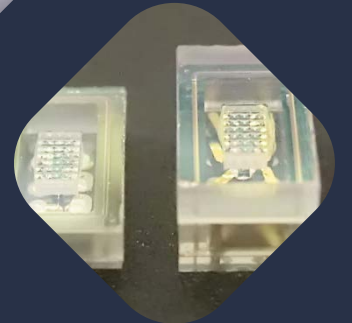


Landscape for photonics packaging services

Stefan Mohrdiek
Swissphotonics workshop on precision assembly
24. February 2022



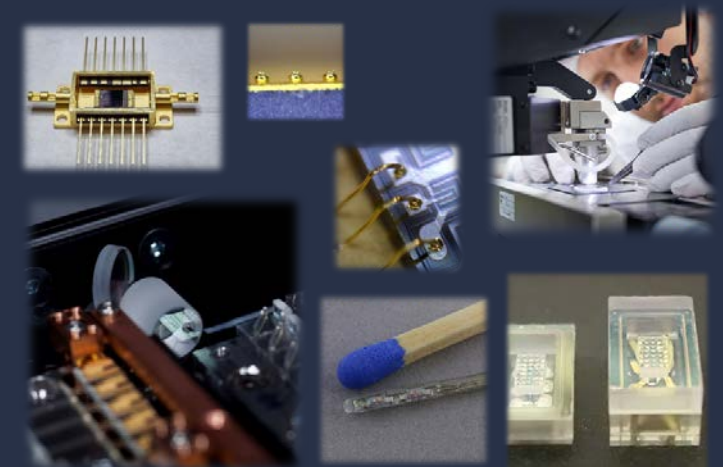
"Packaging" in photonics and microsystems

- *Packaging = Assembly and interconnection technology*
- *Active and passive components connected into systems*
- *Encapsulation to protect against environment*
- *Interfaces to the macro environment*
- *System functions maintained and secured*

Not like this

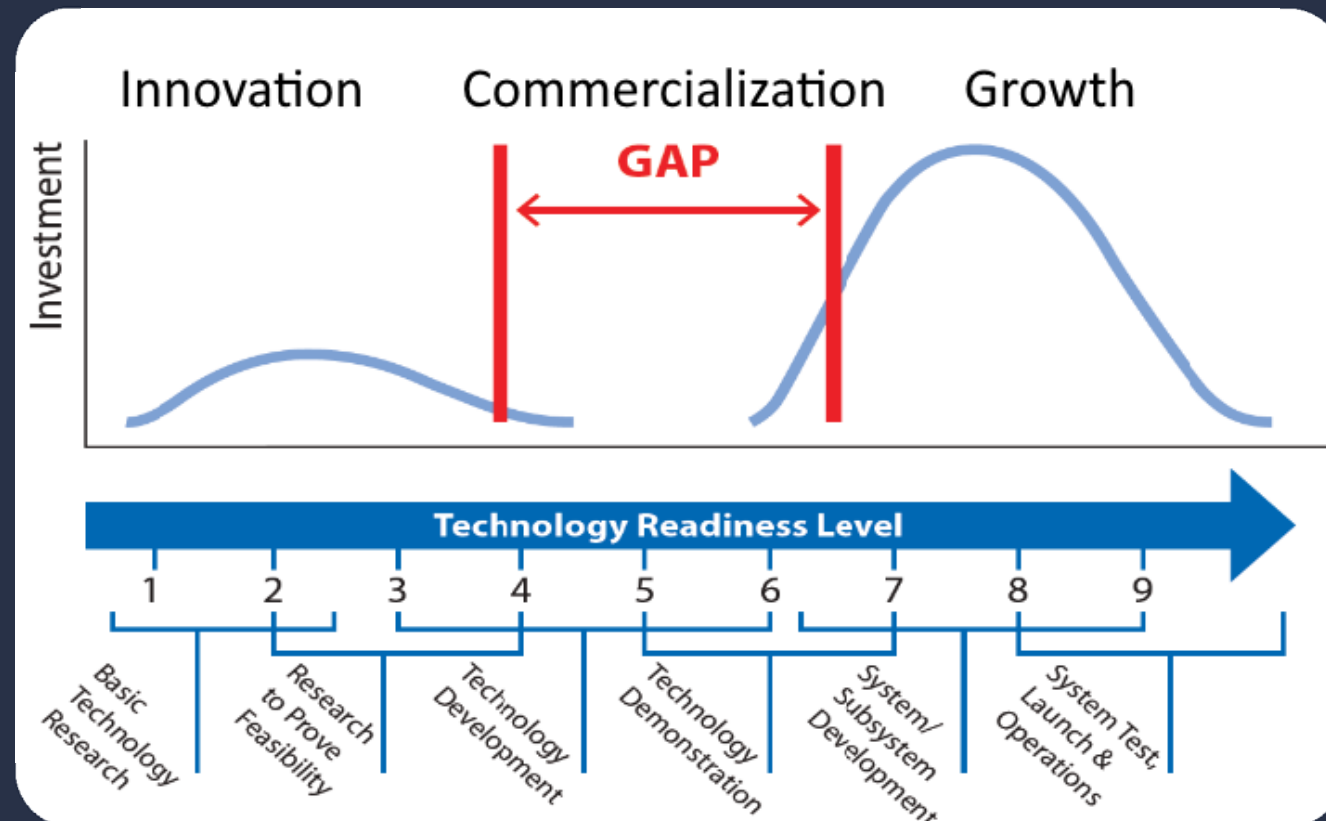


This is more like it



Photonics packaging services . . . Who needs it? . . . What is it?

- *Bridging the gap between invention and commercialization, often named the 'valley of death'*



Source: EARTO - European Association of Research and Technology Organizations

Value chain in photonic integration

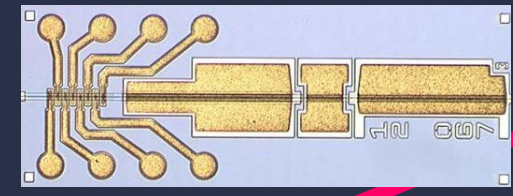


Value chain ↑

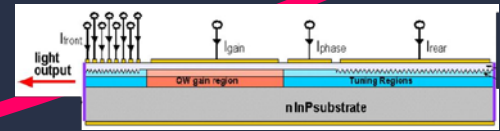
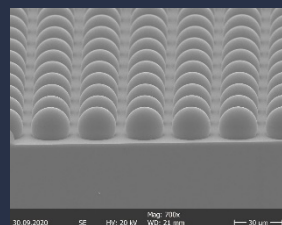
PIC



Monolithic Integration

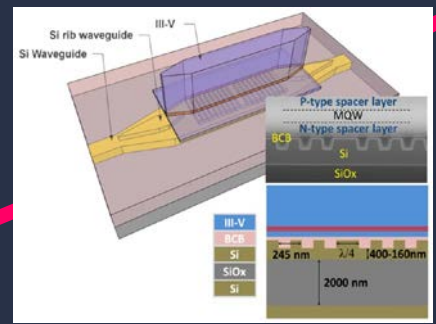


Single Component



Tuneable InP multisection Laser
Reference: Bookham

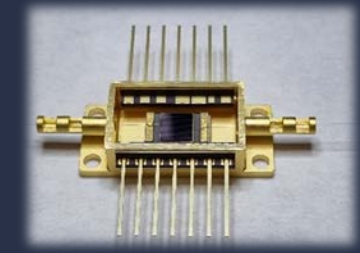
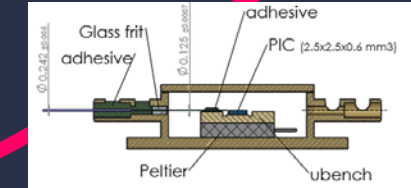
Heterogeneous Integration



DFB laser on Si substrate with waveguide
Reference: UGent

Hybrid

Hybrid Integration



PIC on microbench in package with optical fiber and peltier cooler

Functionality →

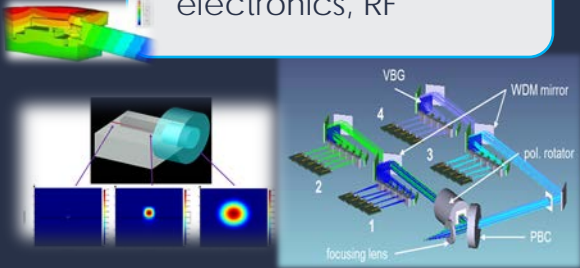
Hybrid Packaging Services

Incoming parts

Waveguides
Lasers
Lenses
Fibers
Substrates
Detectors
ASIC

Design

- 3D CAD, FEM, Zemax, Lumerical
- Optical, thermo-mechanical, PCB electronics, RF



Component Bonding

- Flip-chip, eutectic, adhesive, thermo-compression/sonic
- micron to sub-micro precision



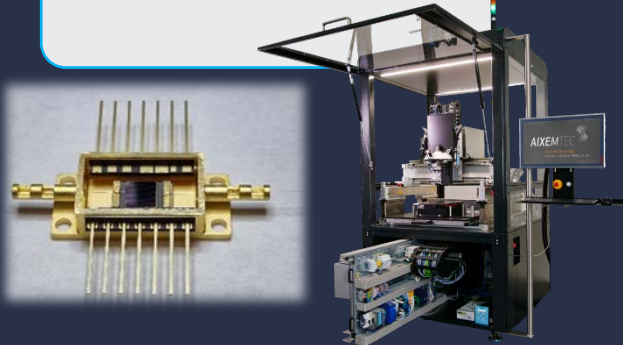
Wirebonding

- Al, Au, Pt, Cu
- Ball, wedge, ribbon, stud bumping



Photonic Assembly

- Sub-micron 6 DOF precision bonding
- Lasers, detectors, waveguides, fibers



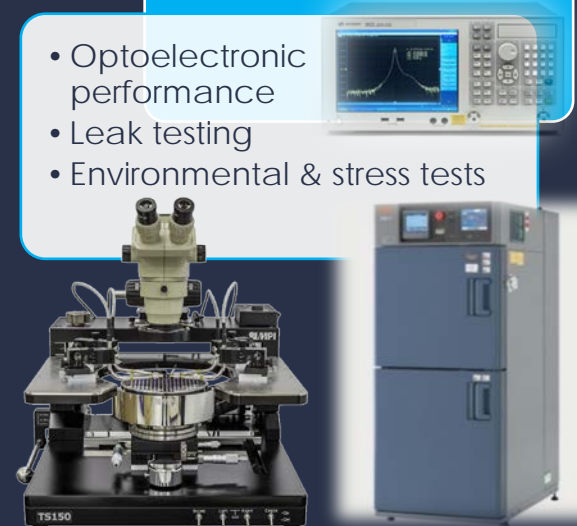
Encapsulation

- Hermetic/non hermetic
- Seam and laser welding, soldering, brazing, adhesive



Inspection & Test

- Optoelectronic performance
- Leak testing
- Environmental & stress tests



European pilot lines

- Access for companies to EU funded **fab technology**
 - PIC assembly and packaging pilot line → Pixapp
 - Photonic medical technologies → MedPhab
 - Free-form optics → Phabulous
 - Mid Infrared technologies → Mirphab
 - Project ended and emerged as Mid IR alliance <https://midiralliance.eu/>
- **New:** Photonhub <https://www.photonhub.eu/>
- Open access to cutting-edge photonics technologies
- 54 partner, 7 pilot lines



6

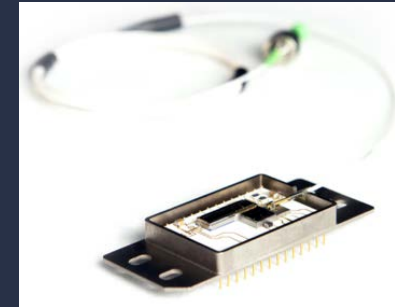
2021



“Clusters” in Europe & USA with strong government investments

- Ireland

- Tyndall National Institute
- Irish Photonic Integration Center



Source: Tyndall National Institute

- Netherlands

- PITC: Photonics integration technology center
- CITC Chip integration technology center
- Podium: photonics assembly consortium
- PhotonDelta: Networking organization



- USA

- American Institute for Manufacturing Integrated Photonics

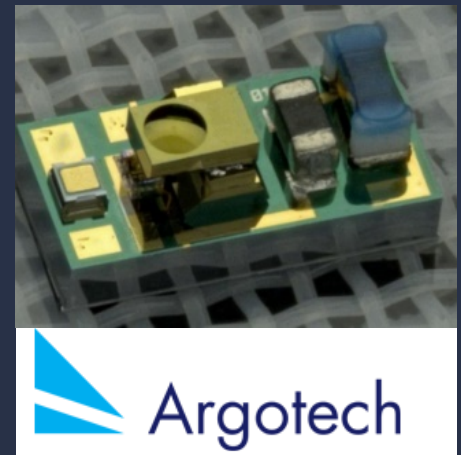
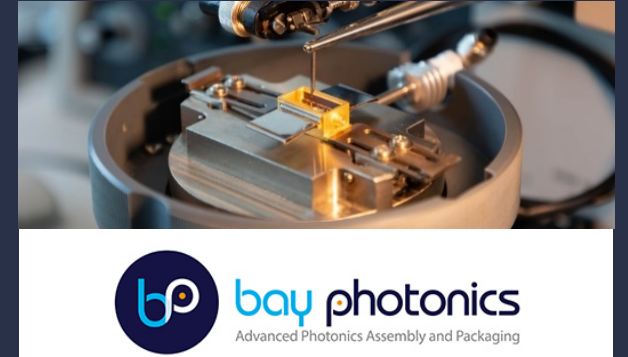
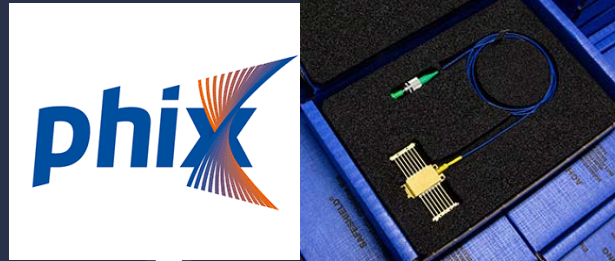


Commercial providers

Non-exhaustive, but still representative

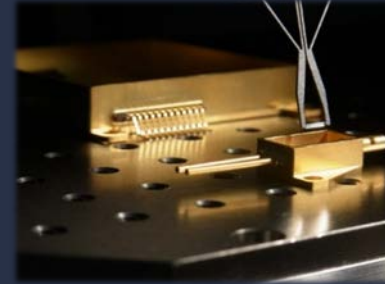


- Alter Technology (Scotland, formerly Optocap)
- Bay Photonics (UK, former Nortel staff)
- Phix (NL, Lionix major stakeholder)
- Argotech (CZ, formerly Infinenon)
- Aifotec (DE, Rosenberger major stakeholder)
- Tegema-Etteplan (NL-FI)

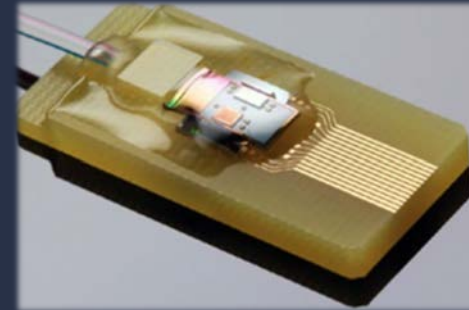


Non-profit Research and Technology Organizations (RTO)

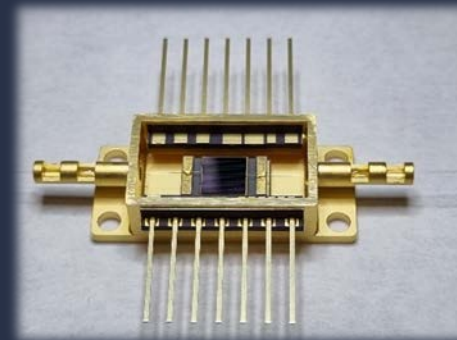
- Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (D)



- VTT (FI)



- CSEM (CH)



SPPL – the Swiss Photonics Packaging Lab

A virtual lab and go-to address in the field of photonics packaging and related joining technologies



- Laboratory Joining Technologies and Corrosion in Dübendorf

Lars P. H. Jeurgens, Jolanta Janczak-Rusch



- University of applied sciences OST with the institute for microtechnology and photonics in Buchs

Dietmar Bertsch, Tobias Lamprecht



- Functional Packaging @ Center Alpnach (& beyond)

Stefan Mohrdiek



Networking platform

Christoph Harder, Christian Bosshard

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