

# Integrated Photonics Packaging

## from Research to Pilot Manufacturing

*(technology sustainability)*

**Prof. Peter O'Brien**

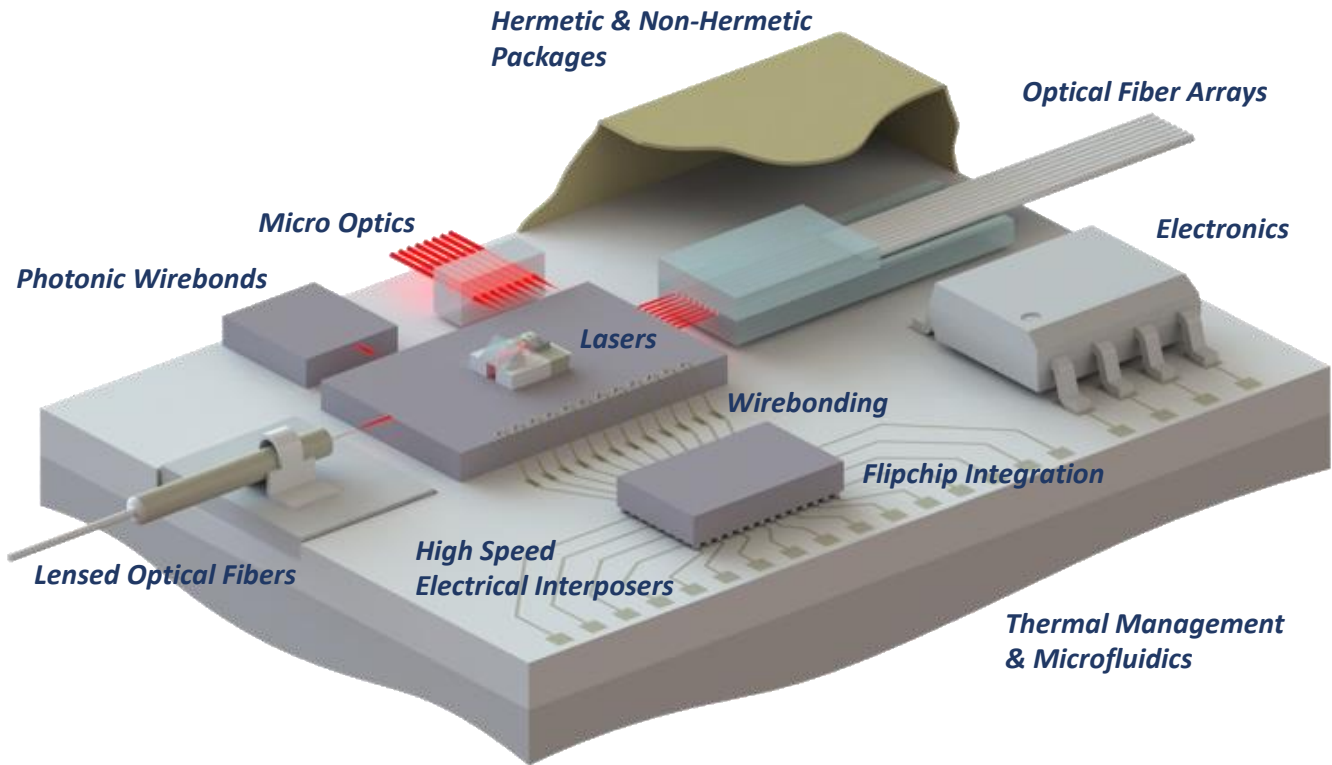
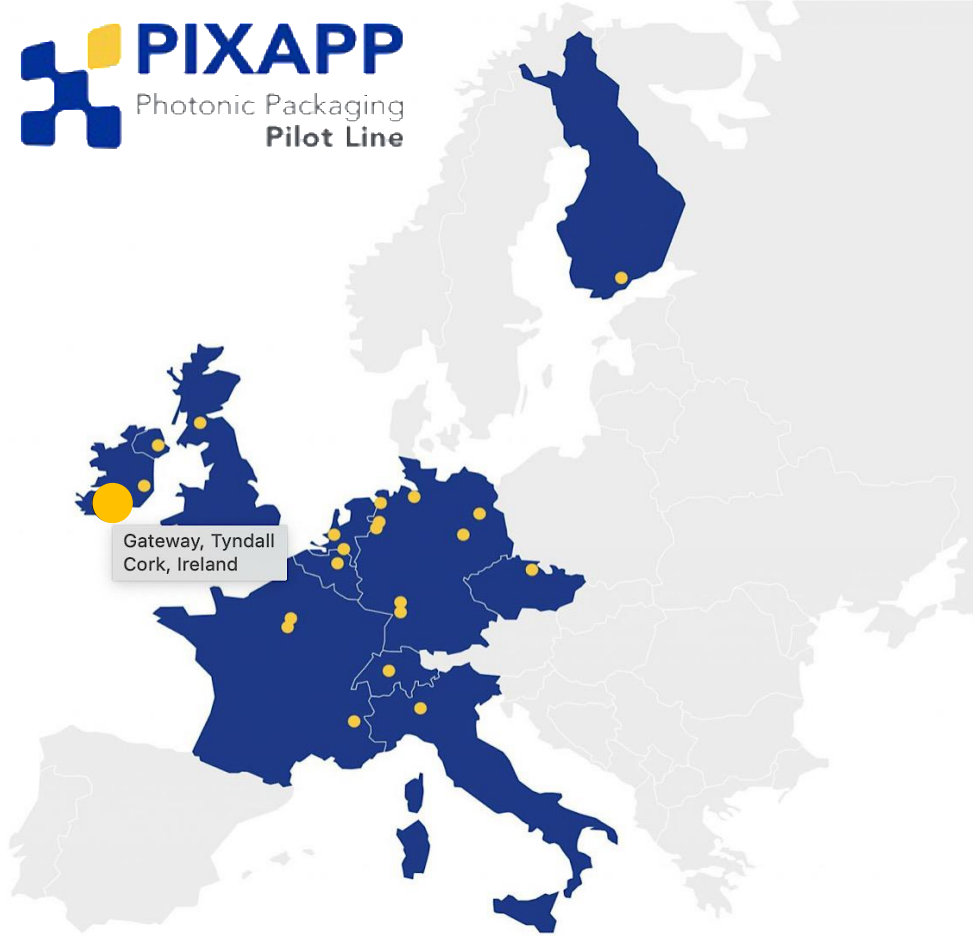
PIXAPP (European Photonic Packaging Pilot Line)

PhotonHub (European Photonics Academy)

Head of Group (Photonic Packaging & Systems Integration)

Tyndall Institute, University College Cork, Ireland.

# Manufacturing (pilot line)




# Manufacturing (pilot line)

### PIXAPP Development Services



Gateway



Training



Development

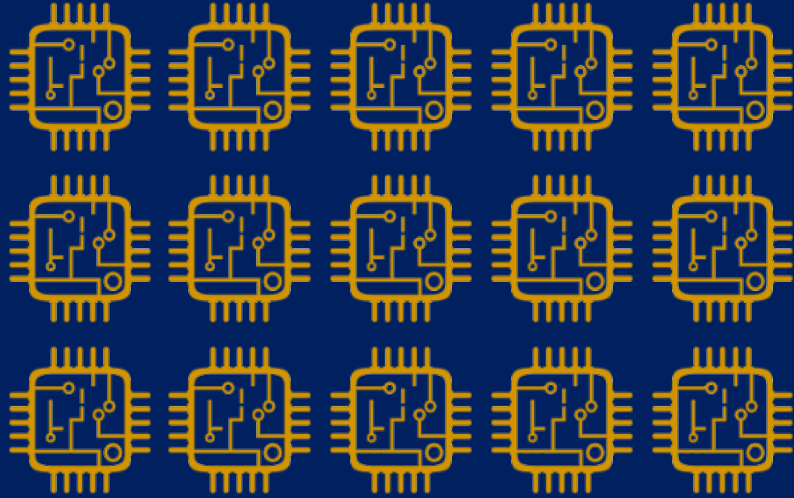


Prototyping

← Technical Support

Scale-Up →

### PIXAPP Manufacturing Services



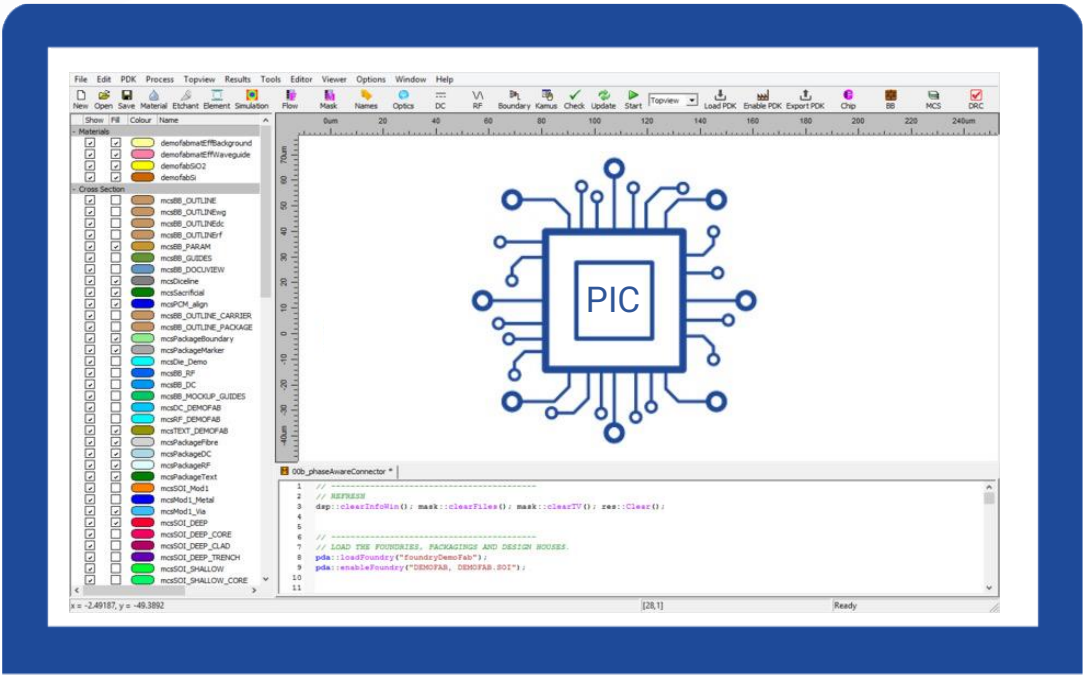
Scale-Up from Prototype to Volume

# Manufacturing (design standards)



## Design Rules for Silicon Photonic Packaging at Tyndall Institute

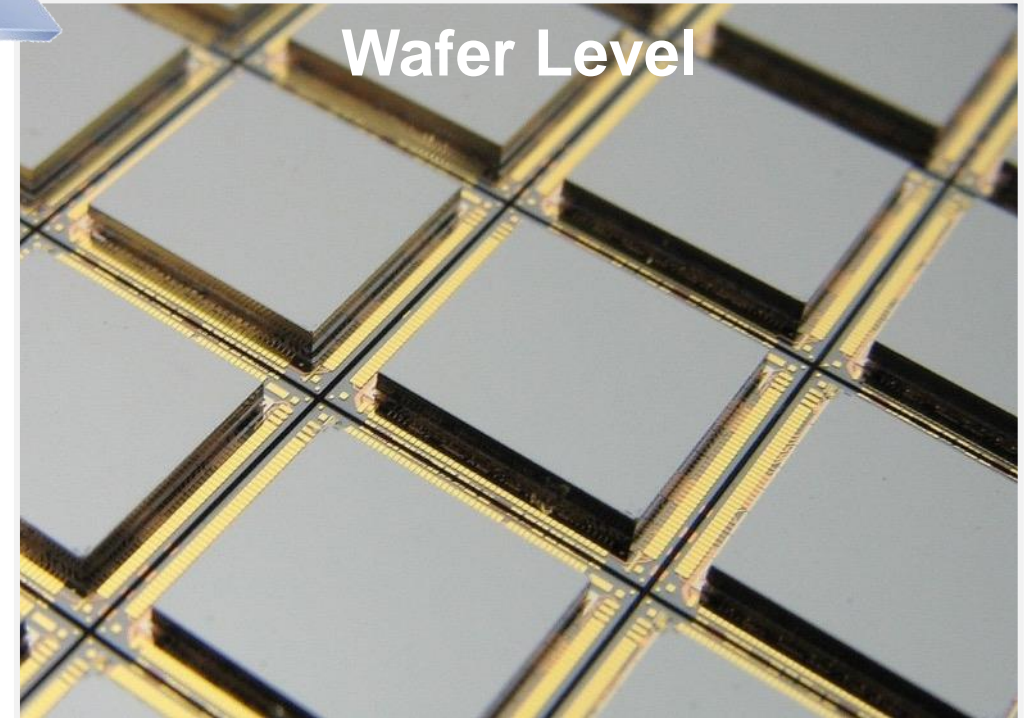
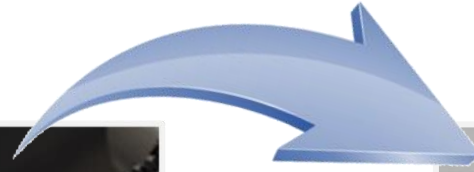
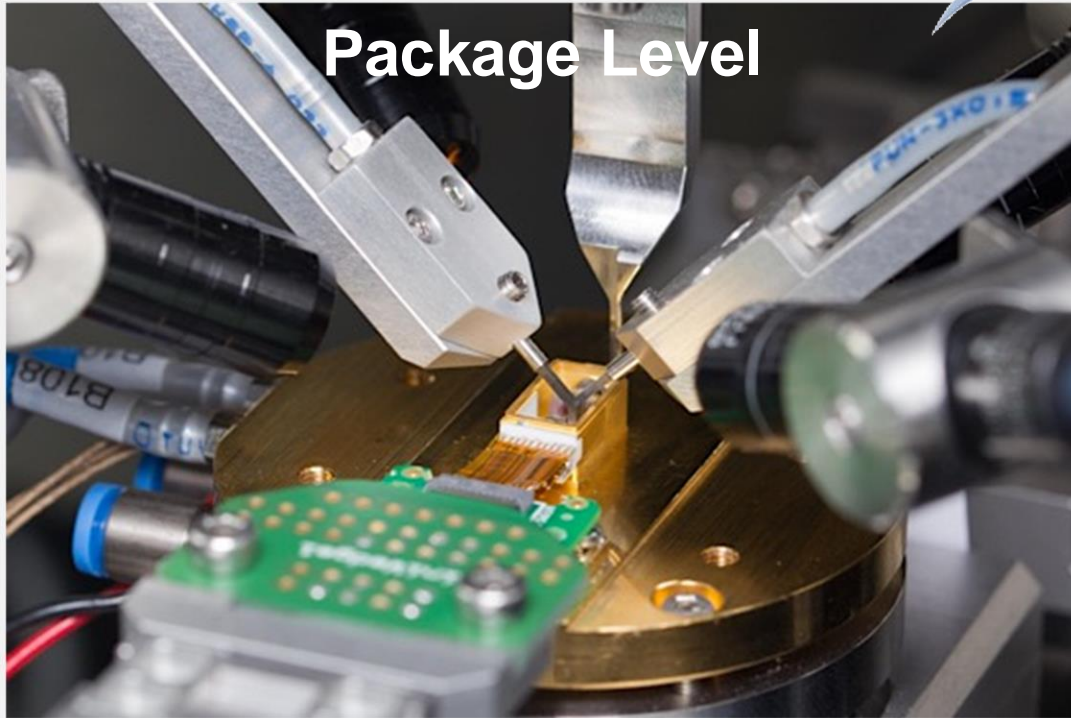
January 2015



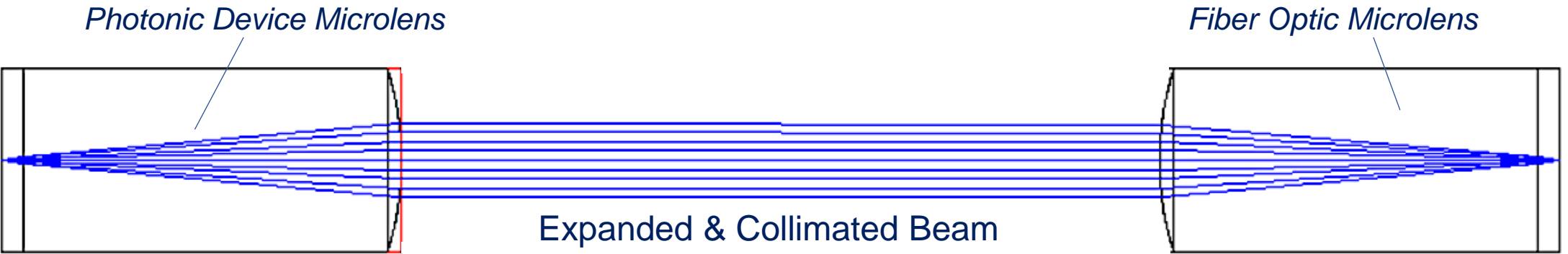
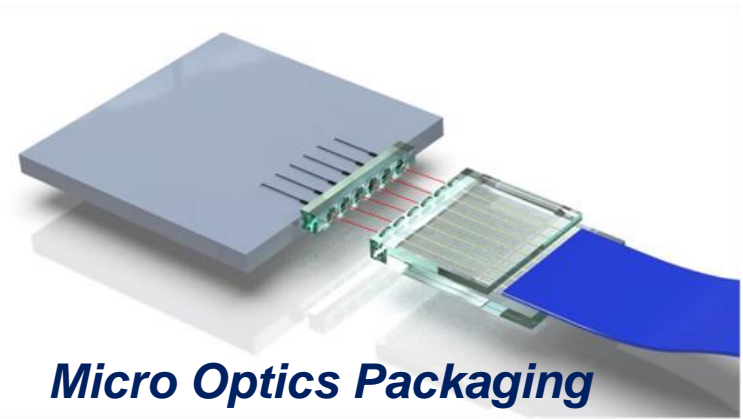
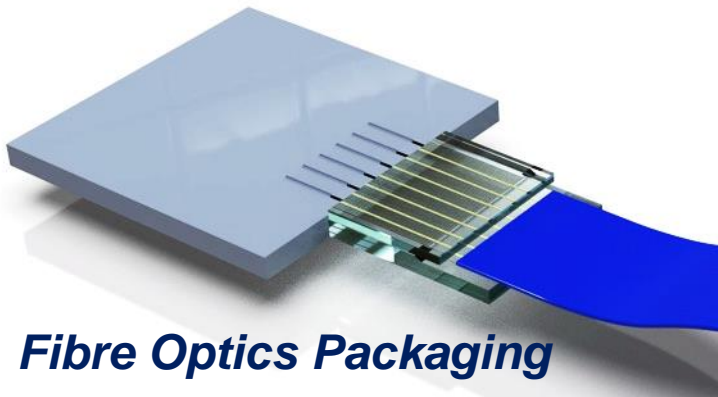
## Assembly Design Kits



# The Packaging Challenge)

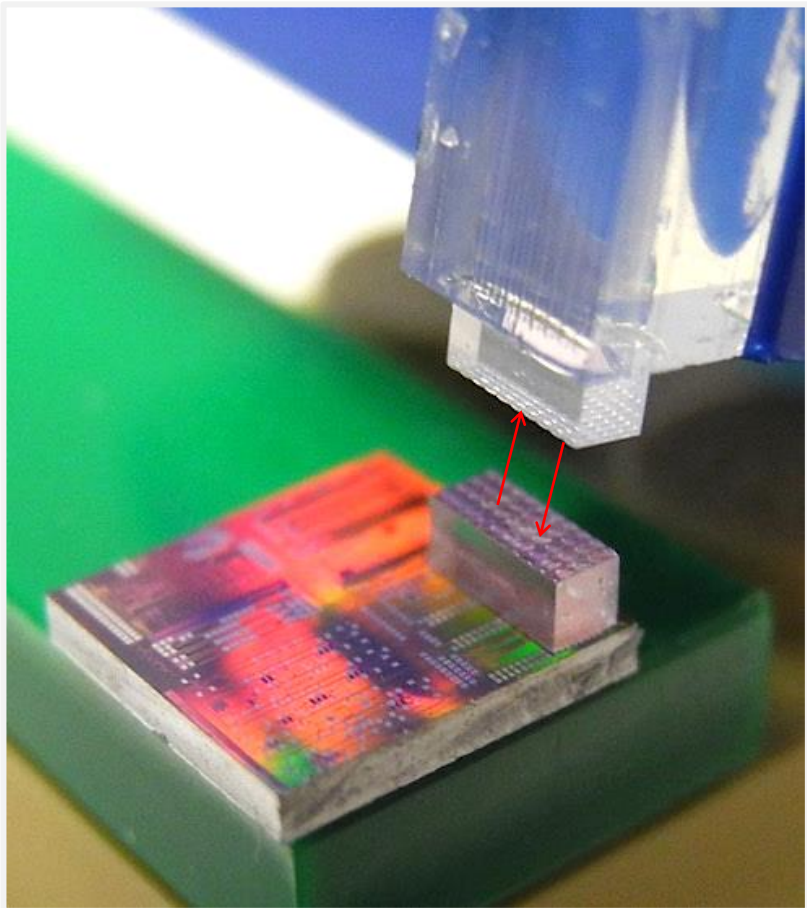


# Micro-Optics (wafer-level packaging)



*'PIXAPP Photonics Packaging Pilot Line - development of a silicon photonic optical transceiver with pluggable fibre connectivity'*  
*IEEE Journal of Selected Topics in Quantum Electronics, May 2022.*

# Micro-Optics (grating coupling)

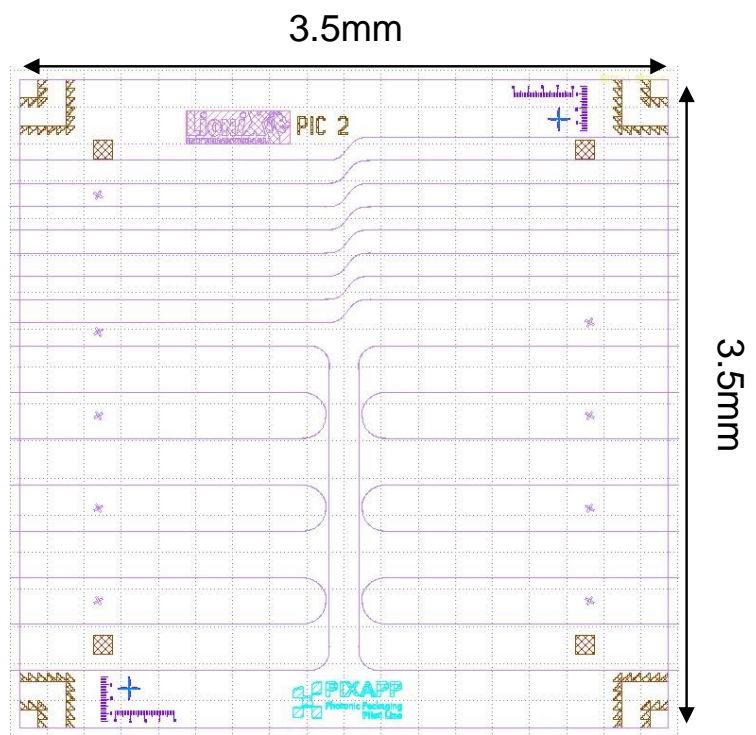
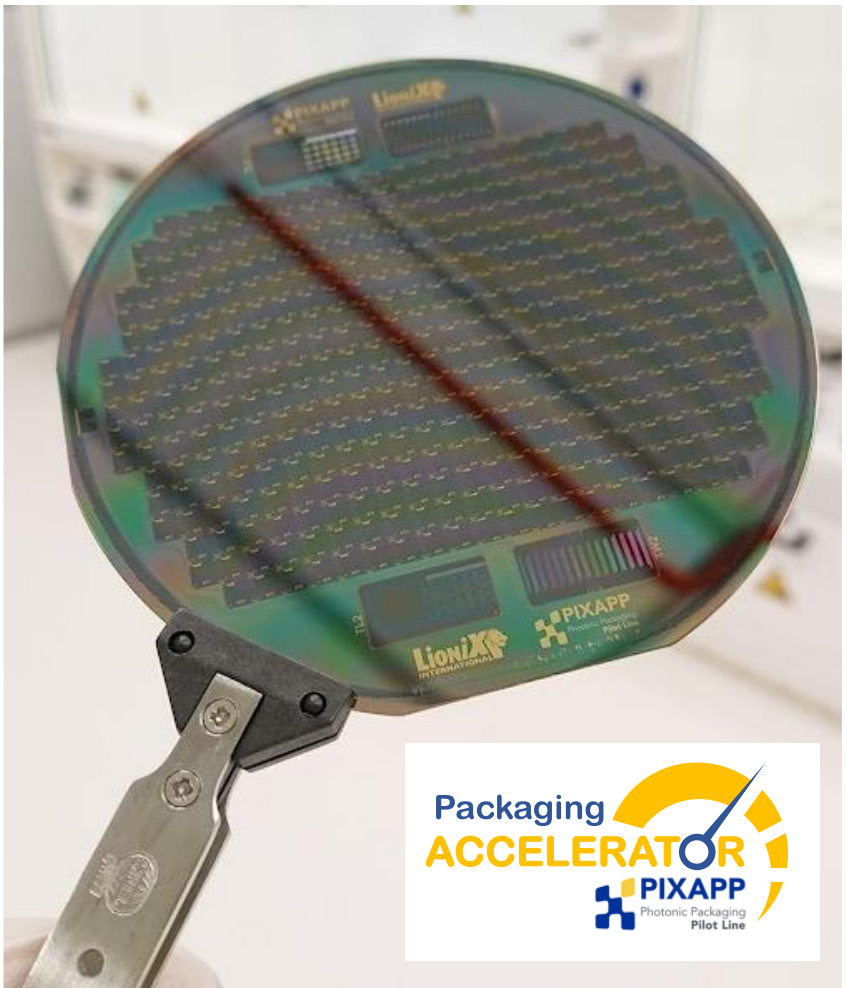


*'Pluggable single-mode fiber-array-to-PIC coupling using micro-lenses'*  
*IEEE Photonics Technology Letters, Sept 2017.*



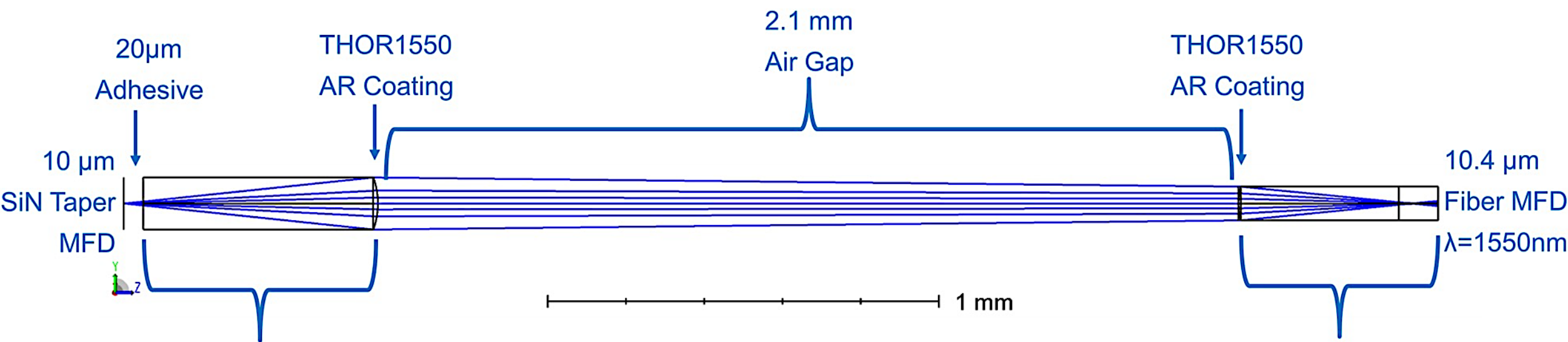


# Micro-Optics (edge coupling)





# Micro-Optics (edge coupling)



## SUSS Lens Array #18-00997

<https://shop.suss-microoptics.com/collections/couplers-collimators-1>

Fused Silica

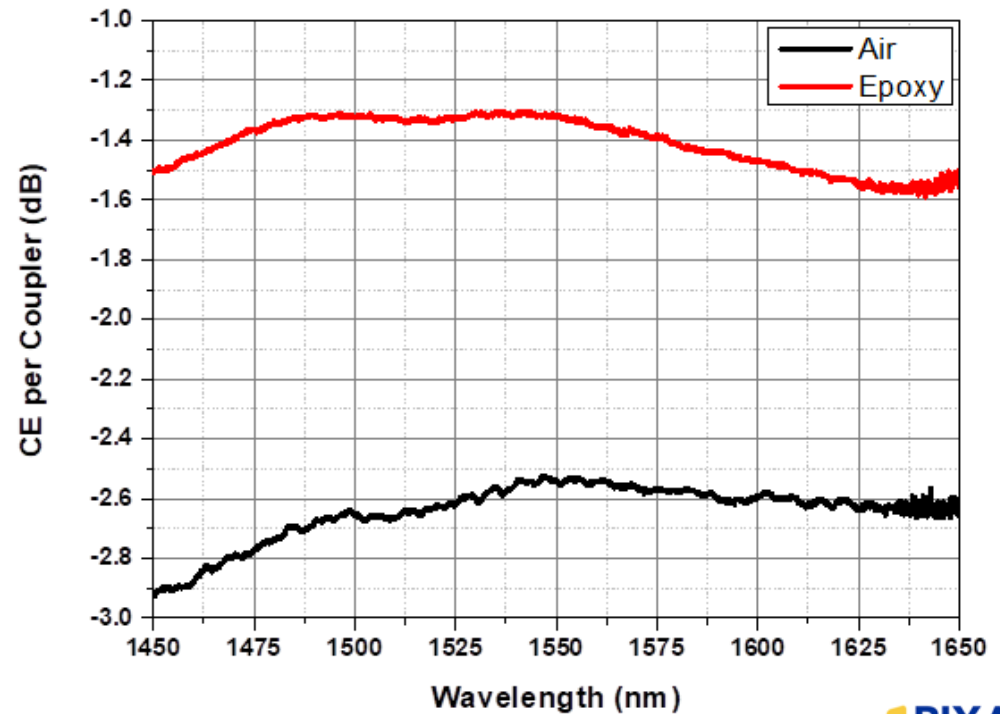
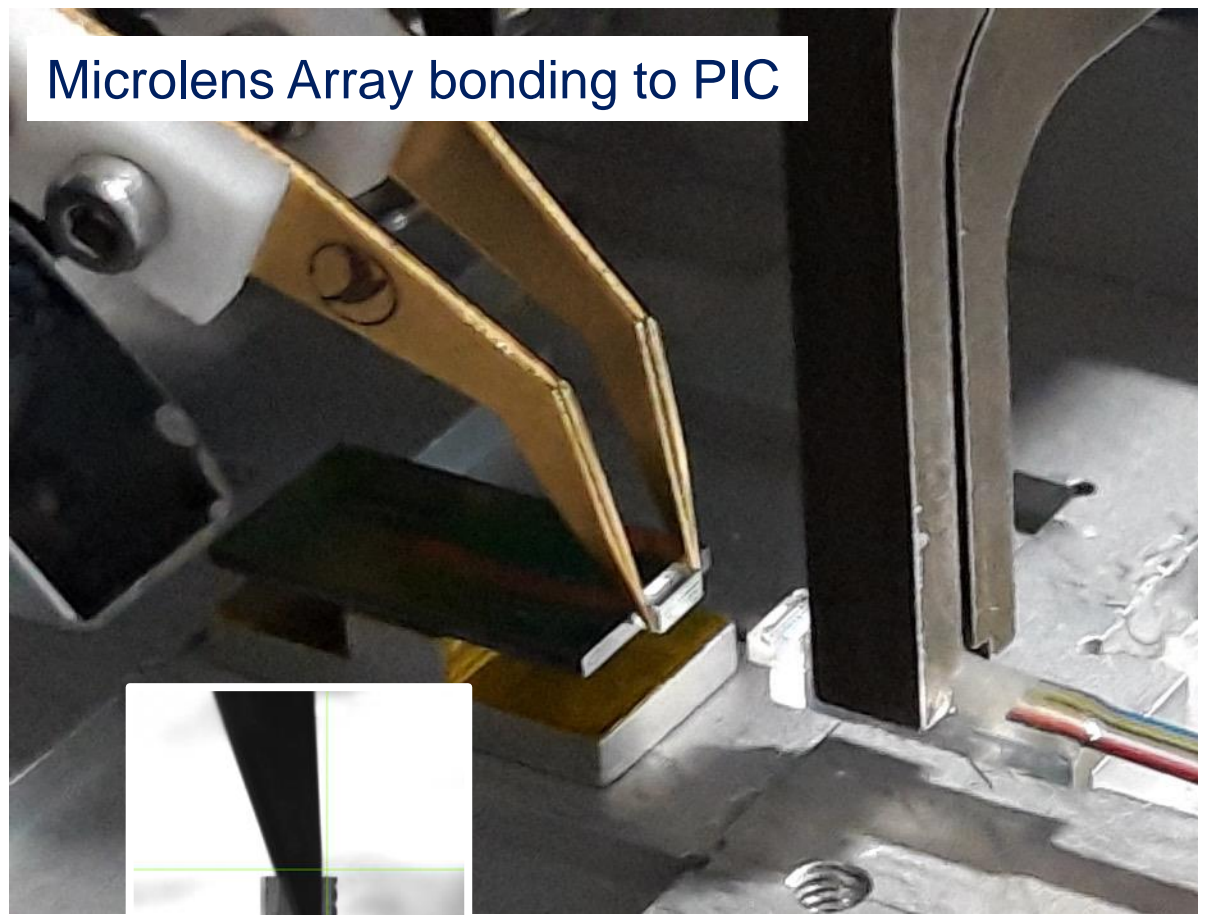
Thickness=0.6mm

Radius of Curvature=0.192mm

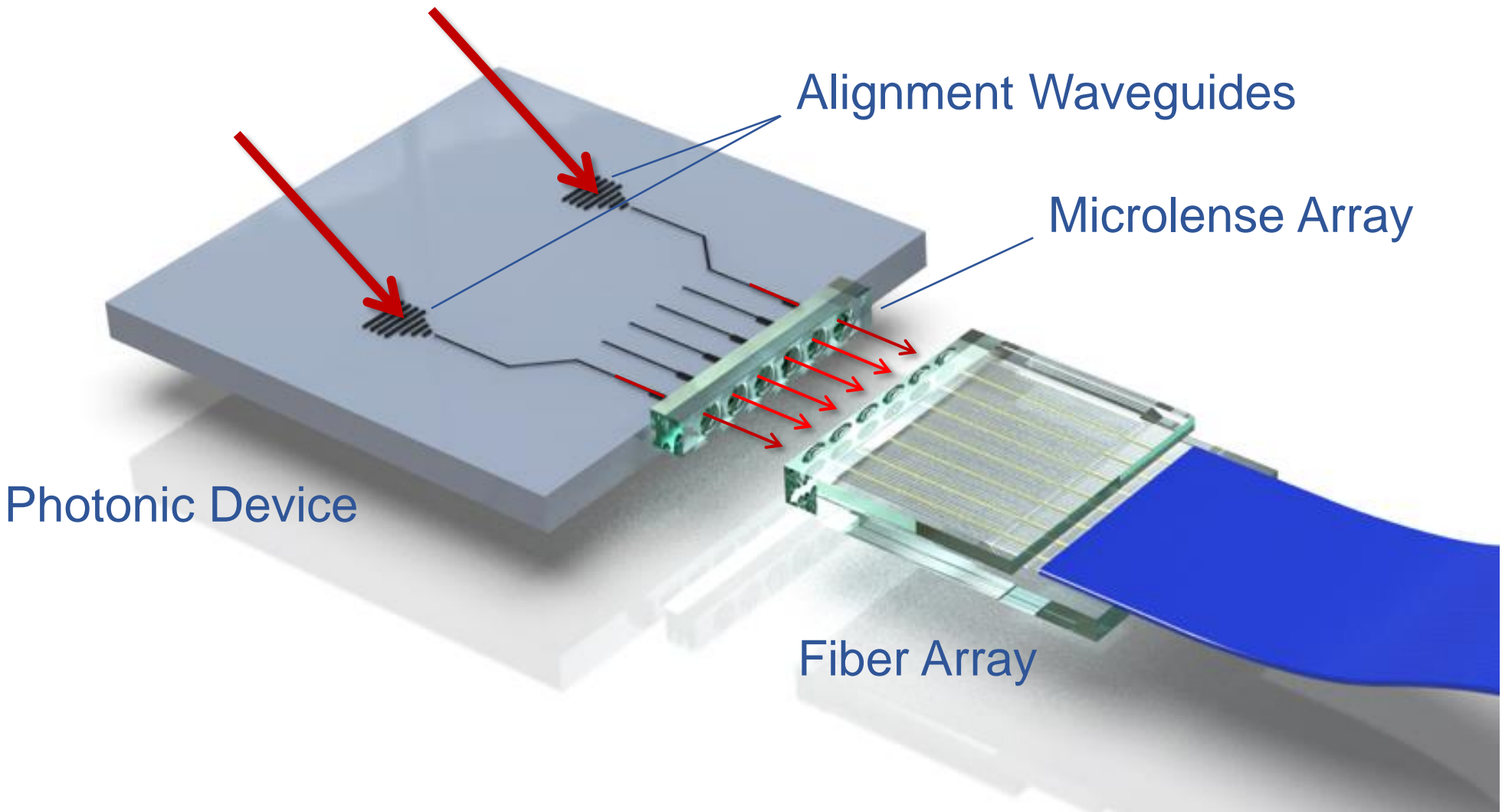
## MT Expanded Beam Ferrule

# Micro-Optics (edge coupling)

Micro-lens Array bonding to PIC

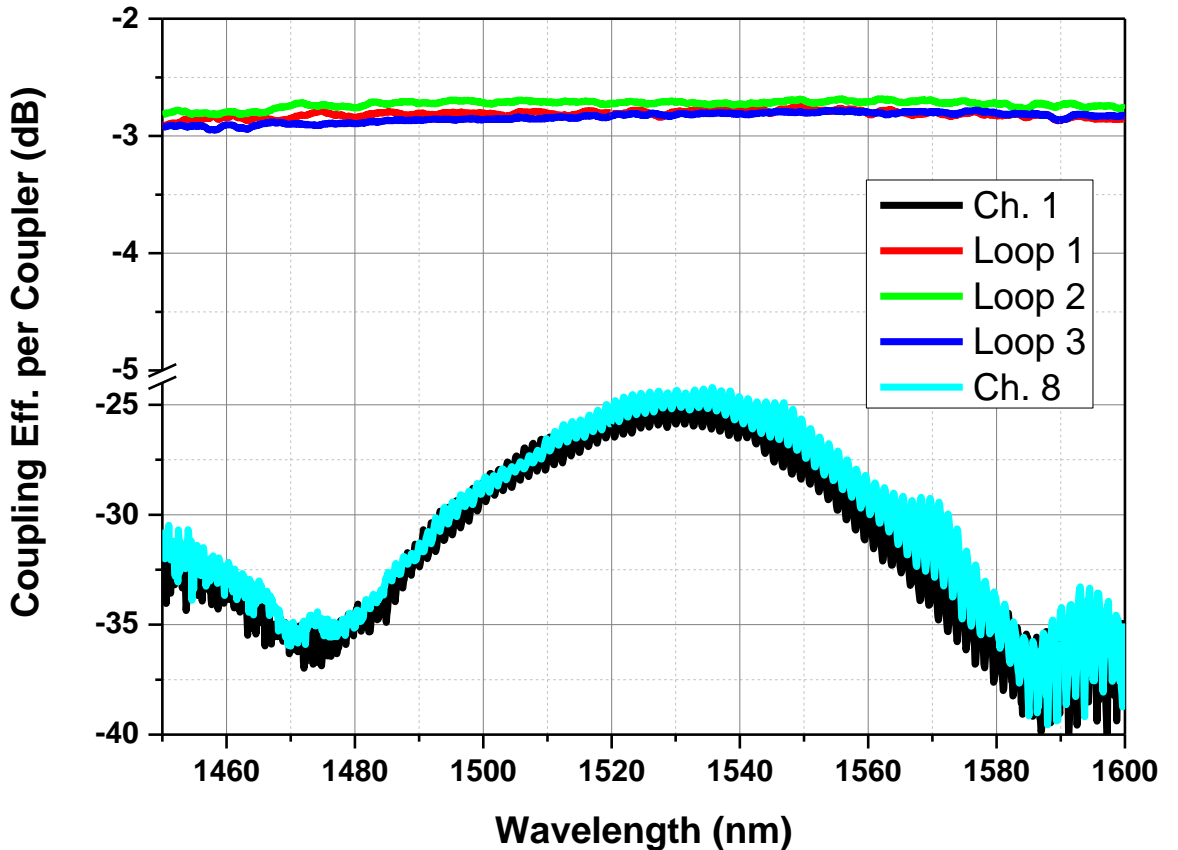
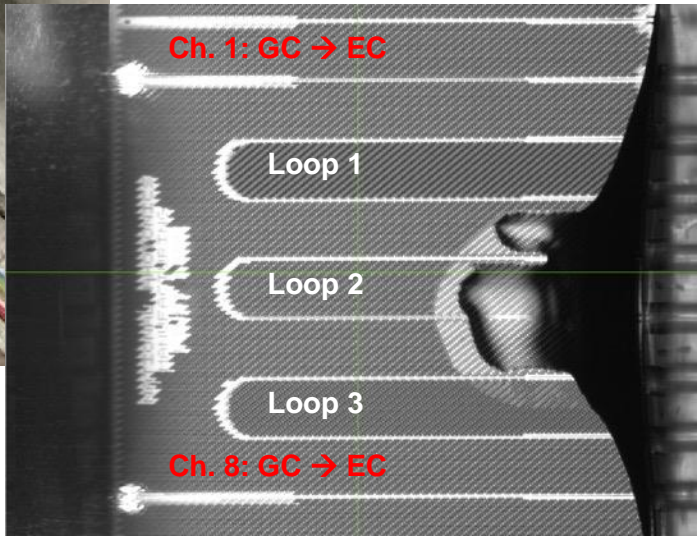


# Micro-Optics (new design rule)



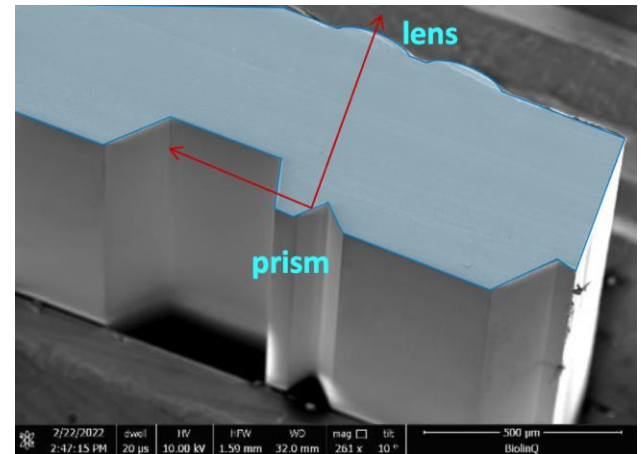
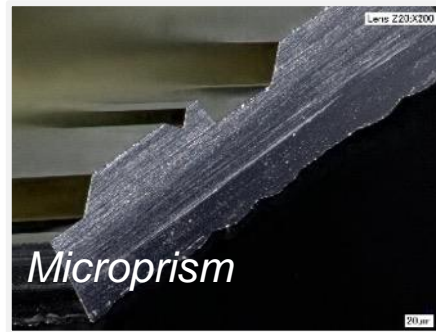
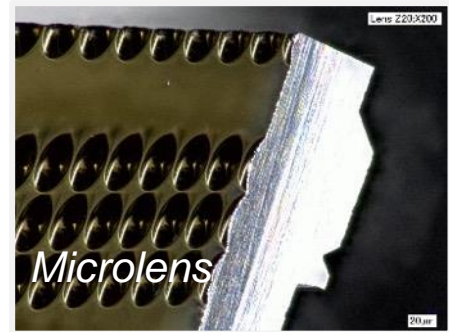
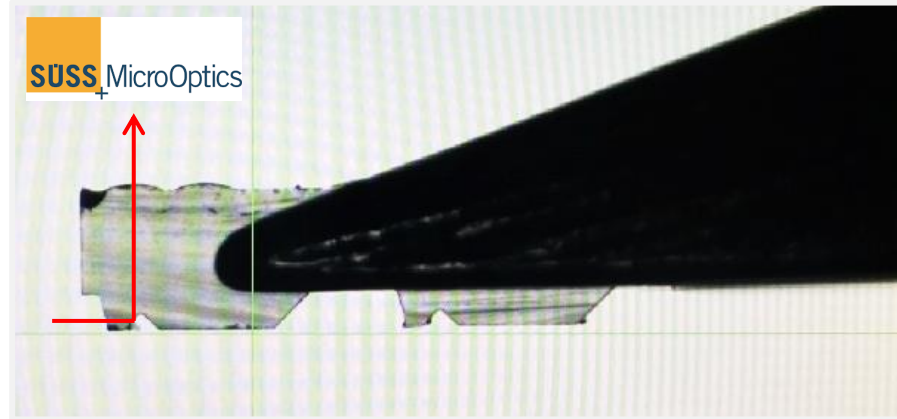
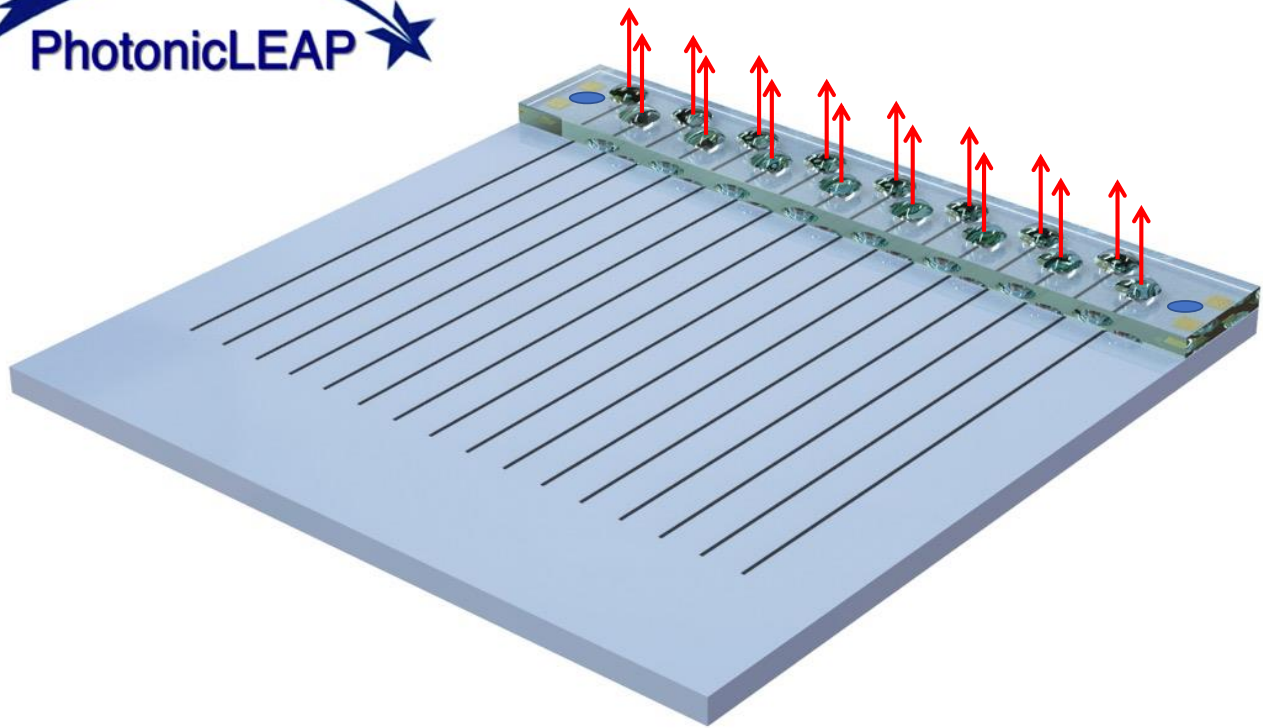


# Micro-Optics (new design rule)



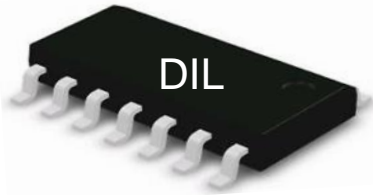


# Micro-Optics (surface coupling)

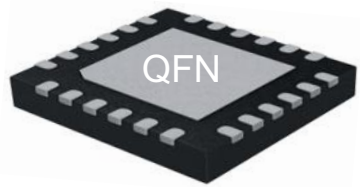


# Wafer-Level Packaging

## Surface Mount Electronics



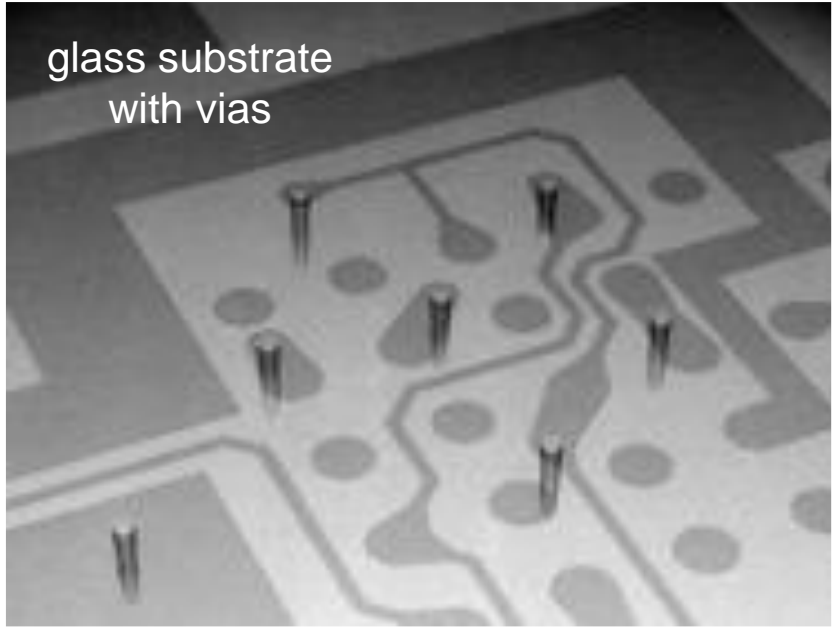
DIP



QFN

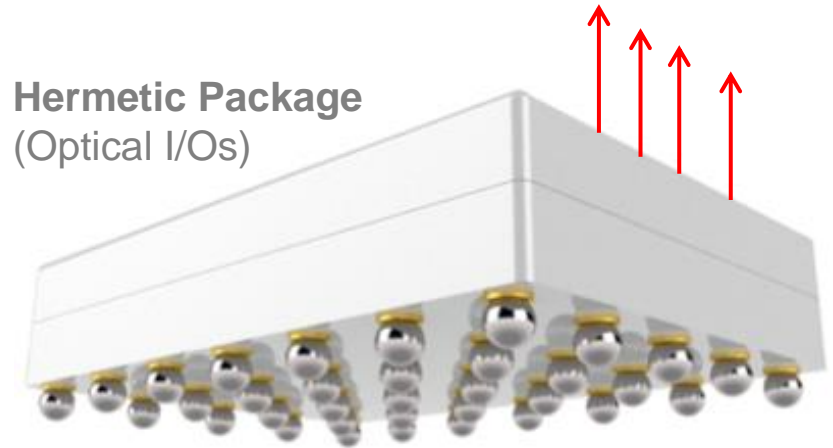


BGA



glass substrate with vias

## Surface Mount Photonics (standardised design)

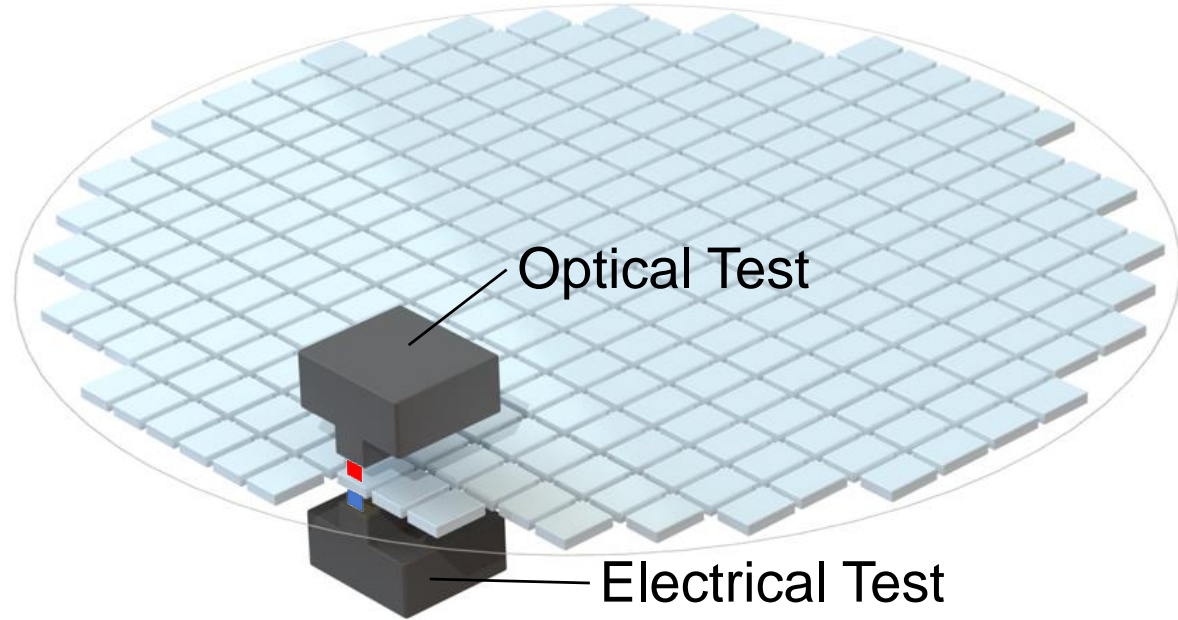
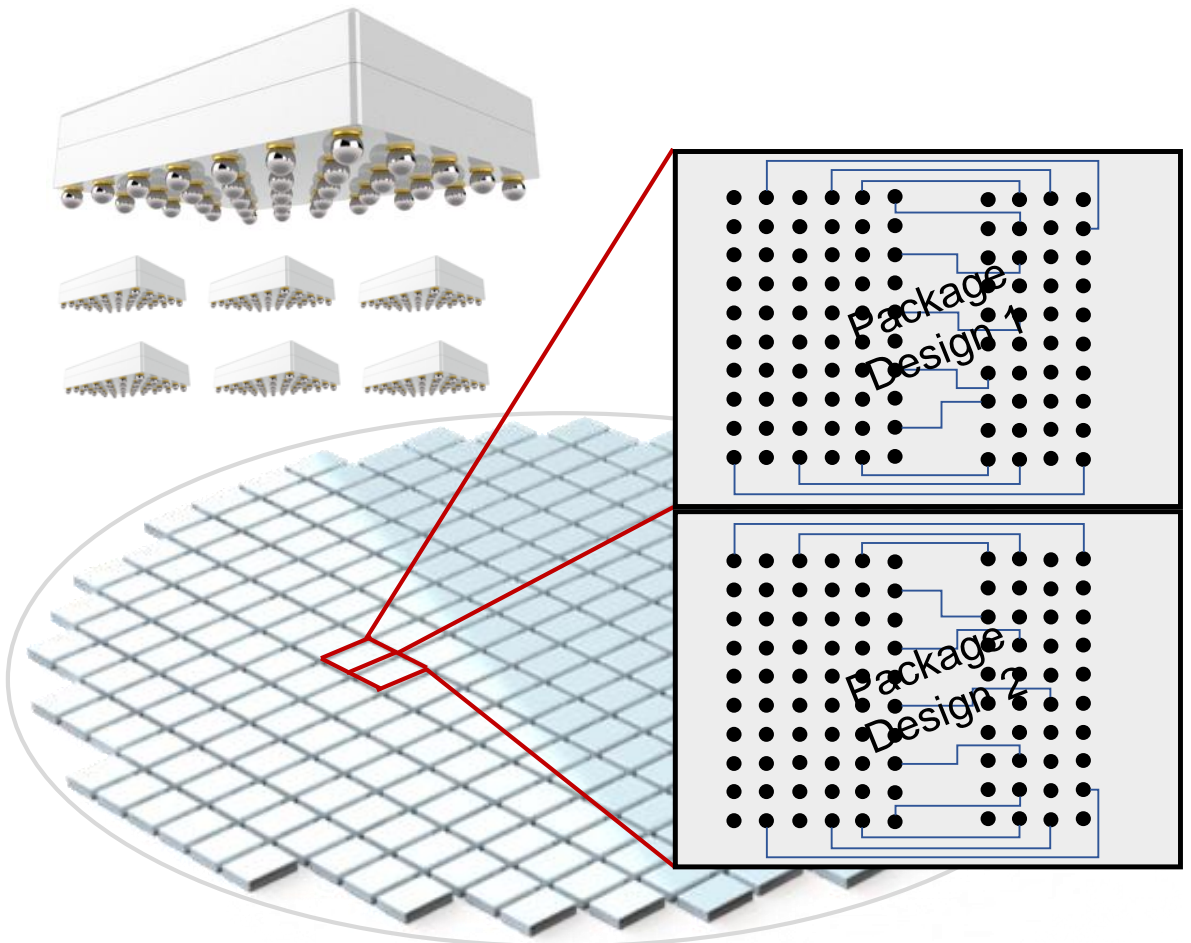


Hermetic Package (Optical I/Os)

Electrical Connections (DC & RF)



# Wafer-Level Packaging (MPWs)



- Multi-Project Packaging (MPW) Runs
- Scale-up to Volume Manufacturing

- Standardized Wafer-Level Test
- Automated Electro-Optical Test





# Thank You & Questions

## Acknowledgements

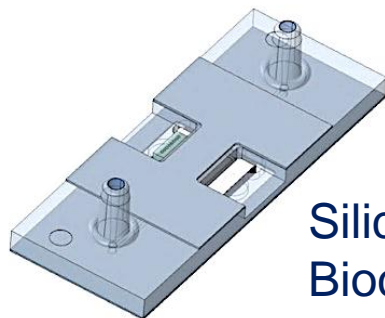
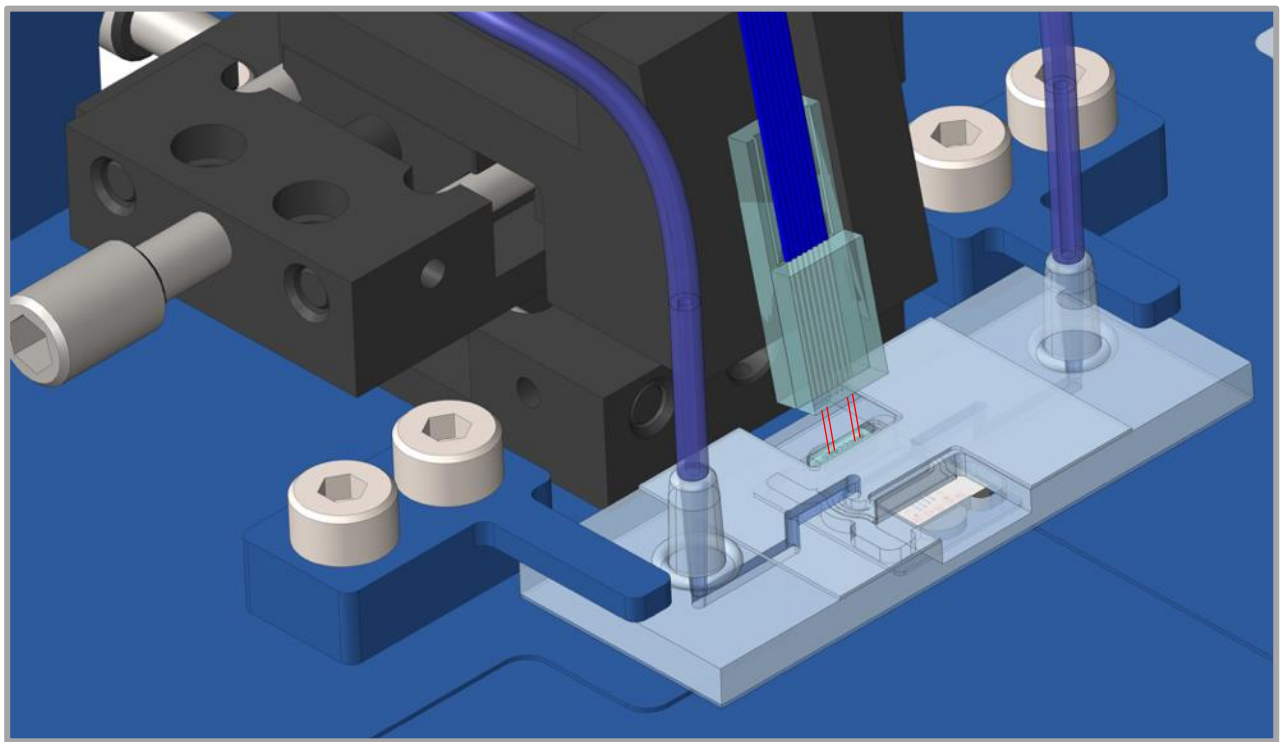


PHOTONICS PUBLIC PRIVATE PARTNERSHIP

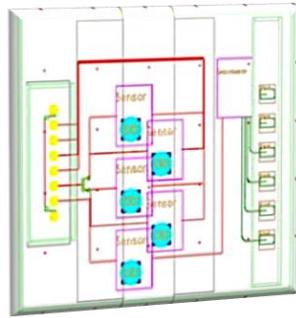
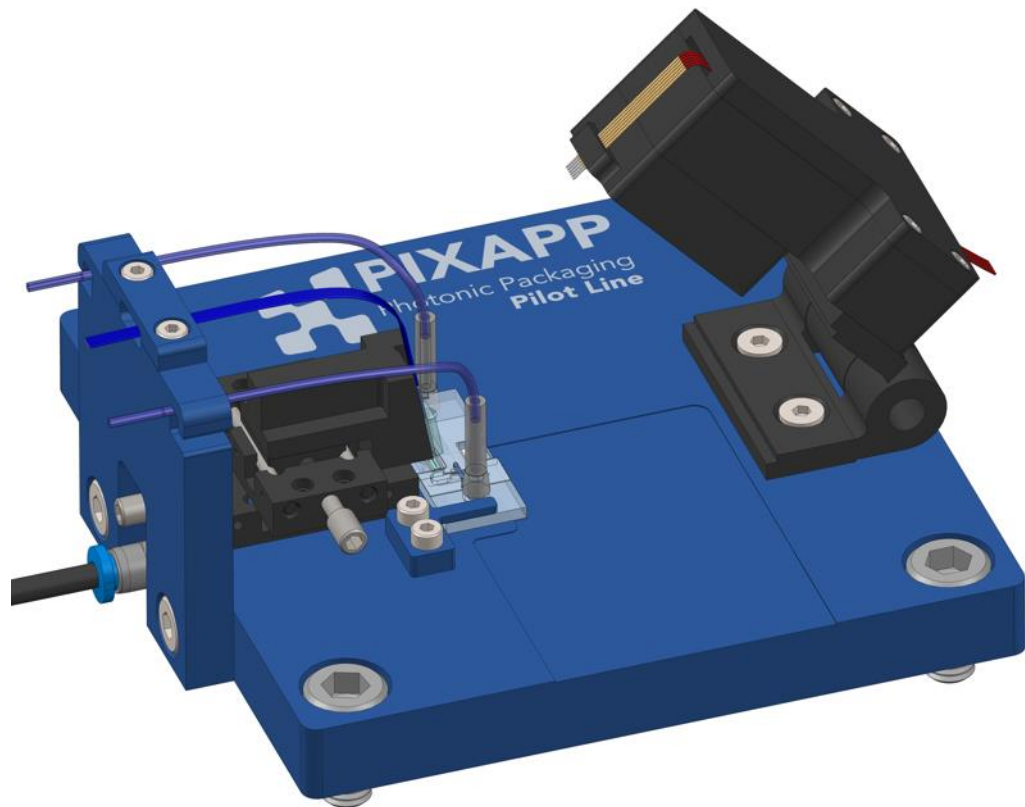




# Micro-Optics (biomedical demonstrator)



Silicon Photonic Biochip



Biochip Assembly Design Kit

# Micro-Optics (biomedical demonstrator)

