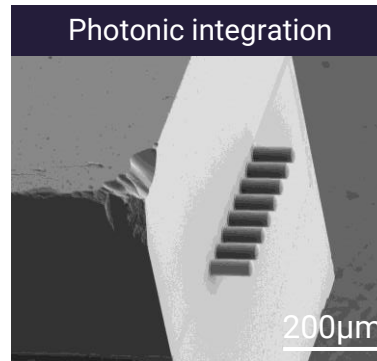
- Reduce coupling losses → < 1dB
- Steer and form beams from
  - From small to large or large to small Mode Field Diameters (MFD)
  - In different directions (0°,45°,90°,...)
- Relax alignment tolerances for optical coupling → +- few μm (X-Y-Z)
- Flexible on any material platform → aligned 2PP 3D Printing



**Nanoscribe**  
Quantum X align  
with automated  
alignment



\*Chip from HandheldOCT





# Think big. Print nano.

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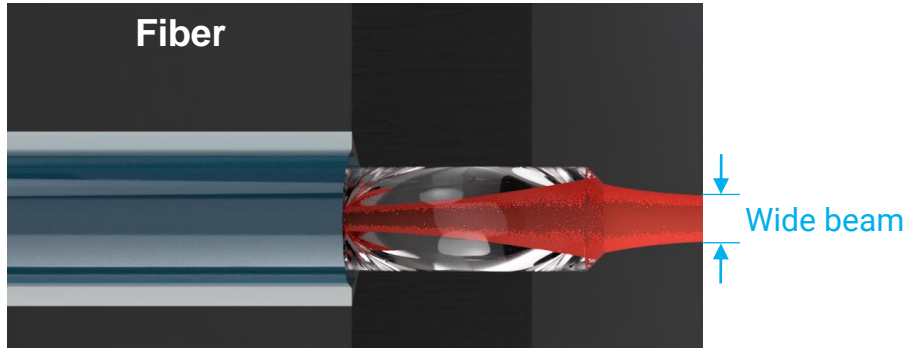
[Smolenski@nanoscribe.com](mailto:Smolenski@nanoscribe.com)



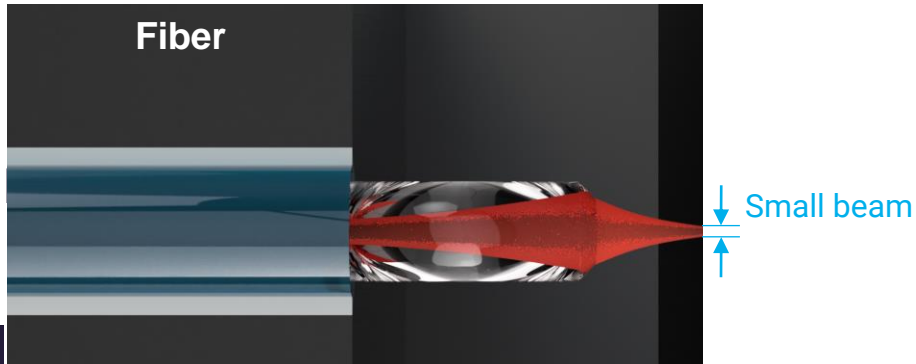
# Application examples

# Application example – Printing on fibers

## Tailored lensed fibers



Beam expander for relaxed alignment tolerances in packaging



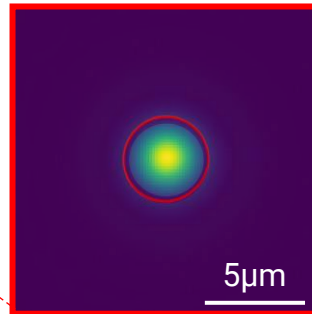
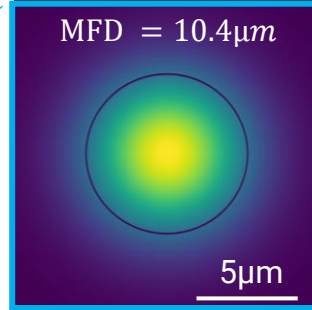
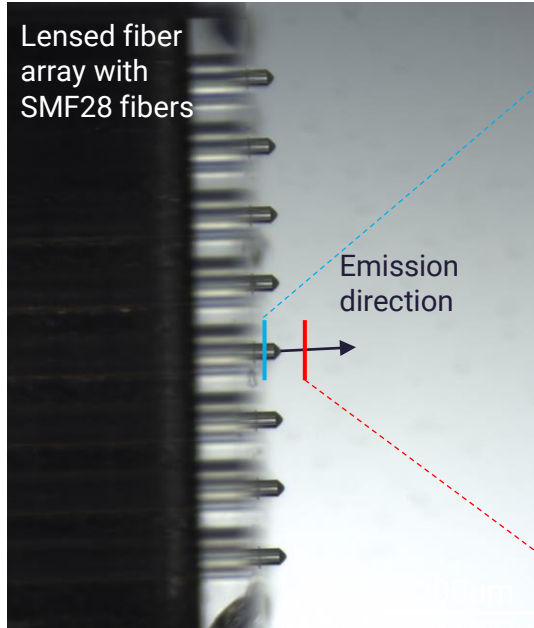
Focusing lenses for low loss direct coupling to tapered waveguides



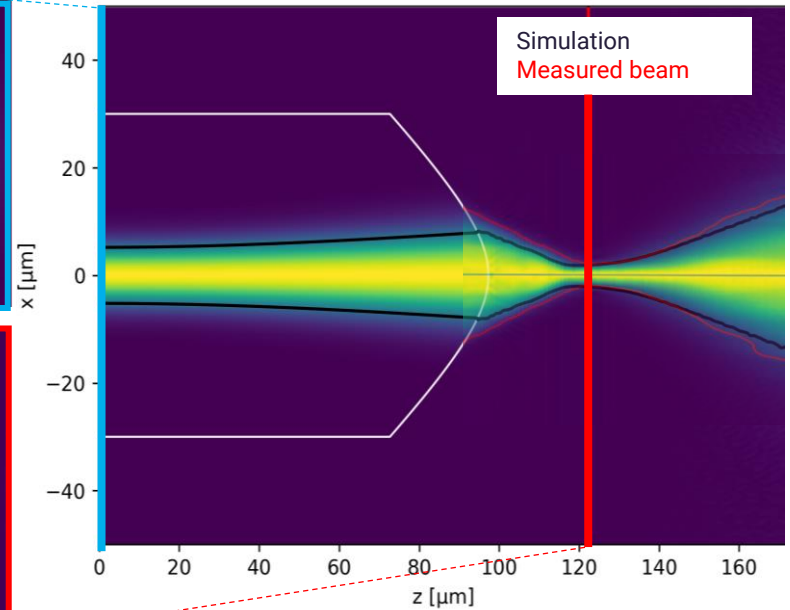


# Application example – Printing on fibers

## 3.6 $\mu\text{m}$ MFD focus lens for 1550nm

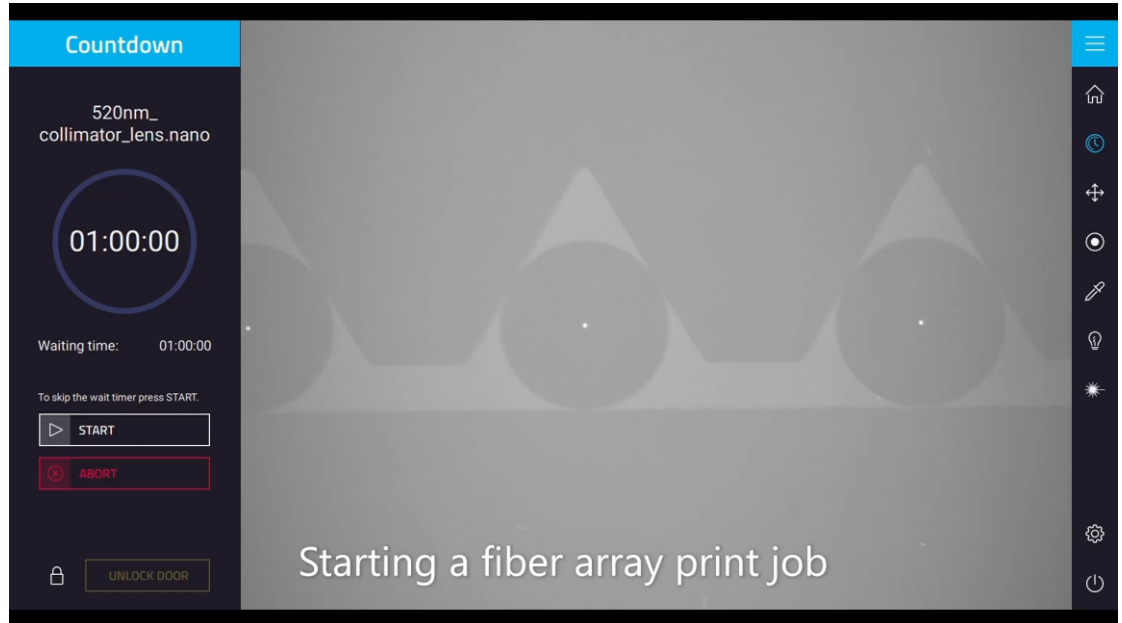
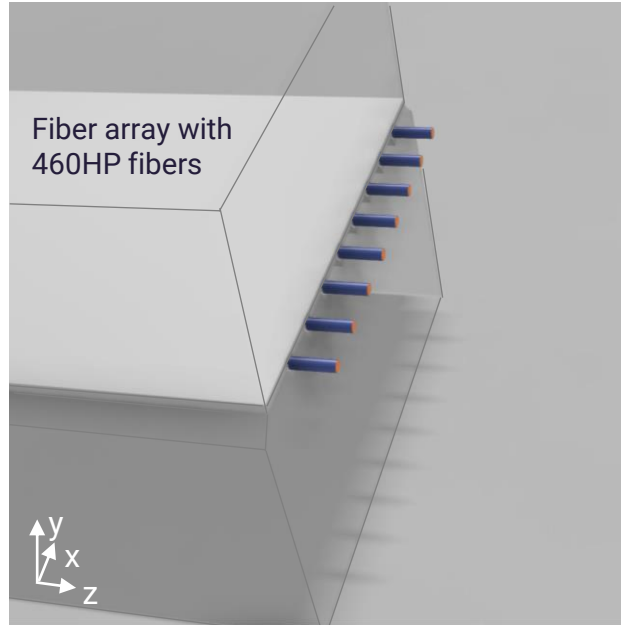


Simulation  
Measured beam



# Application example – Printing on fibers

## Beam expander for 532nm wavelength

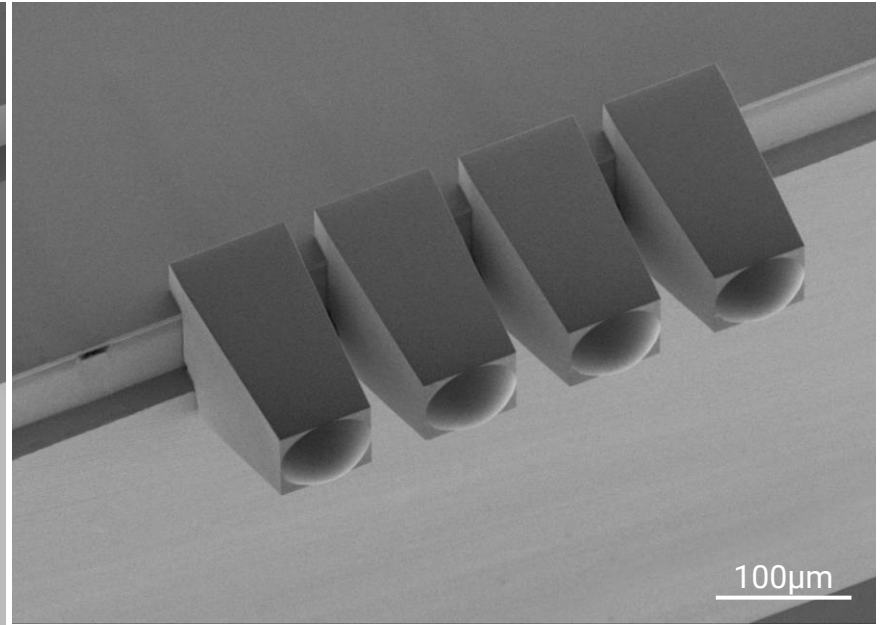
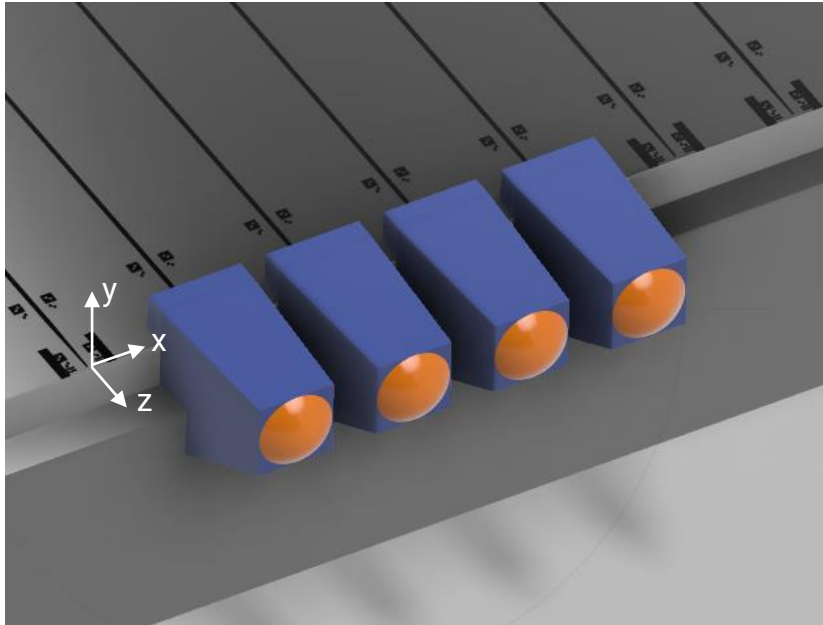


# Application example – Printing on photonic chips

## Beam shaping optics for 1060nm



### 7. Development and visual check

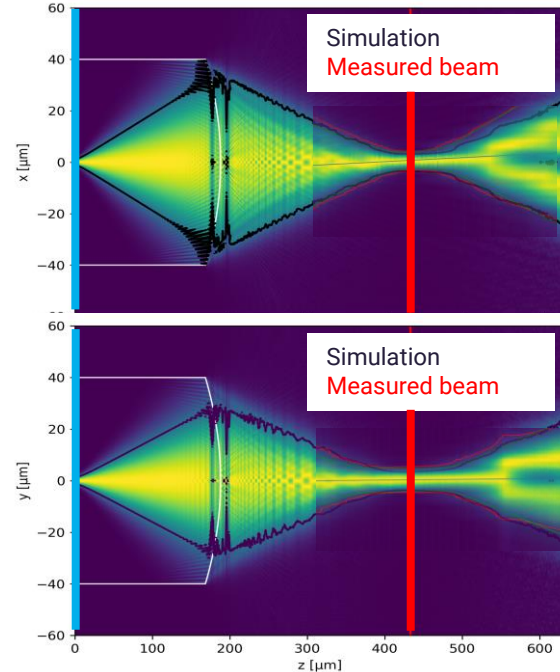
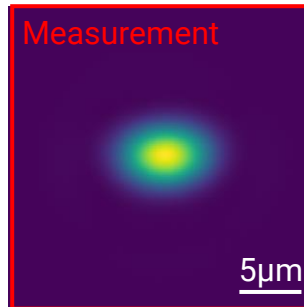
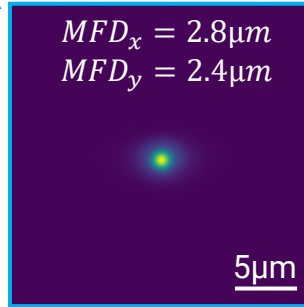
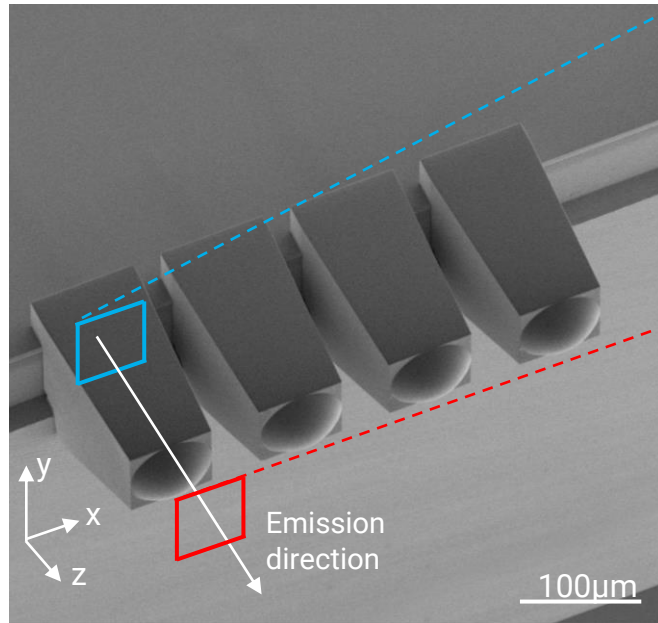




# Application example – Printing on photonic chips

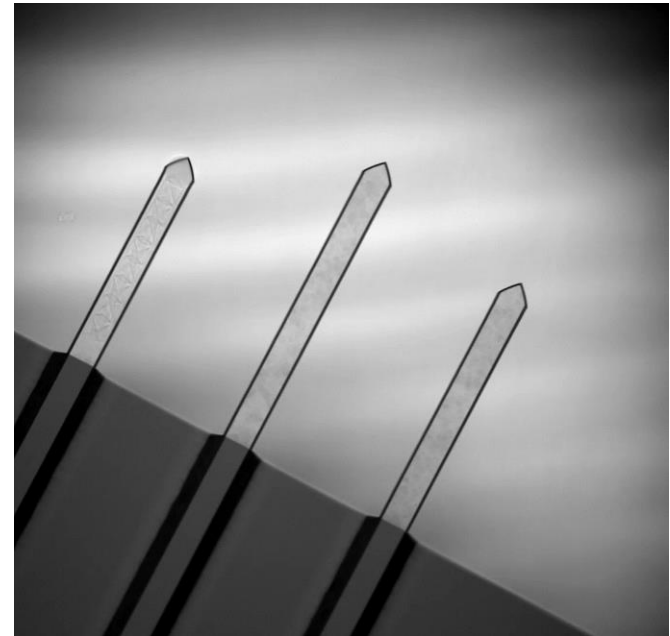
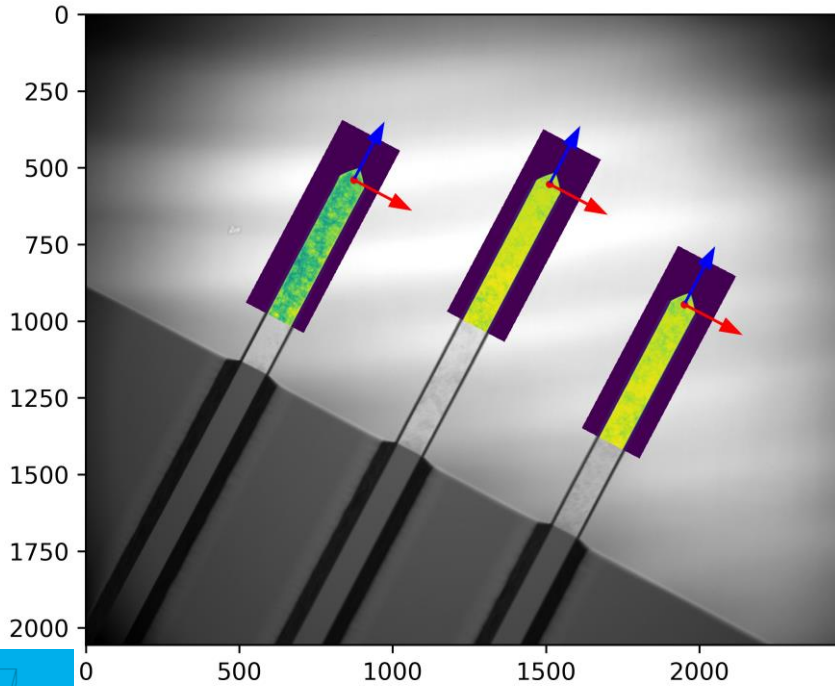
## Beam shaping optics for 1060nm

### 8. Beam characterisation



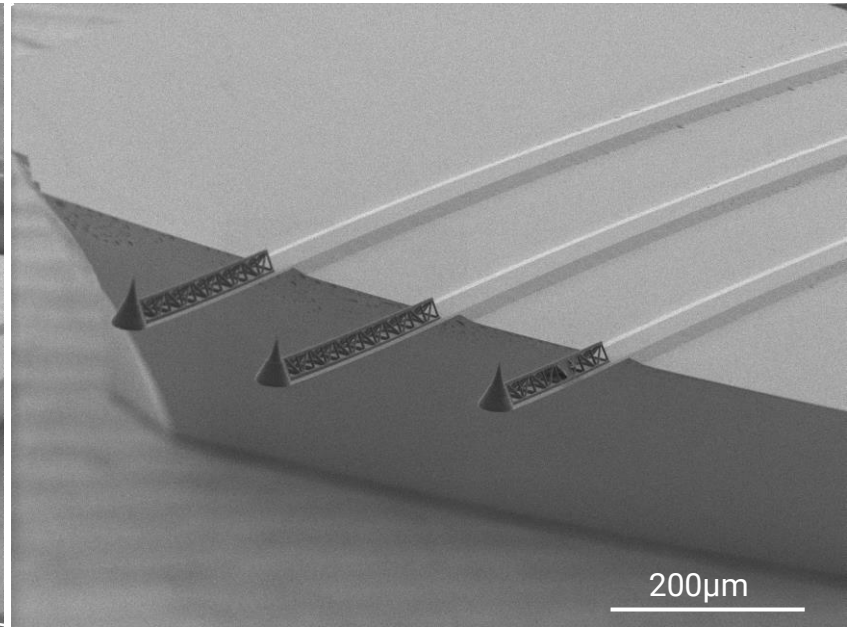
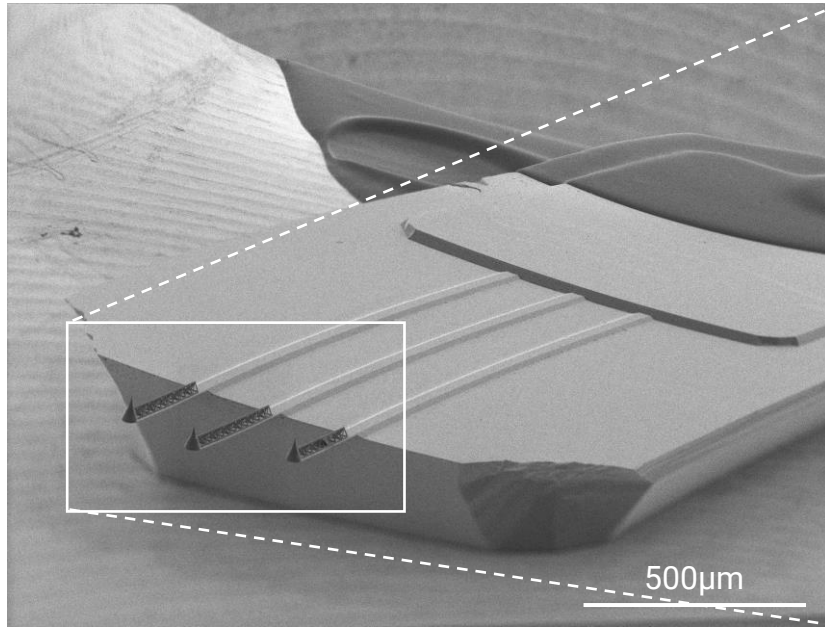
# Application example – Printing on 3D topographies

## Tips and rebar structures on AFM cantilever



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## Tips and rebar structures on AFM cantilever





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