

# The photonics platforms at Applied Materials – How to leverage 55 years of knowledge in the semiconductor industry to build new type of photonics devices?

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Product Marketing - CTO Office – Photonics Platforms

EPIC Meeting Munich – 13<sup>th</sup> and 14<sup>th</sup> of November 2023

Applied Materials Confidential



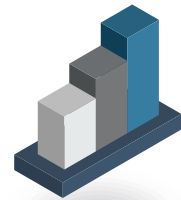
# Who is Applied Materials?



FOUNDED IN 1967

## World's #1

semiconductor and display equipment company



**\$25.79 billion**  
revenue

TOTAL FISCAL 2022



**\$2.8 billion**  
R&D spending



**~15,700**  
patents\*



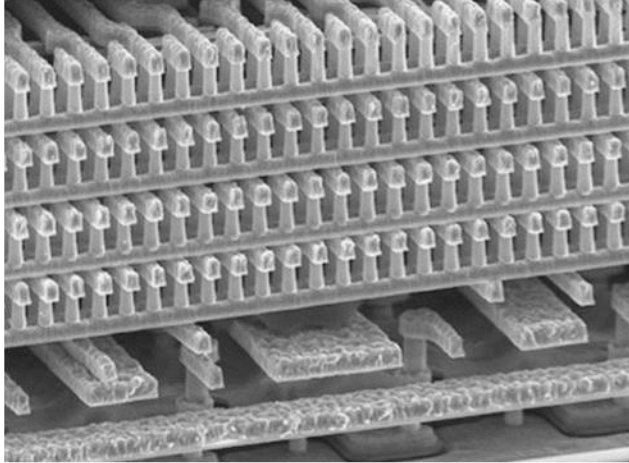
**~33,300**  
employees  
in **19\*** countries

Data as of fiscal year end, October 30, 2022 except \* which are as of fiscal year end, October 31, 2021

# Enabling the Engineered Optics Industry

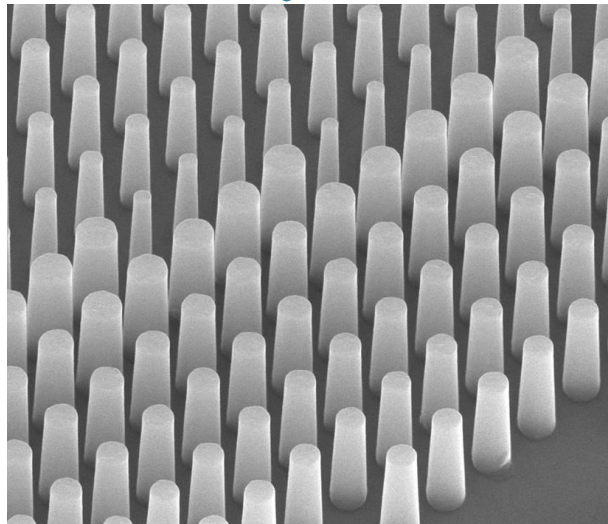
## Flexible Materials Engineering Capability

Semiconductor



Nanostructures  
Manipulating  
**Electrons**

Engineered Optics



Nanostructures  
Manipulating  
**Photons**

## Leveraging Our 50 Years of Experience

Optical Device  
Performance

New Materials, Precise Control of  
Material Optical Properties &  
Critical Dimensions & Shapes

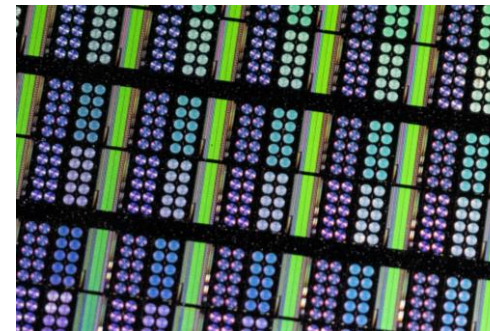
Exotic Transparent  
Substrates

Customized Equipment & Process

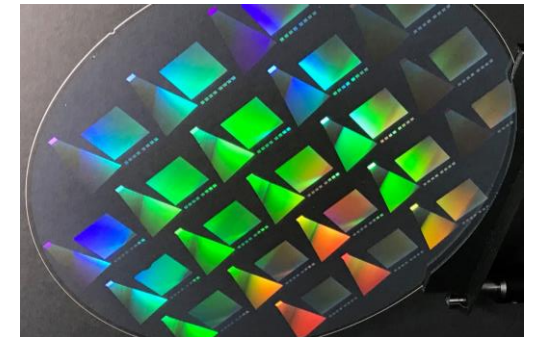
Yield, Cost

Mature & Proven 300mm Wafer  
Processing

## Scaled by Applied Materials...

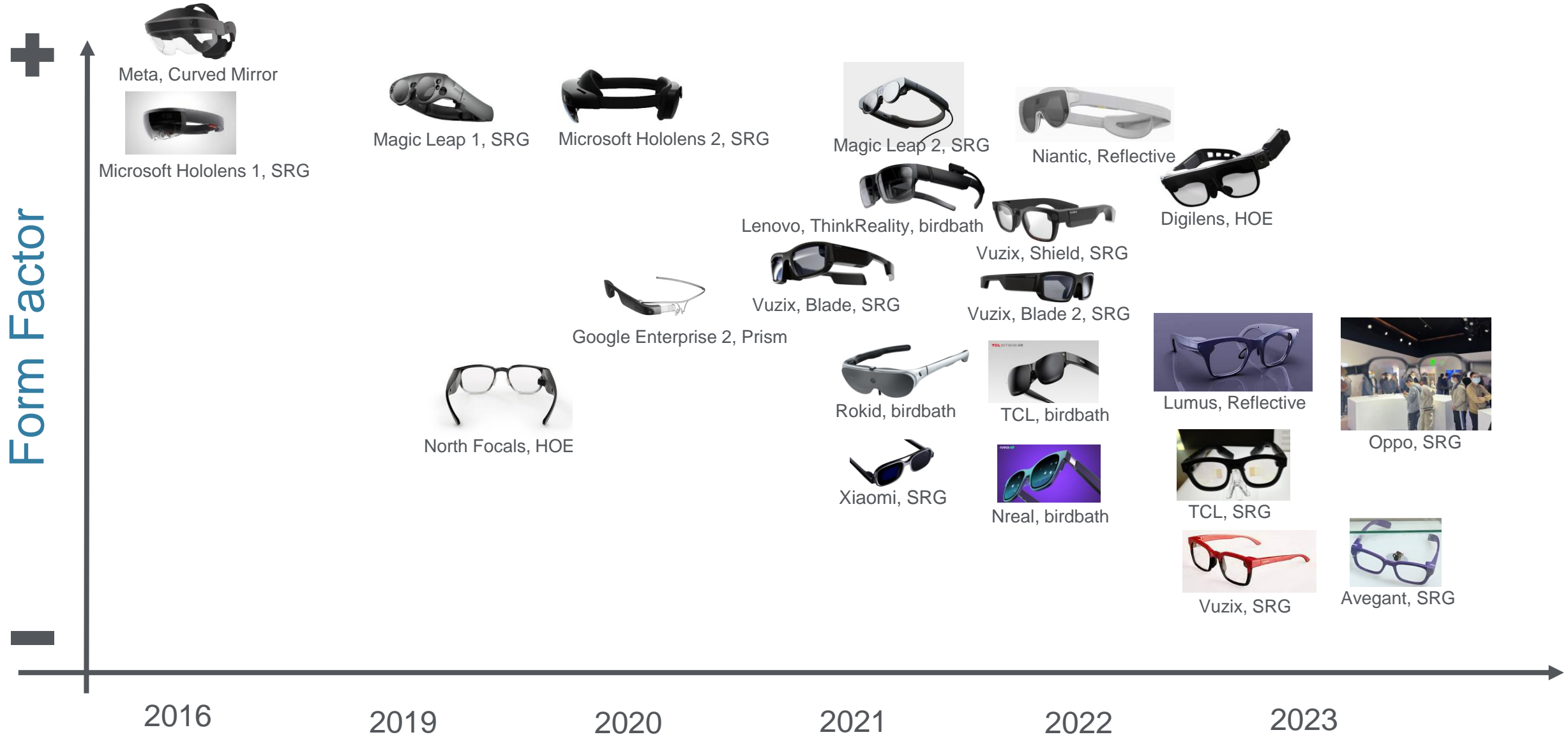


IR Lenses

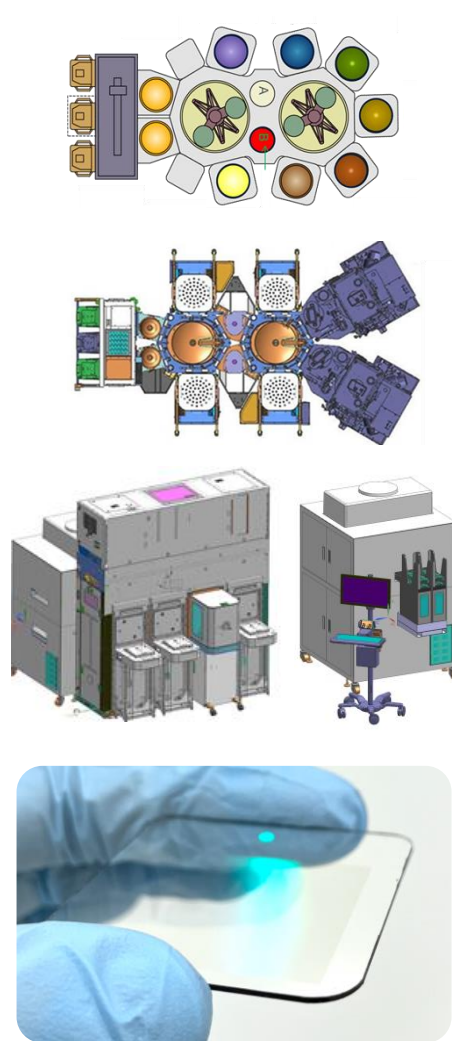


Waveguide Combiners

# AR/MR Evolving Form Factor

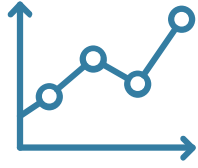


# Process Flow for High Performance AR Waveguides



- Film Stack Deposition
- Litho
- Etch (Angle + Depth Variation)
- Backside Litho + Etch  
For Double Sided
- Encapsulation + Coatings
- Dicing, Edge Blackening, Packaging
- Optical Performance Metrology

# Metalenses for NIR 3D Sensing and Imaging



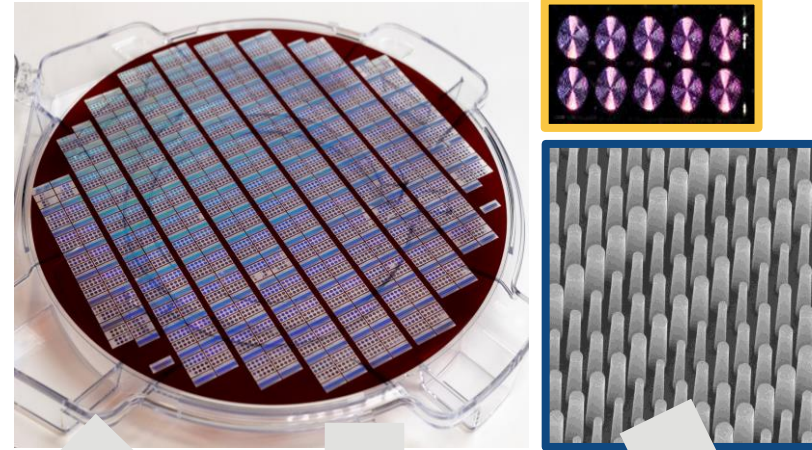
Market of **17B\$ in 2027**,  
**8B\$ in 2021** (Yole)



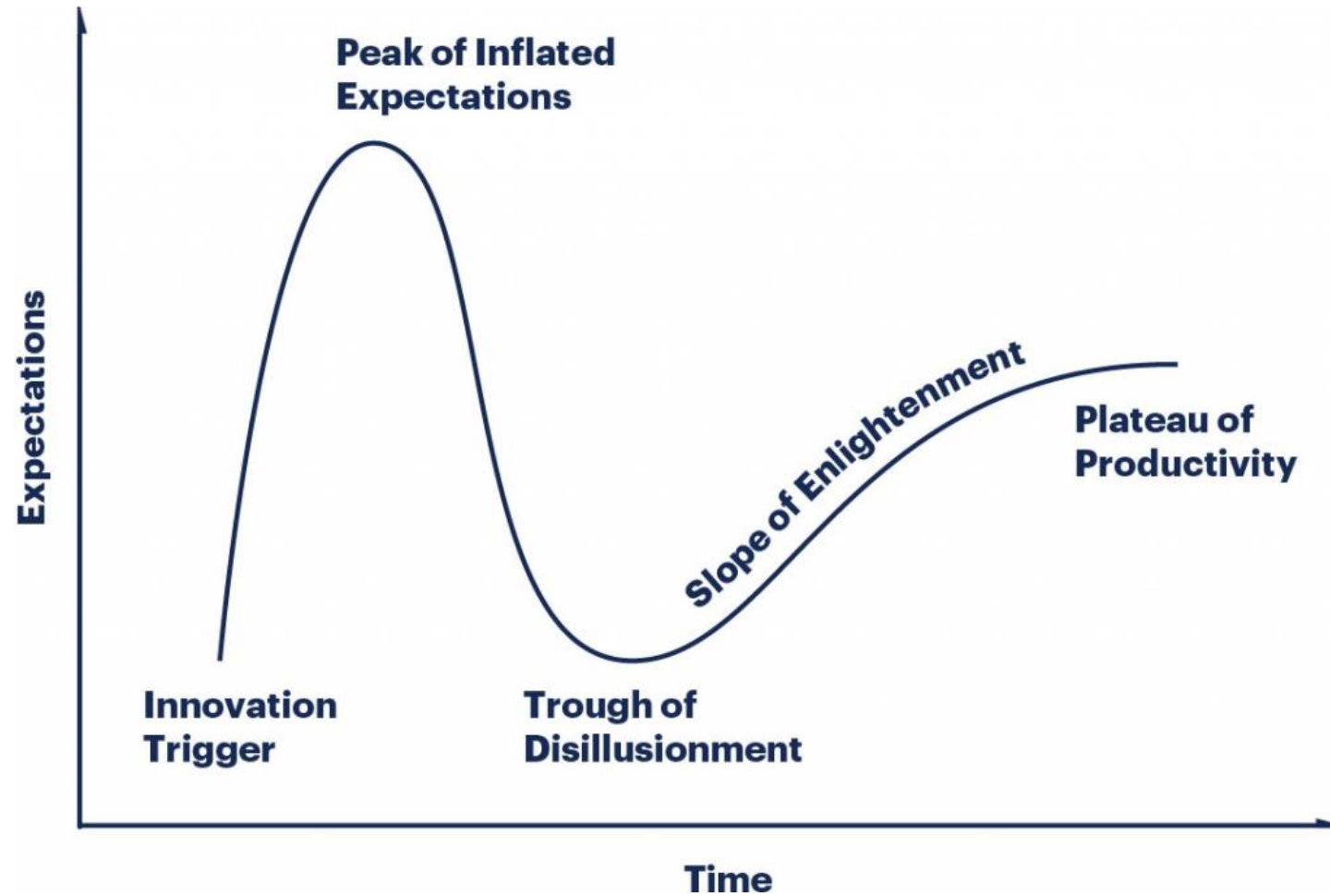
Narrow Band, One Wavelength



Reducing Cost



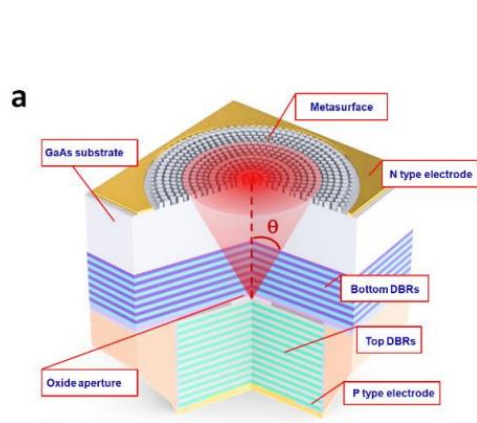
# Why meta-optics? And Are we over the Death Valley/Trough of Disillusionment?



(Gartner Curve, Hype Cycle, ...)

# Why meta-optics? And Are we over the Death Valley/Trough of Disillusionment?

- Polarization control
- Local Phase engineering
- Amplitude control
- Thinner
- Multi-functional



Xie, YY., Ni, PN., Wang, QH. et al. *Nat. Nanotechnol.* 15, 125–130



Zhang, F., et al *Adv. Mater.* 2021, 33, 2008157.



## Top 10 Emerging Technologies 2019

NEWS RELEASE 22-DEC-2022

### Meta-Optics: the disruptive technology you didn't see coming

Peer-Reviewed Publication

ARC CENTRE OF EXCELLENCE FOR TRANSFORMATIVE META-OPTICAL SYSTEMS

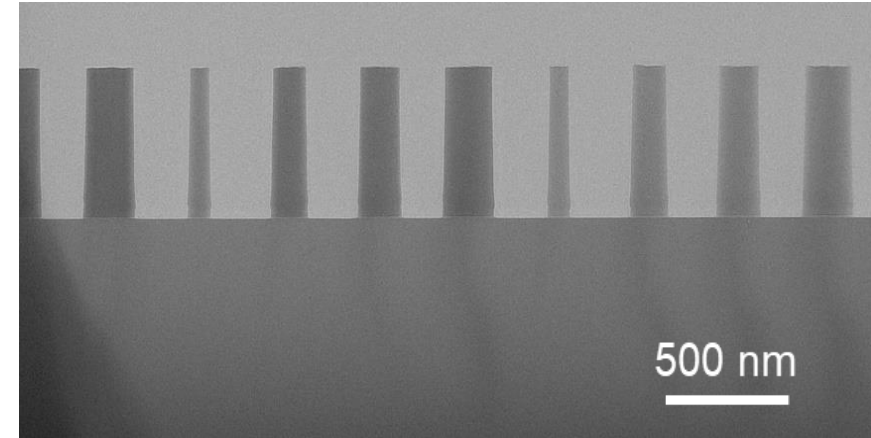
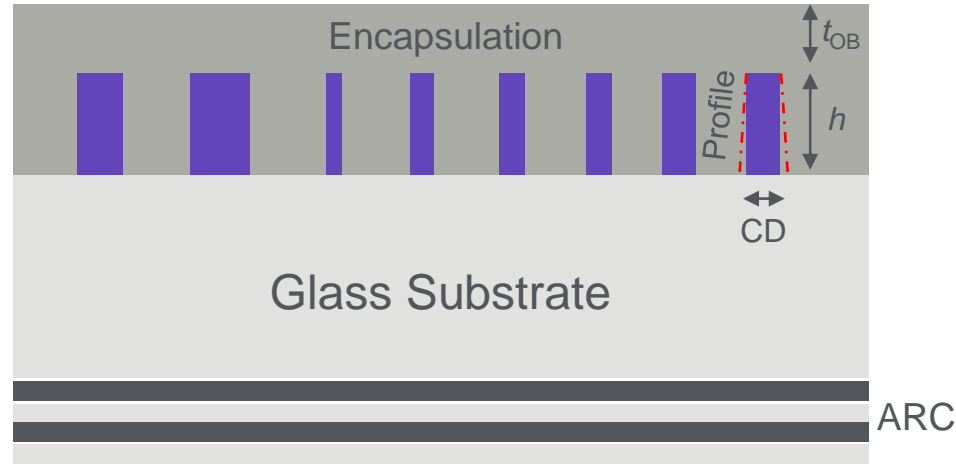
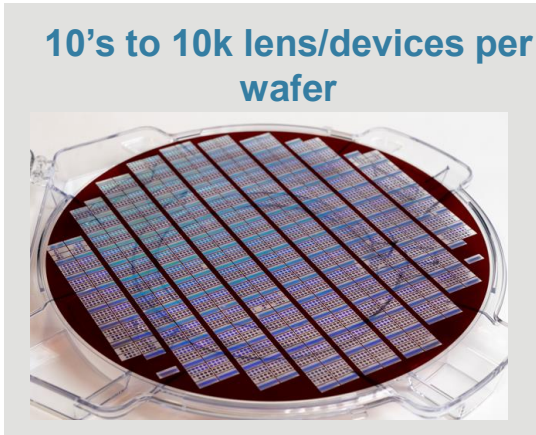
## Metaoptics for the consumer market

[Giampaolo Pitruzzello](#)

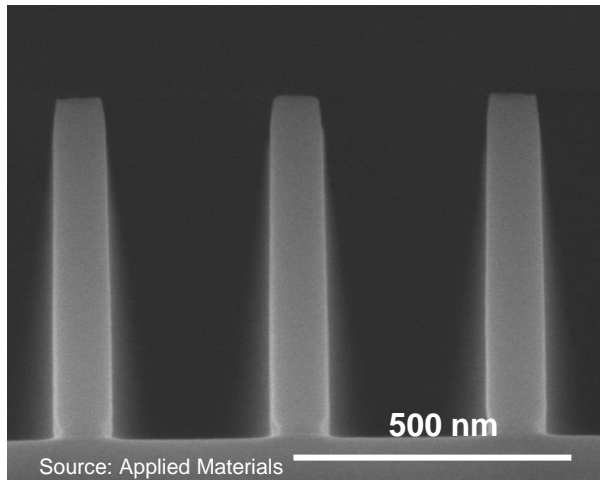
[Nature Photonics](#) 17, 6–7 (2023) | [Cite this article](#)



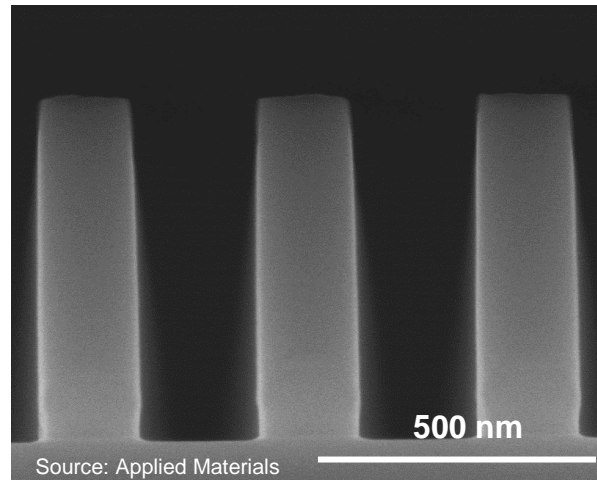
# Metaoptics, a closer look



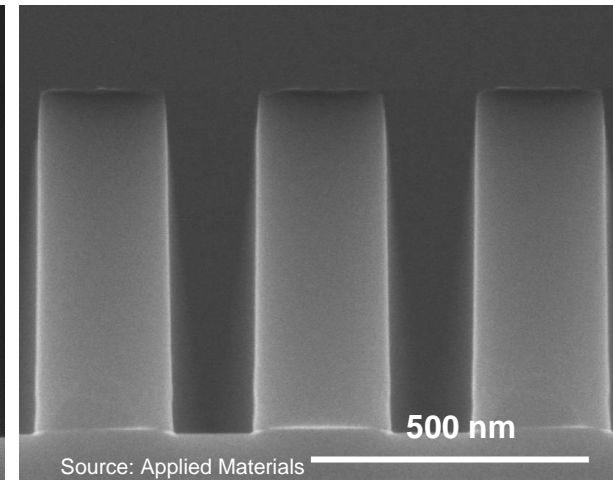
Small size pillar



Medium size pillar



Large size pillar



**Sidewall angle > 88° across the design rule CD range can be well controlled.**

