

Packaging of Integrated Photonic Devices;

Applications, User Foundry Services & Design Rules

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Irish Photonics Integration Centre

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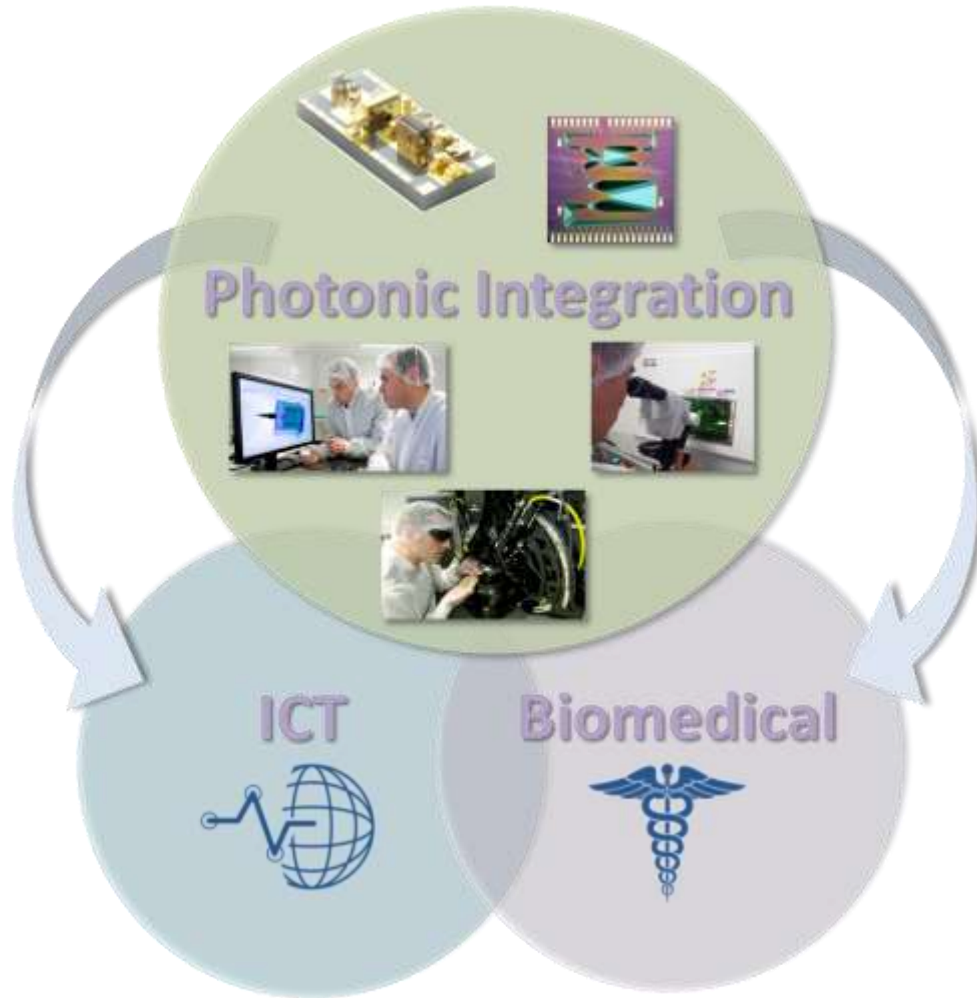


Ireland's Largest Research Institute

- Photonics
- Microsystems
- Nanotechnology
- Theory Modelling & Design



Photonic Integration at Tyndall



Simulation & Design

Materials & Epitaxy

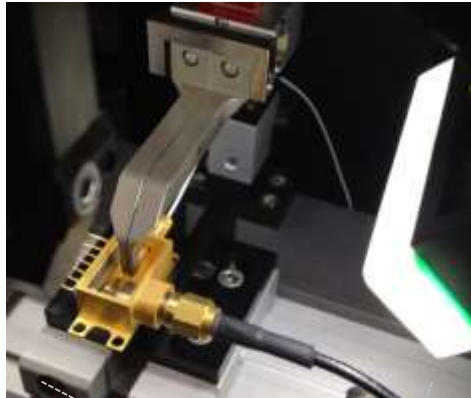
Fabrication & Devices

Packaging & Integration (2009)

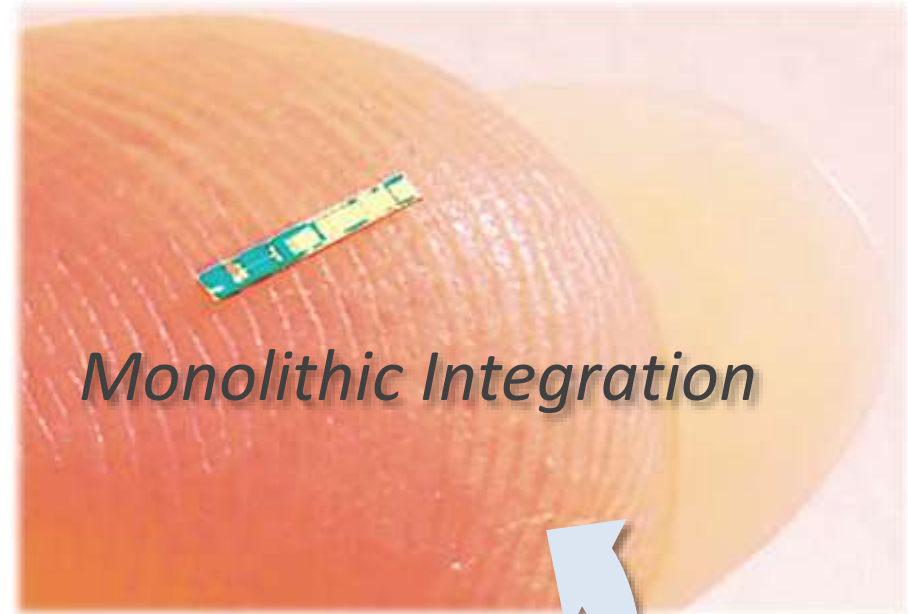
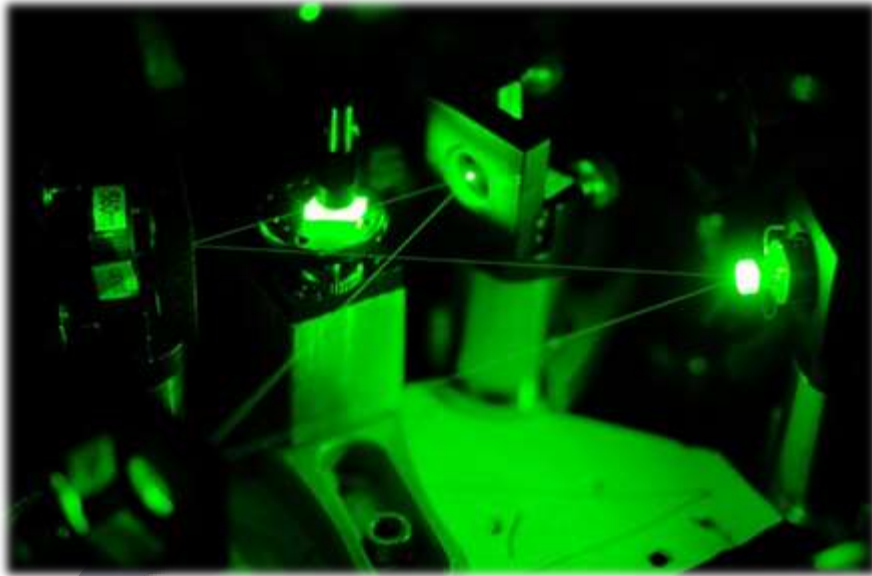
Photonic Systems



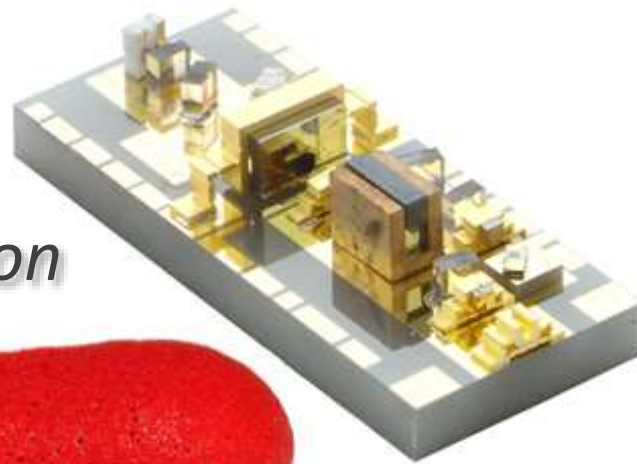
Photonic Integration Laboratory



Photonic Integration



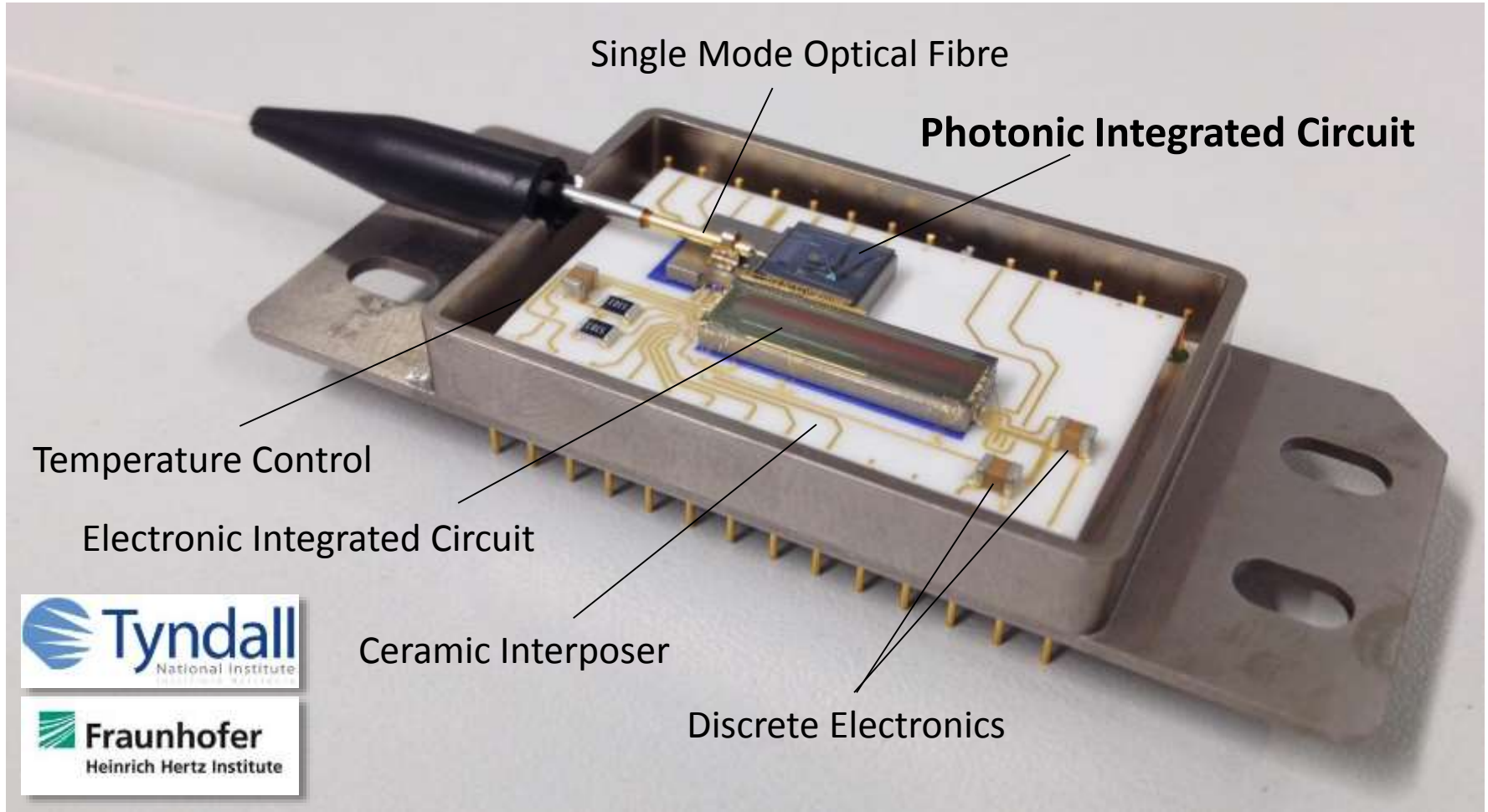
Monolithic Integration



Hybrid Integration

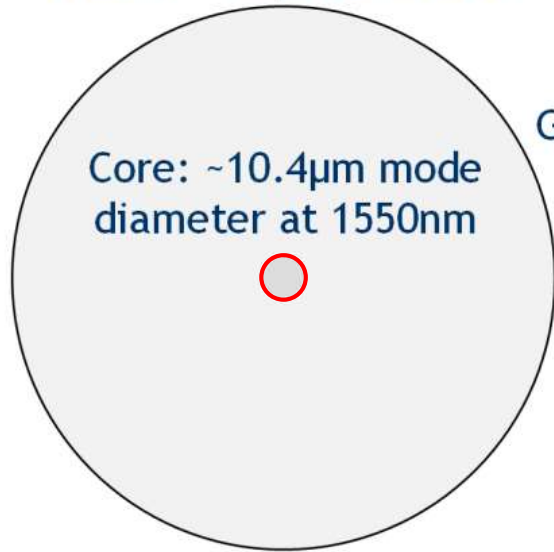


Photonic Integration (Many Challenges)



Optical Integration (Fibre Coupling)

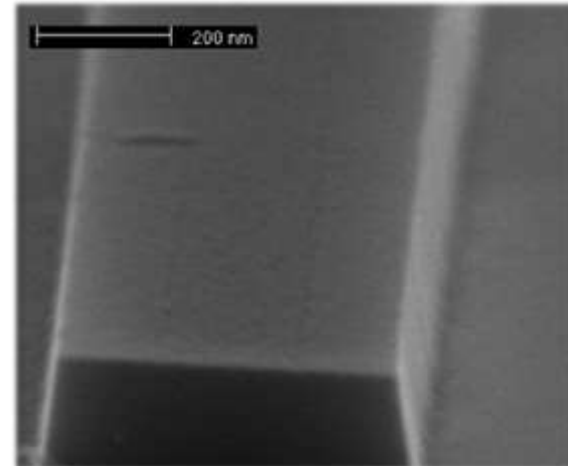
Fiber: $\sim 125\mu\text{m}$ diameter



Grating: $12\mu\text{m} \times 20\mu\text{m}$

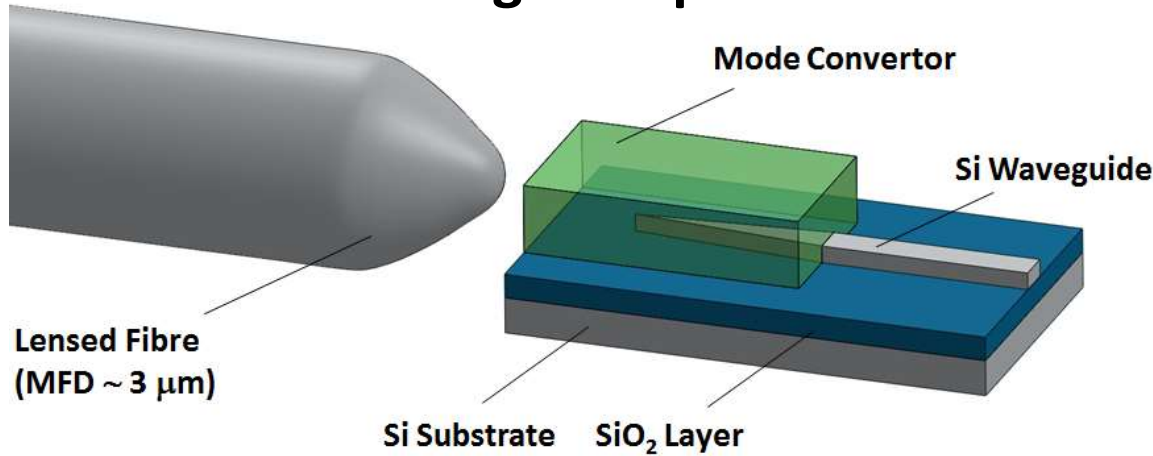


SOI Waveguide: $0.45\mu\text{m} \times 0.22\mu\text{m}$

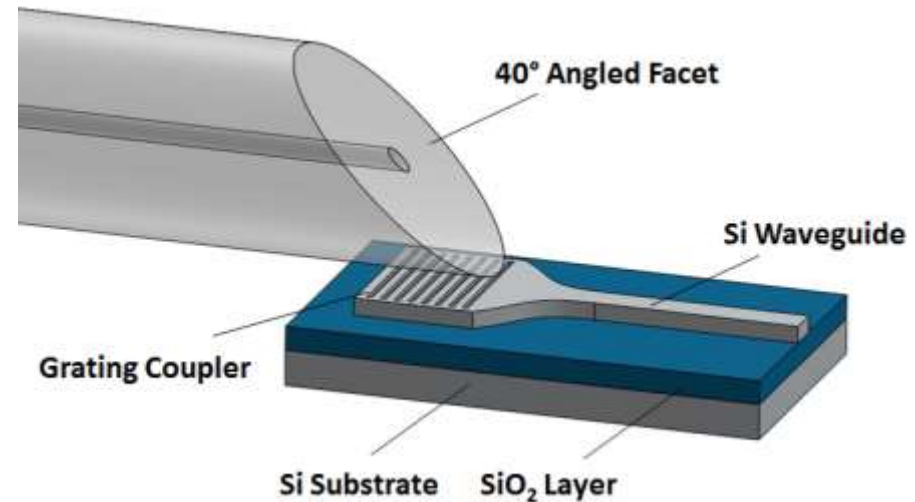


Optical Integration (Fibre Coupling - Silicon)

1. Edge Coupled

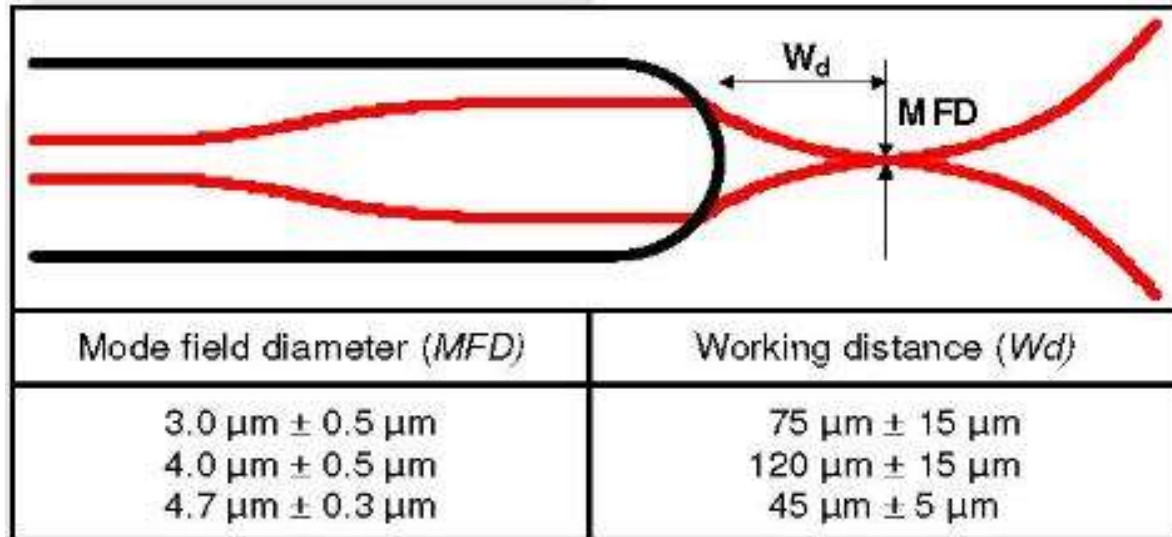
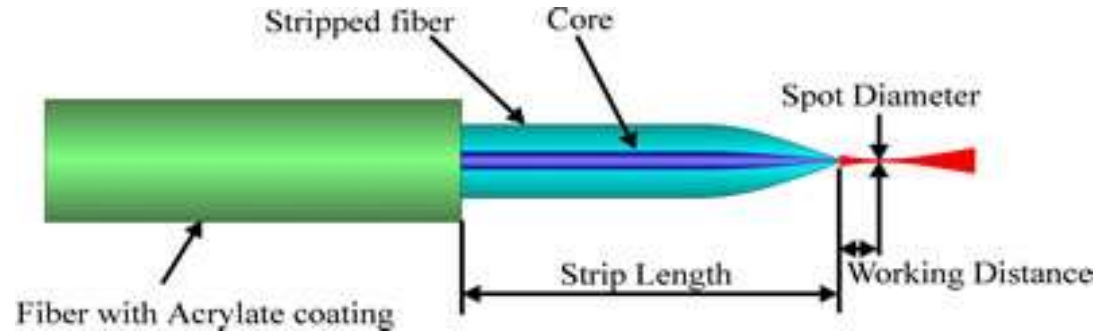
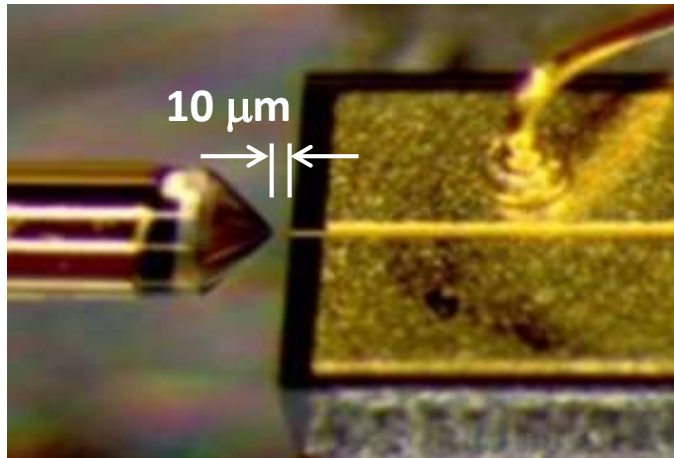


2. Grating Coupled

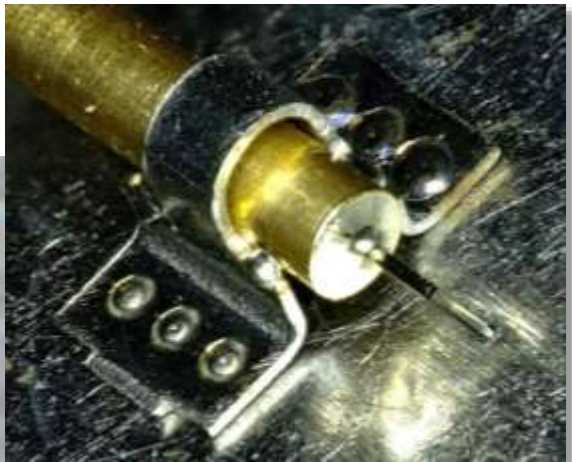
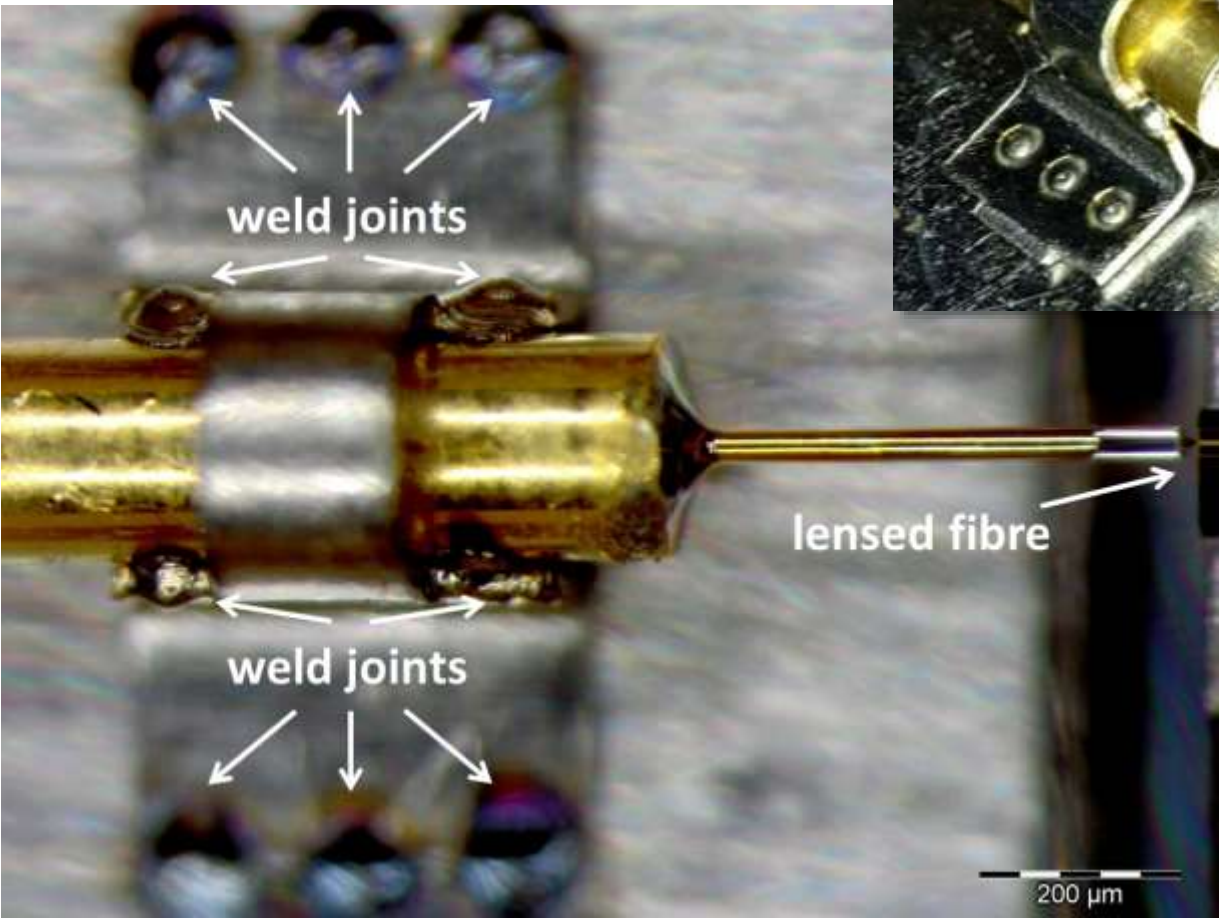


Challenge: Fibre coupling to sub-micron waveguides

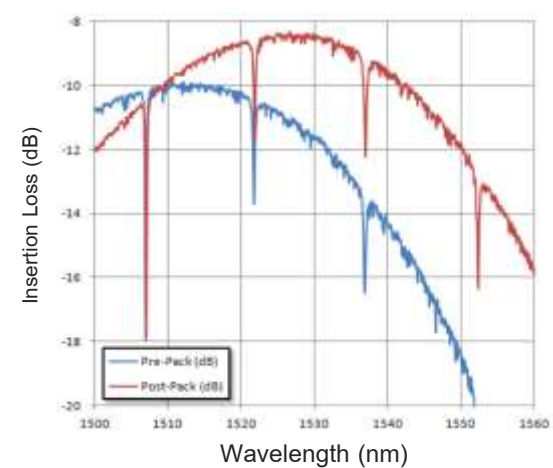
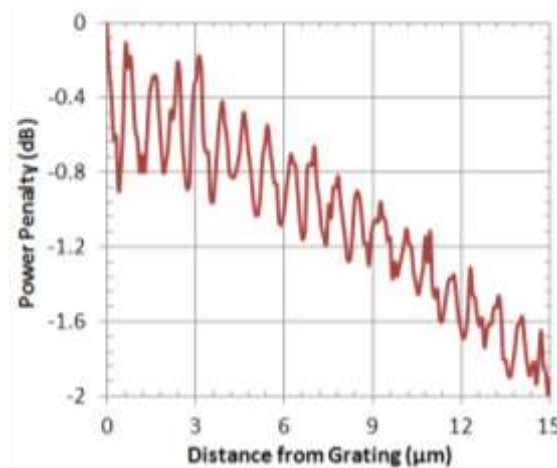
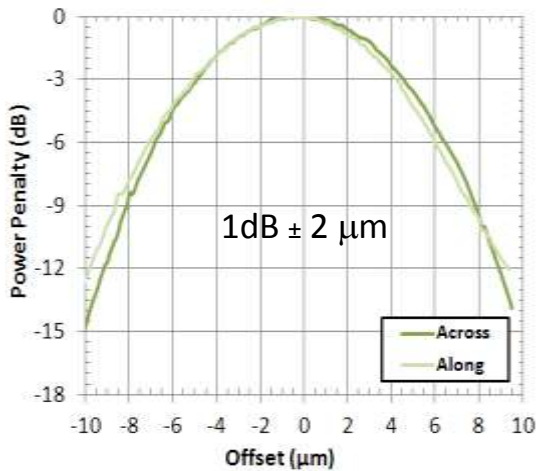
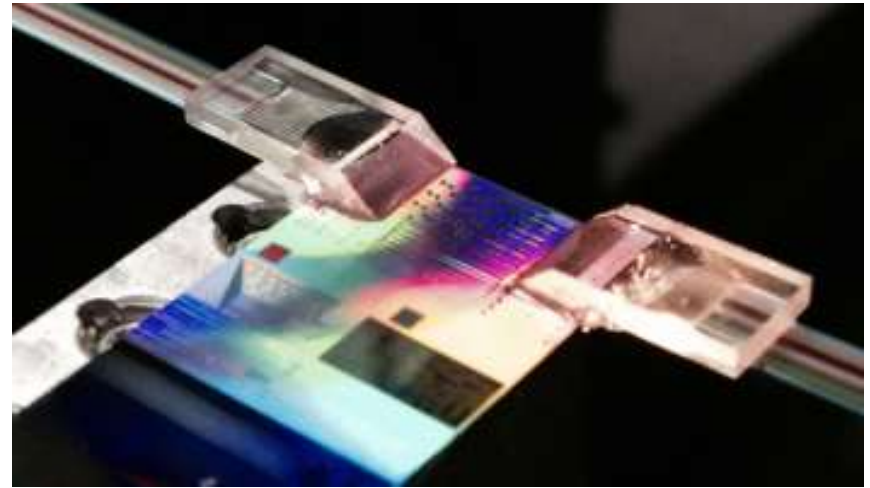
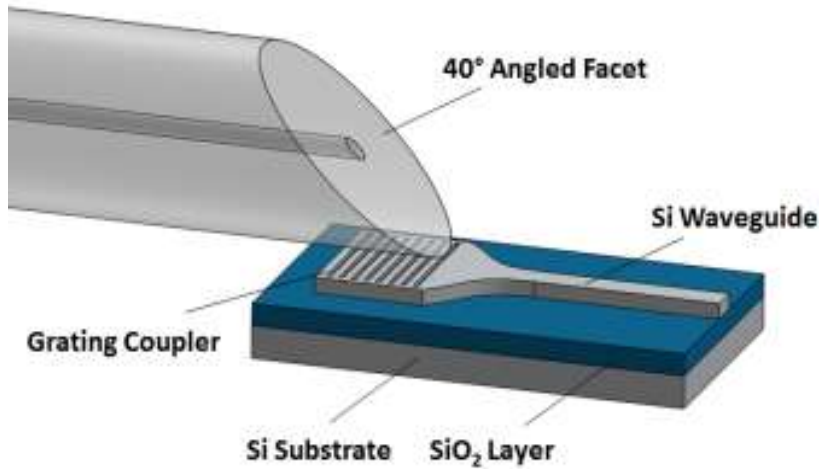
Optical Integration (Fibre Coupling)



Optical Integration (Fibre Coupling)

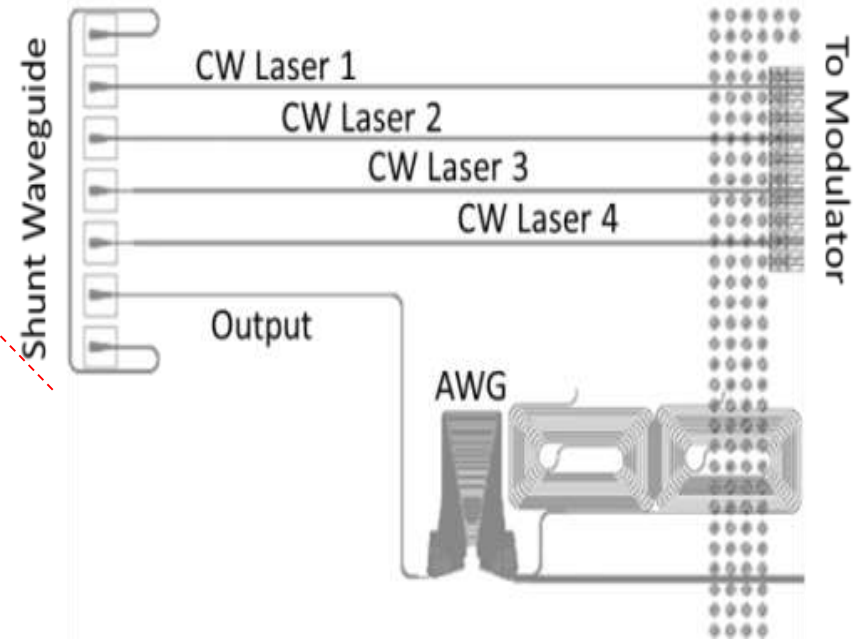
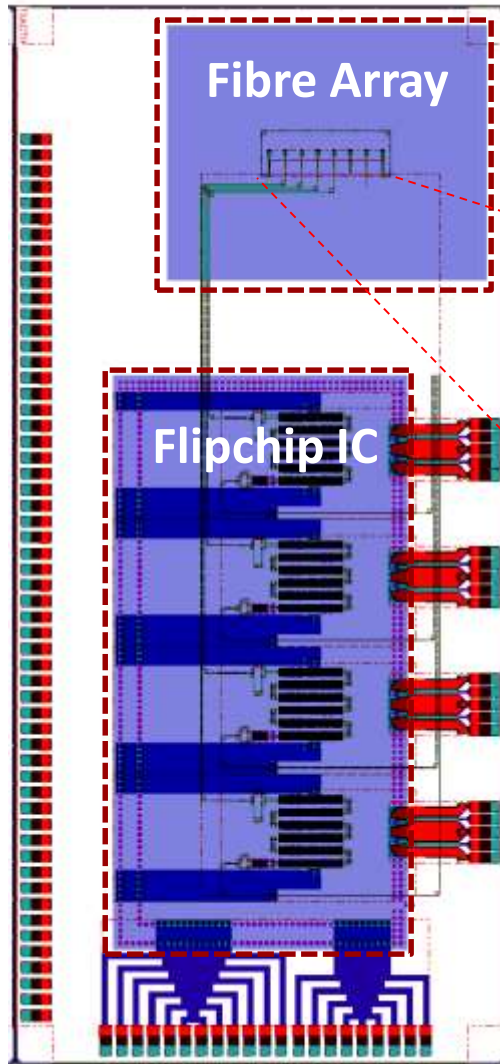


Optical Integration (Fibre Coupling - Silicon)

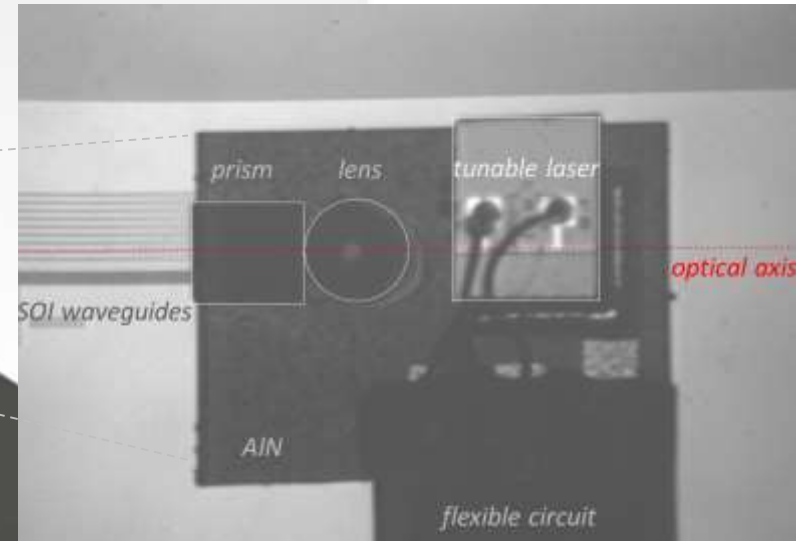
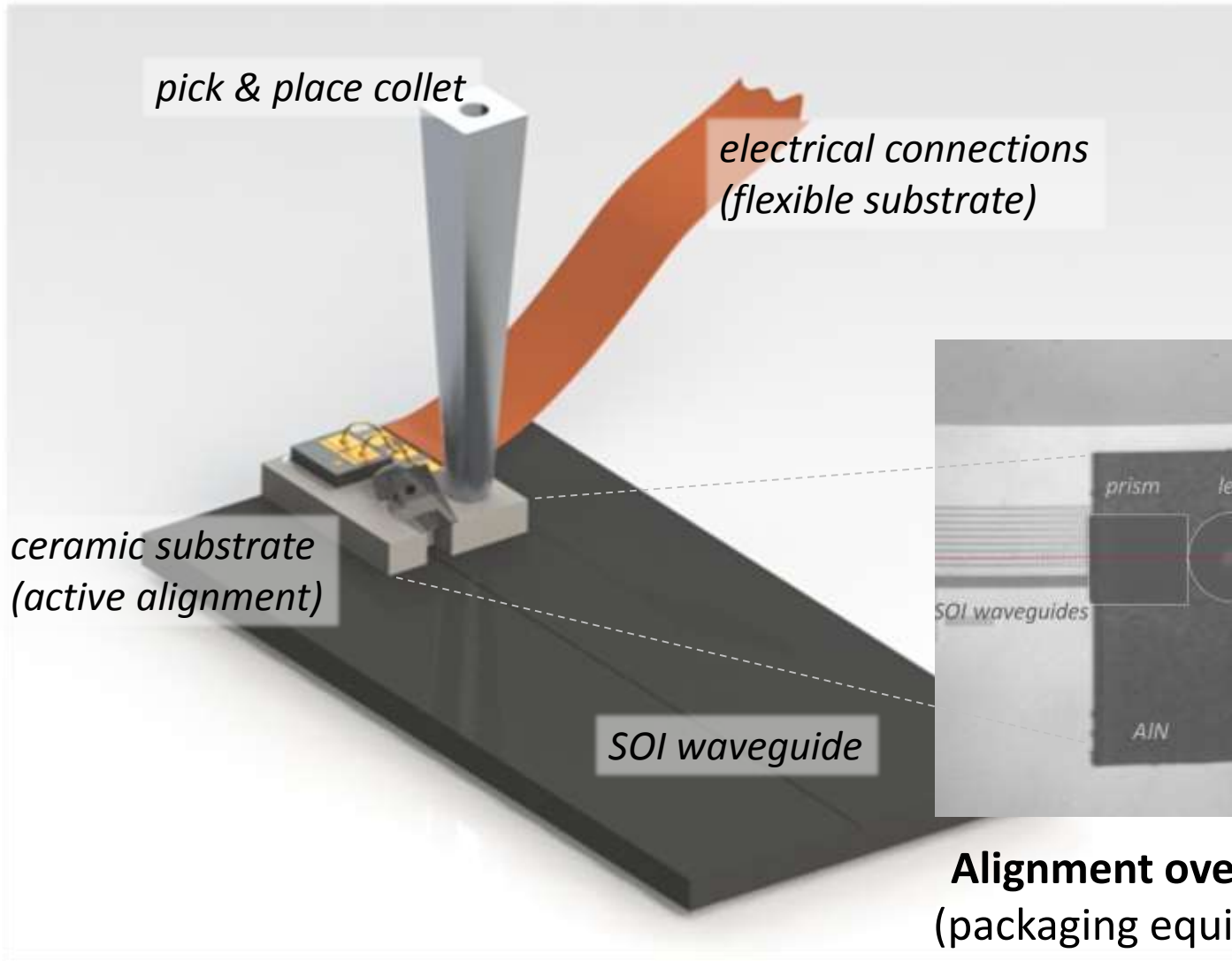


*“Packaging Process for Grating-Coupled Silicon Photonic Waveguides Using Angle-Polished Fibers”,
B. Snyder and P O’Brien, IEEE Trans on Comps, Packaging and Manufacturing Tech., Vol. 3, No. 6, June 2013.*

Optical Integration (Fibre Coupling Arrays - Silicon)

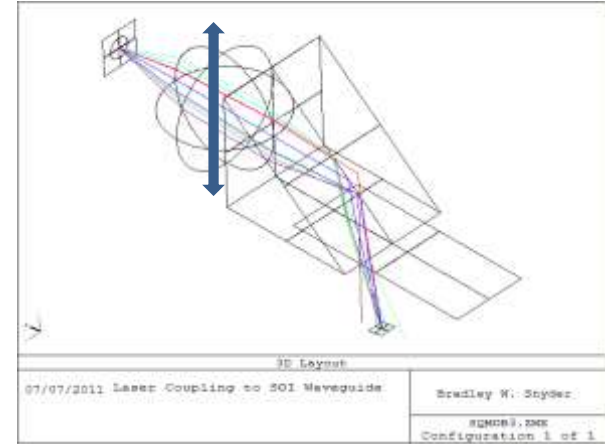
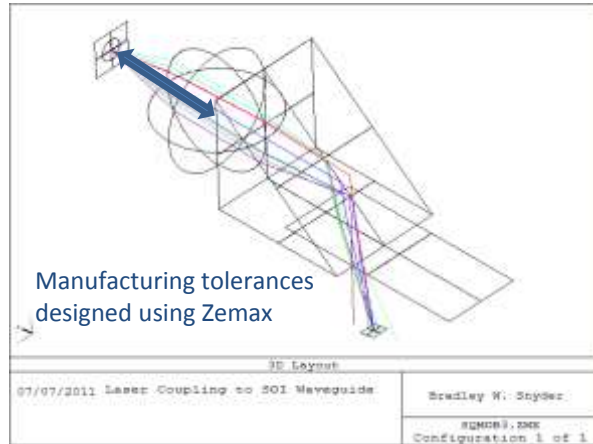


Optical Integration (Sources - Lasers)

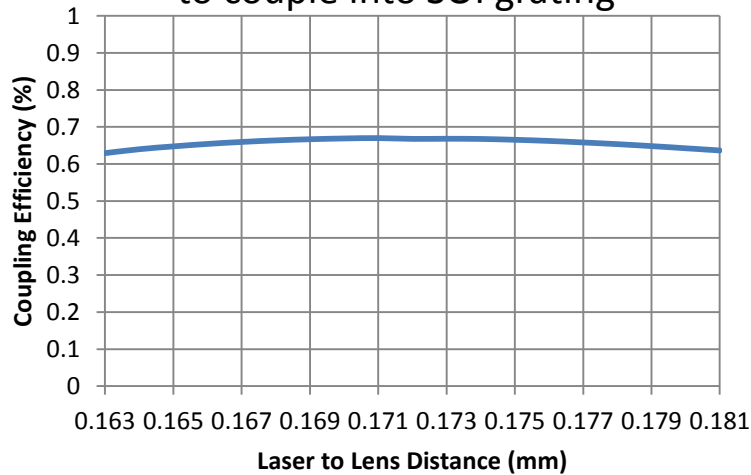


Alignment over waveguide grating
(packaging equipment vision system)

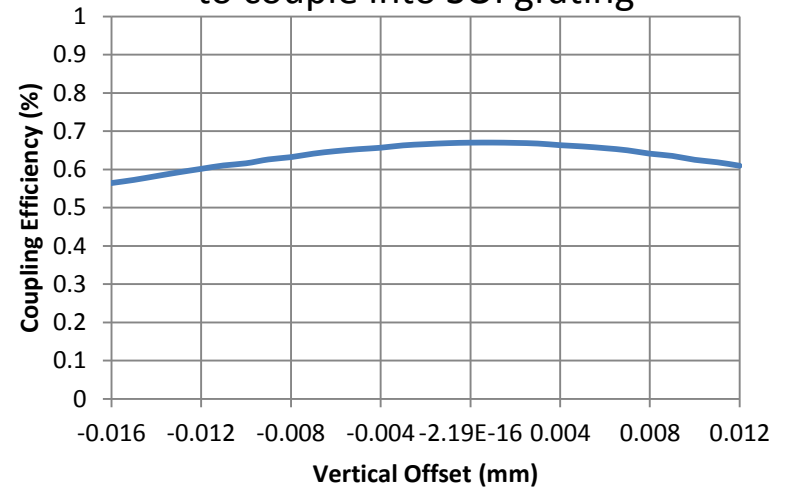
Optical Integration (Sources - Lasers)



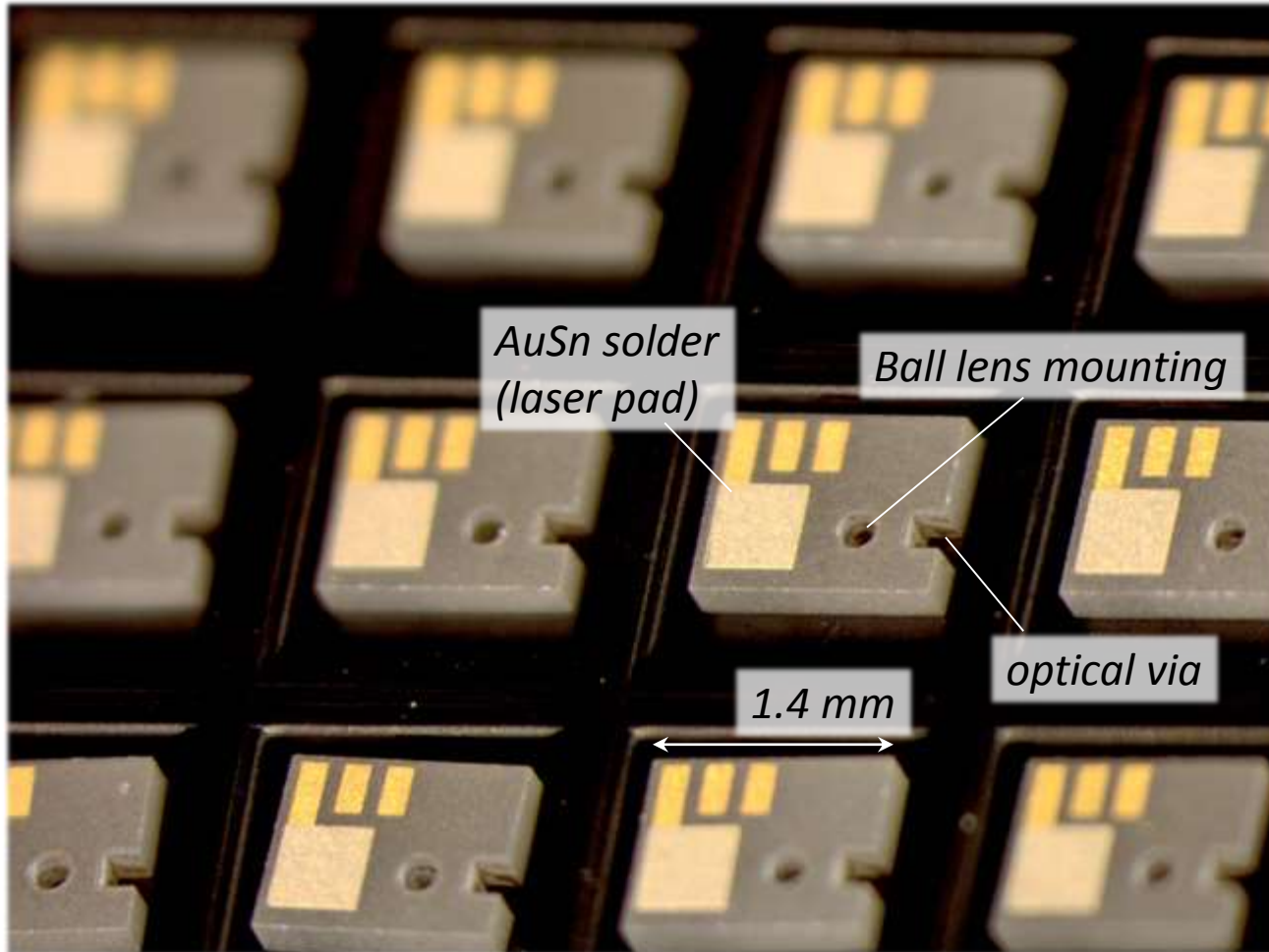
Laser placement tolerance to couple into SOI grating



Ball lens height tolerance to couple into SOI grating

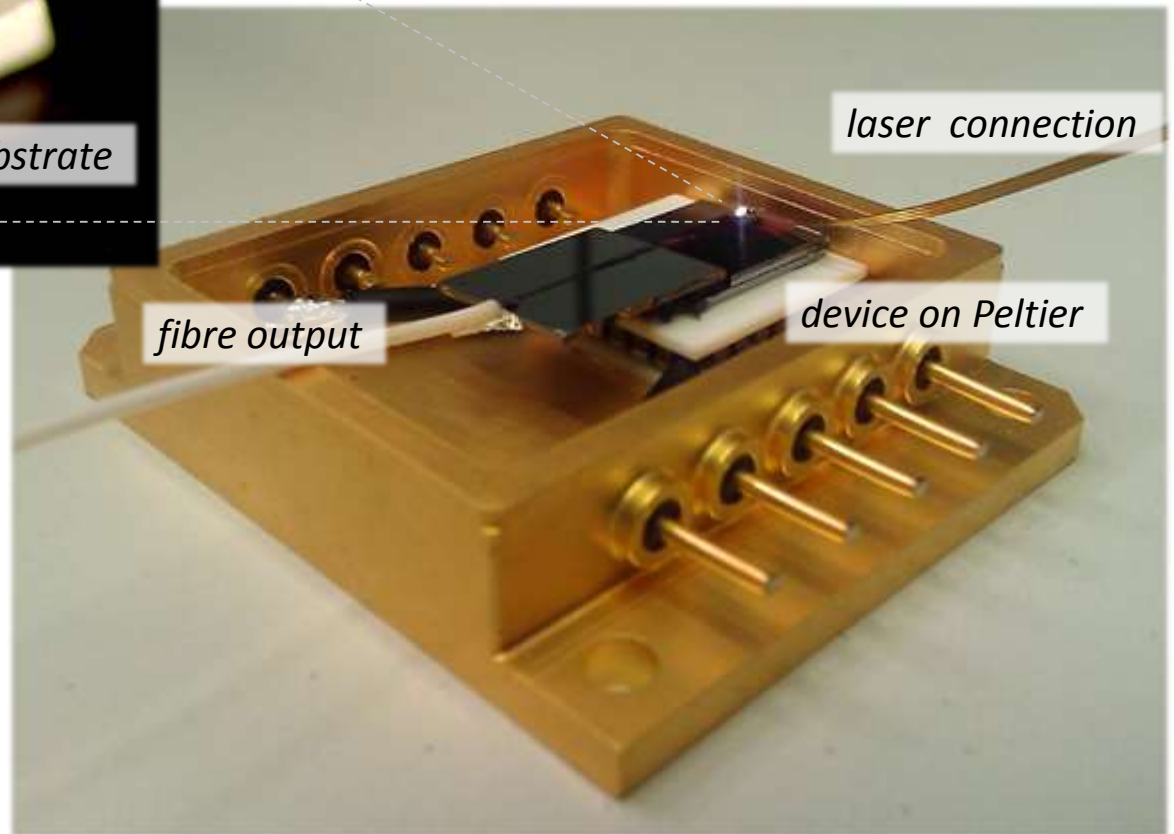
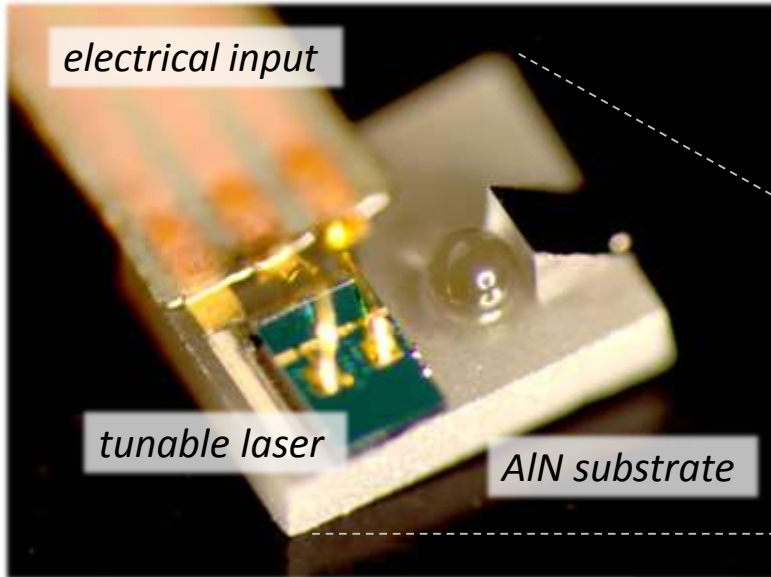


Optical Integration (Sources - Lasers)



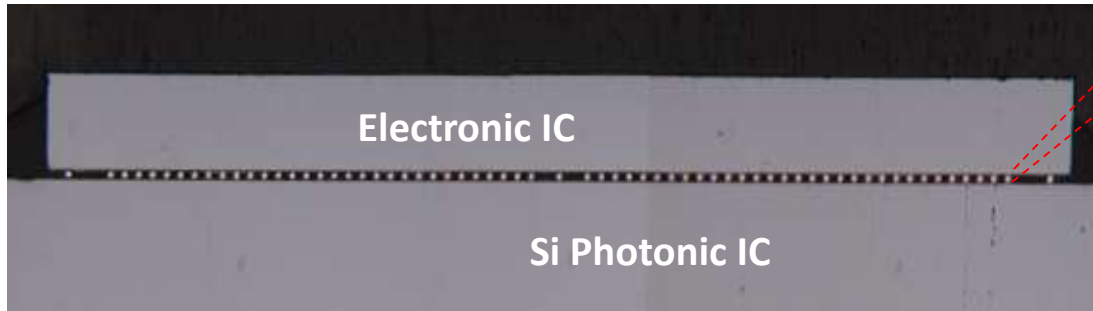
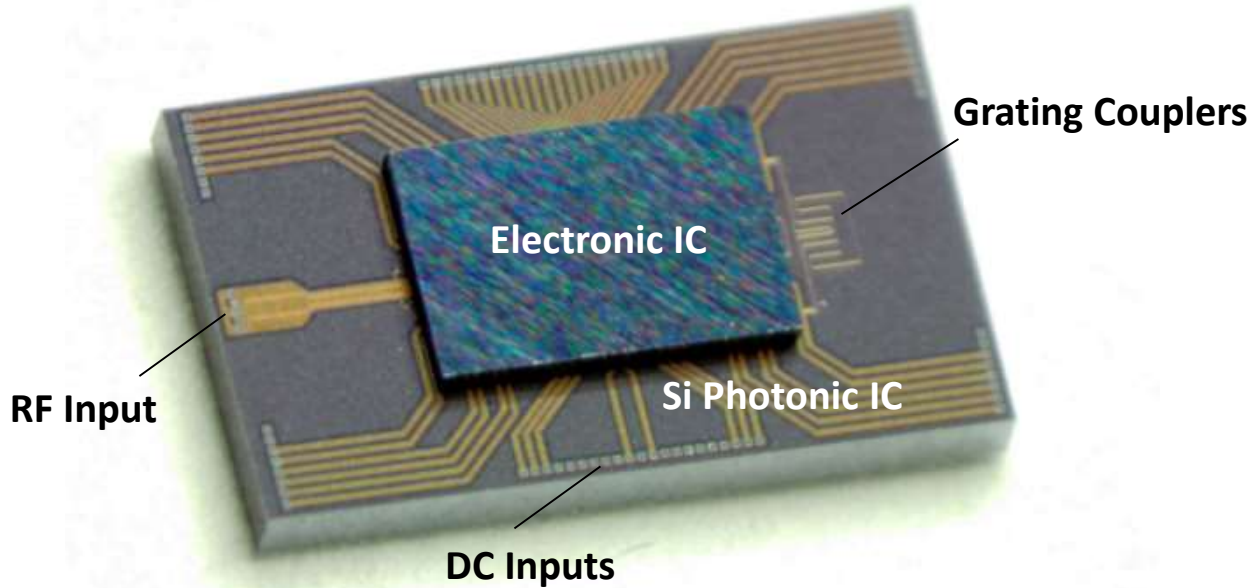
AlN ceramic submounts for laser integration on Silicon

Optical Integration (Sources - Lasers)

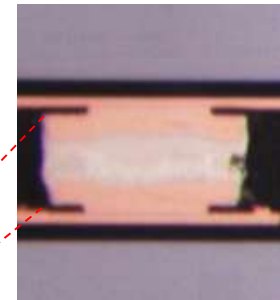


“Hybrid integration of wavelength-tunable laser with silicon photonic integrated circuit”,
B. Snyder, B. Corbett and P O’Brien, IEEE, Journal of Lightwave Tech., Vol. 31, No. 24, Dec 2013.

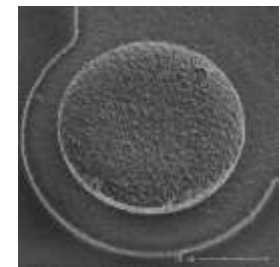
Electronic Integration (Drivers, Modulators, ...)



Flipchip Integrated Photonic-Electronic Sub-Assembly



20 μm Copper Pillar
SnAgCu Solder Cap

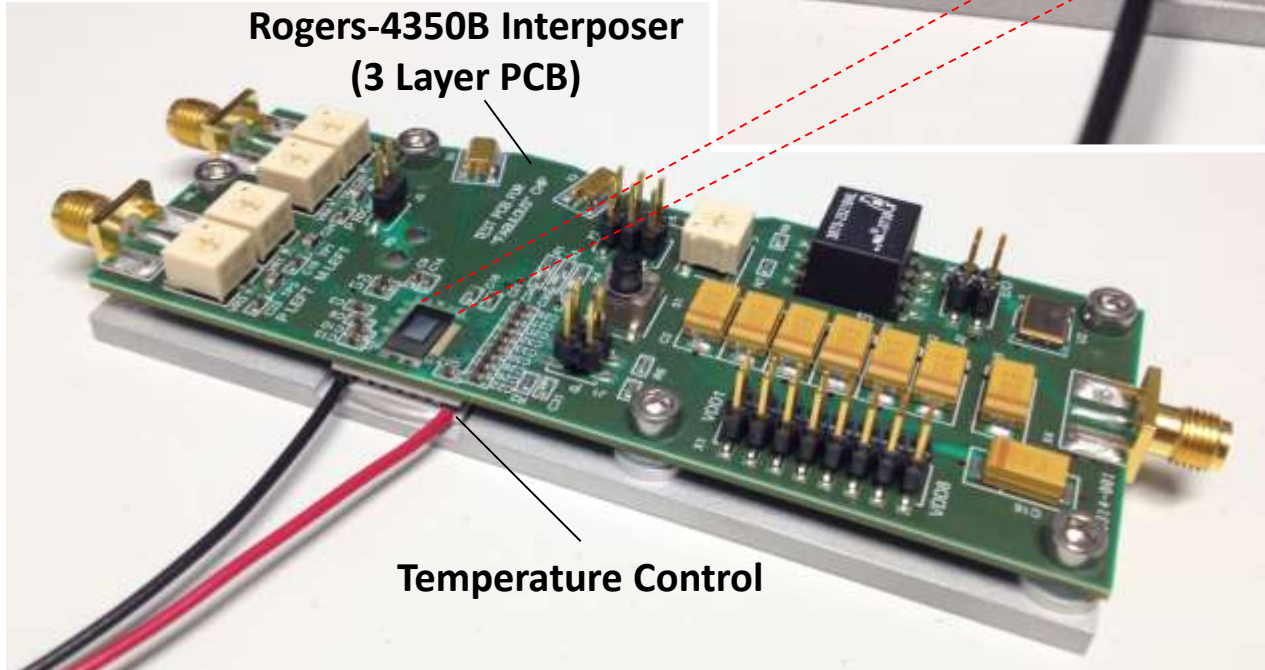
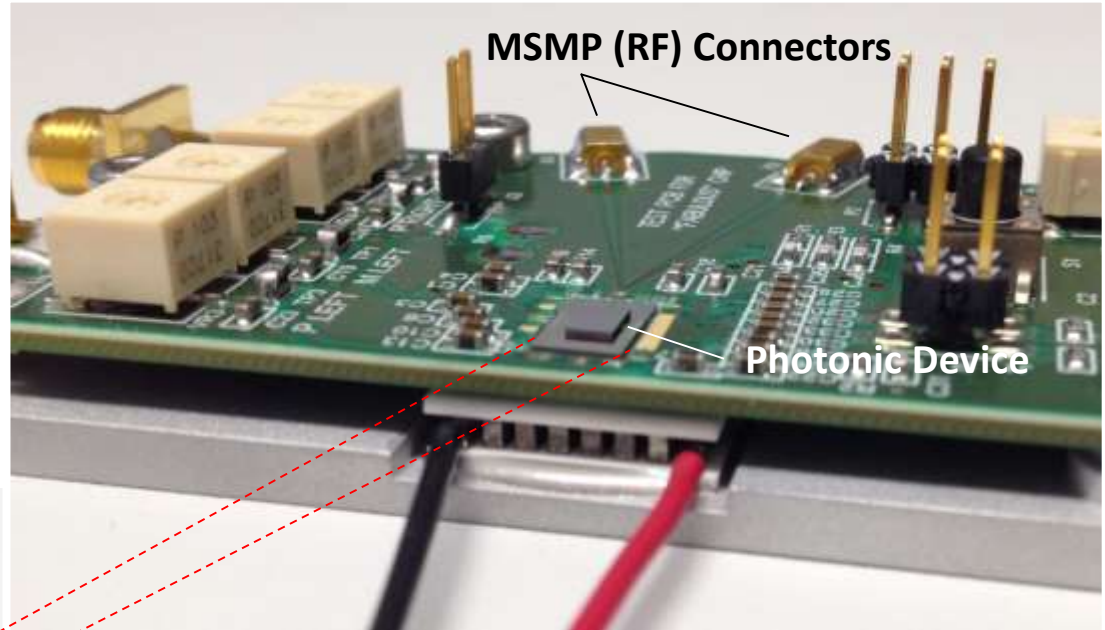


Electronic Integration (Drivers, Modulators, ...)

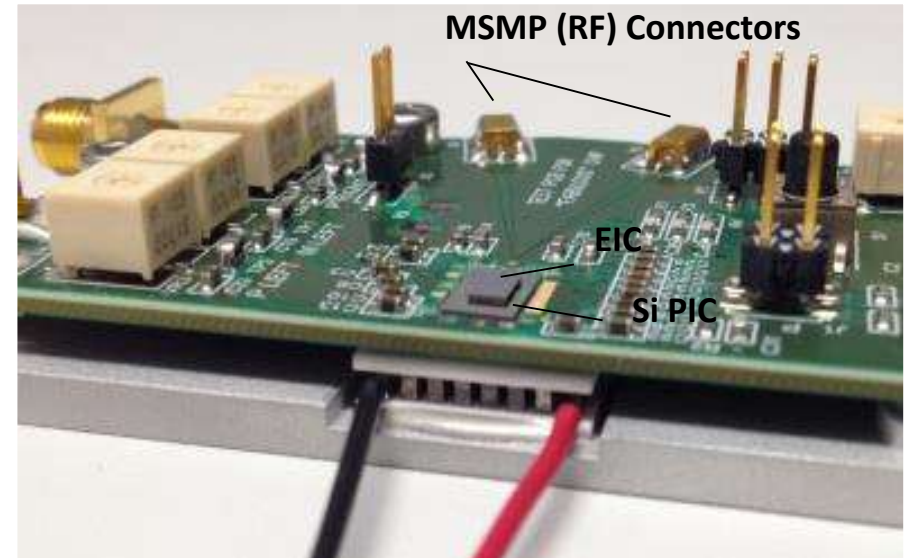
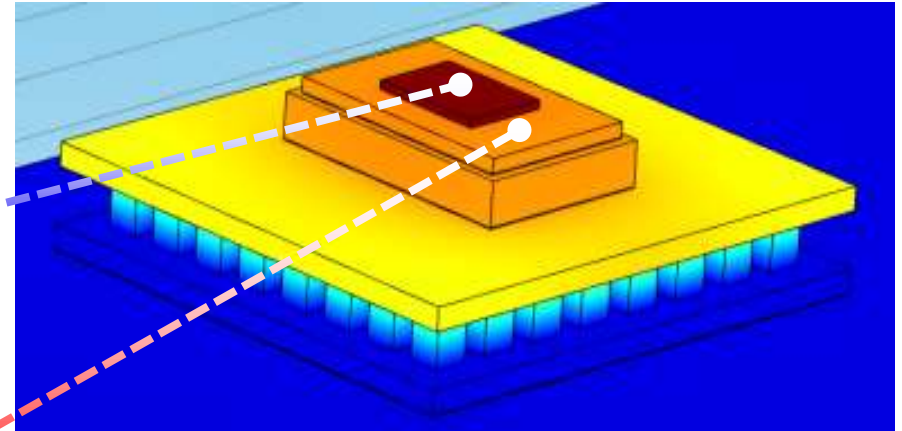
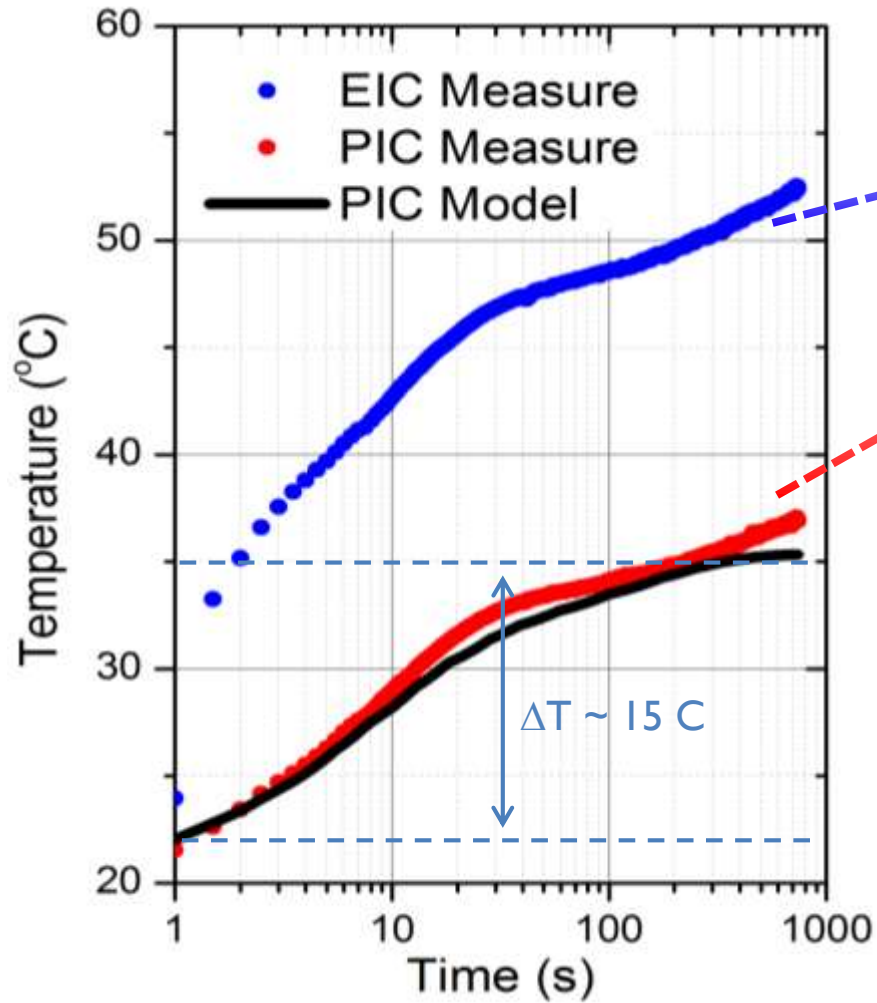


Solder Sphere Jetting (50 μm Spheres)

Electronic Integration (Drivers, Modulators, ...)



Thermal Effects



Photonics Integration (Medical Devices)



stryker®



Lake Region
MEDICAL



Medtronic



COVIDIEN



Radisens
DIAGNOSTICS



Medtronic
imec



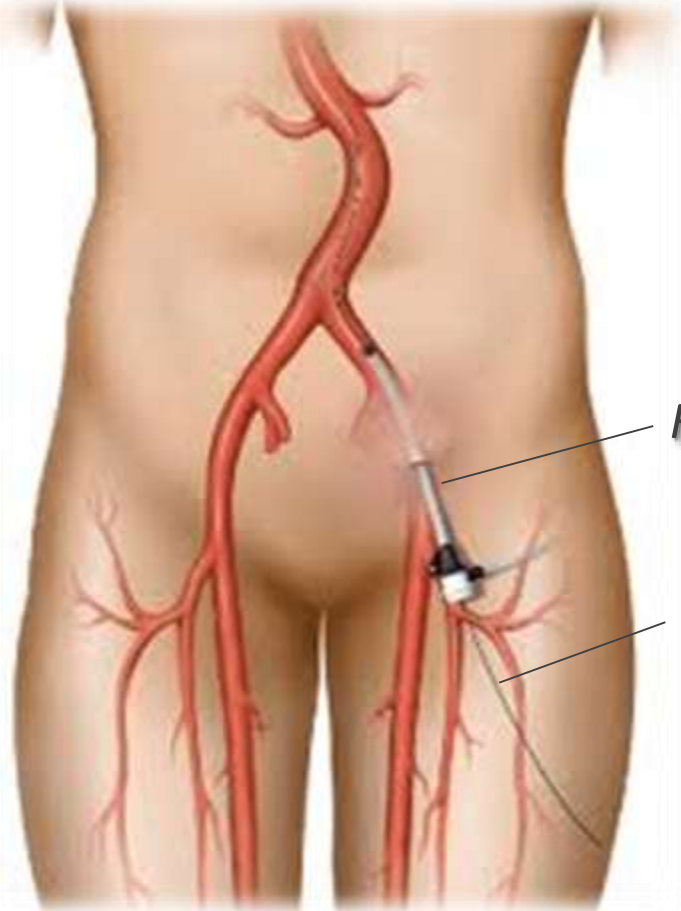
Barts and The London
School of Medicine and Dentistry



Maastricht University
Faculty of Health, Medicine and Life Sciences

*Silicon photonic integrated laser doppler vibrometer
for screening of arterial stiffness and stenosis*

Photonics Integration (Vascular Guidewires)



Femoral artery

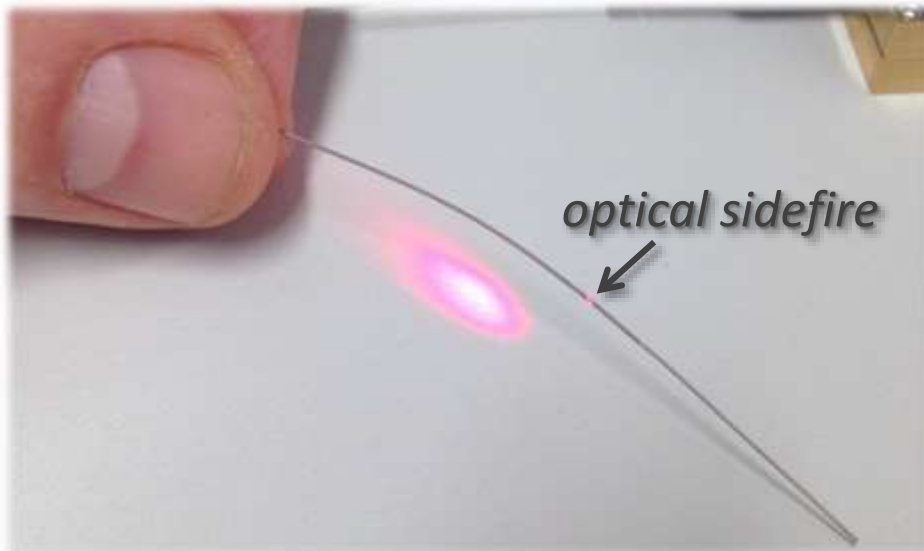
guidewire



Blood Flow Analyser

- optical fibre in guidewire
- maintain guidewire diameter
- maintain guidewire flexibility

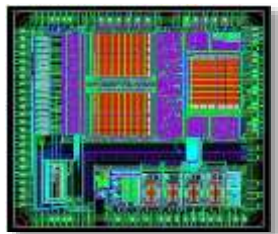
Photonics Integration (Vascular Guidewires)



European Integrated Photonics Foundries (Silicon)



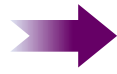
www.epixfab.eu



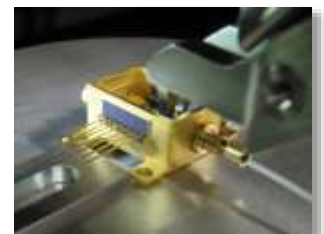
Design



Wafer Fab

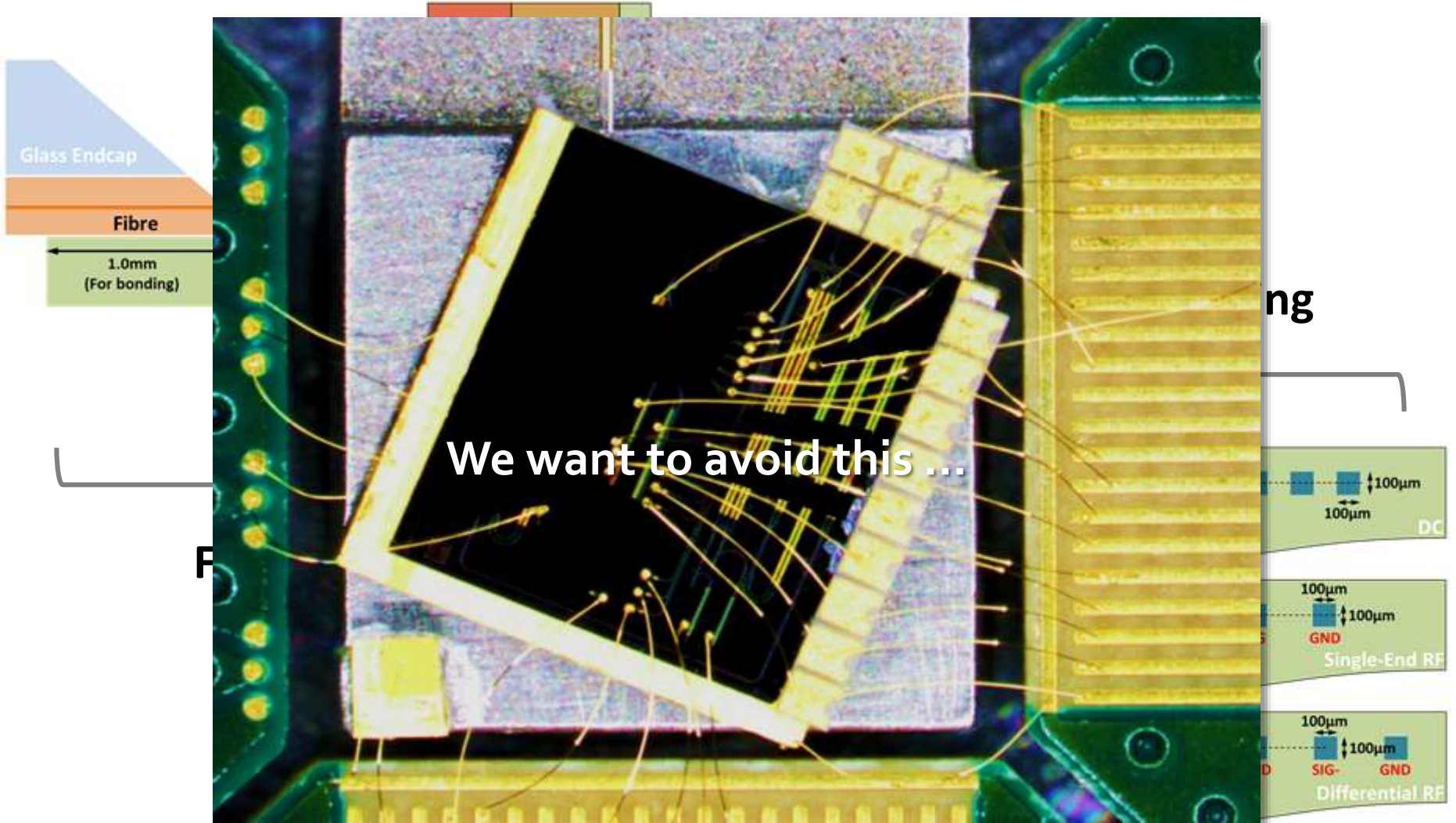


Device



Packaging

Photonic Integration Design Rules (Design Kit)



Photonic Integration Design Rules (Design Kit)



Summary

