EPIC
European Photonics
Industry Consortium

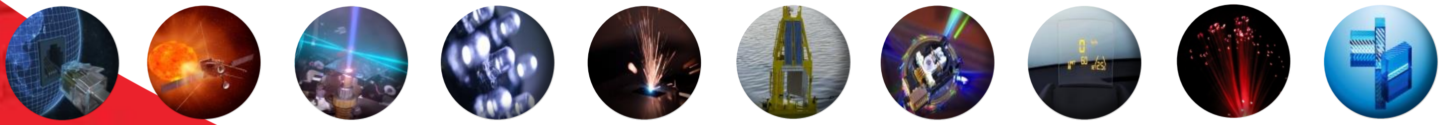
EPIC’s landscape on PICs (visible, short- near- and mid- IR)

The Future Photonics Hub Industry Day

12 September 2016

Southampton

Jose Pozo
Director of Technology and Innovation
EPIC
jose.pozo@epic-assoc.com
Mobile: +31 626978312



EPIC European Photonics Industry Consortium

EPIC is the industry association that promotes the sustainable development of organisations working in the field of photonics in Europe. EPIC fosters a vibrant photonics ecosystem by maintaining a strong network of **260+ members and acting as a catalyst and facilitator for technological and commercial advancement**. EPIC publishes **market and technology reports, organizes technology workshops and B2B roundtables, coordinates EU funding proposals, advocacy and lobbying, education and training activities, standards and roadmaps, pavilions at exhibitions**.

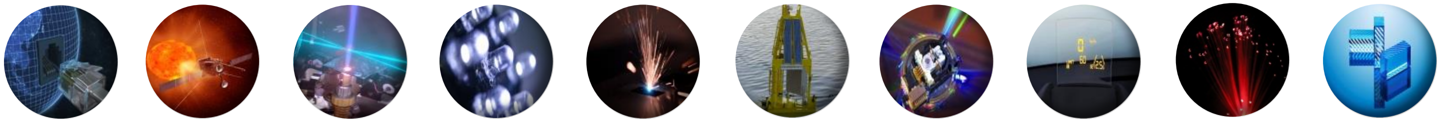
www.epic-assoc.com

Our members and activities encompass the entire value chain from:

- Biophotonics
- Displays
- Imaging
- Lasers (for industrial, military, medical applications)
- LED, OLED, and Smart Lighting
- Optic fiber
- Optical components
- Photonic Integrated Circuits: III-V, Silicon Photonics, and TriPleX
- Projectors
- PV solar energy including CPV and OPV, and Batteries
- Sensors (for automotive, defense, medical, … applications)
- and all other photonic related technologies

280 members companies

www.epic-assoc.com/membership/epic-members



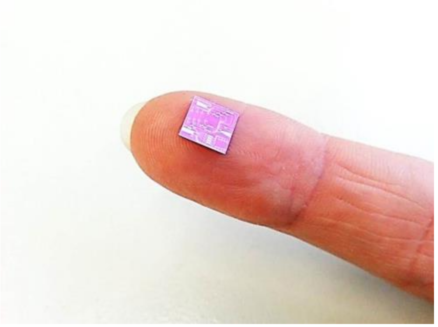
280 members companies

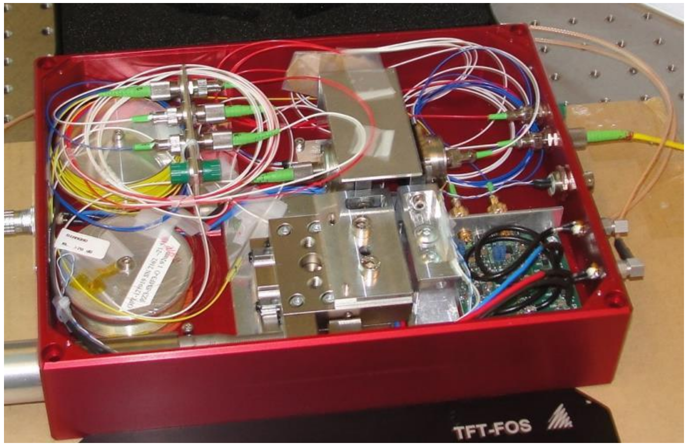
www.epic-assoc.com/membership/epic-members

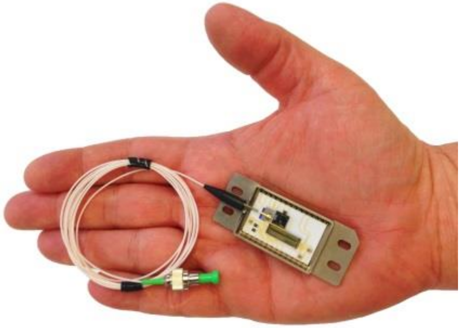
PICs technology from application perspective

Photonic ICs bring competitive advantage to your products:

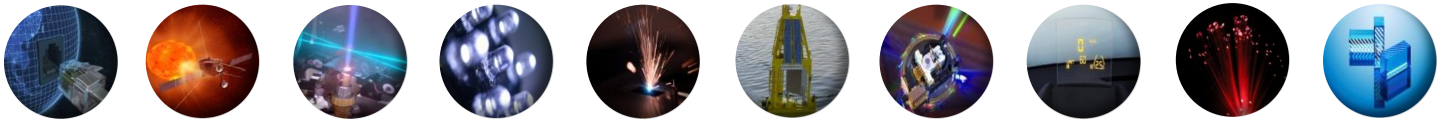
- ✓ Miniaturization
- ✓ Cost reduction
- ✓ Performance enhancement







Courtesy of PICs4ALL project



PIC technologies

Hybrid Photonic Integration

Combine the best of two worlds!

InP + TriPlеX™

Active devices: lasers, SOAs, fast modulators, & PDs

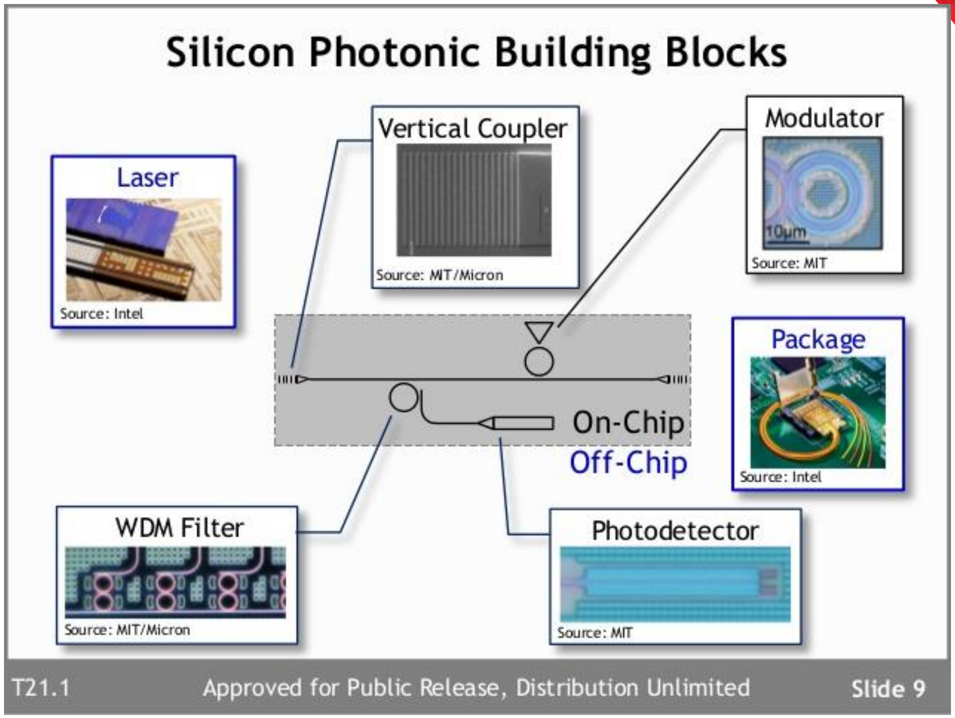
Low-loss waveguides & spot-size converters

Visible & NIR ranges

Full value chain platform ready for users:

Design tools & PDK · Chip design · TriPlеX & InP fabrication · Packaging

Visit us at booth #5001 Holland **Live demo** on Wed 11th at 16:30



Silicon Photonic Building Blocks

T21.1 Approved for Public Release, Distribution Unlimited Slide 9

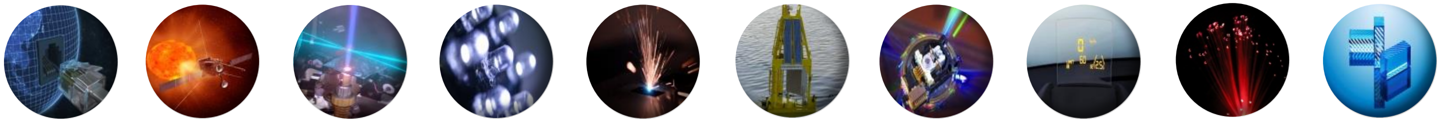
Source: Intel

And others: PLC, GaAs,…

EPIC’s PIC value chain

Software

Layout	PhoeniX Software Solutions for Micro and Nano Technologies	LUCEDA PHOTONICS
Component simulation	lumerical	CST
Circuit	VPIphotonics DESIGN AUTOMATION	



EPIC’s PIC value chain

Design

Foundry/technology independent design

VLC PHOTONICS

BRIGHT Integrated PHOTONICS

Silicon Photonics

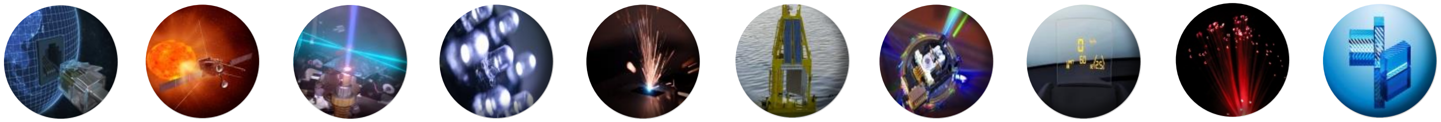
Rockley PHOTONICS

LUCEDA PHOTONICS

TripleX

XiO photonics

Excellence in integrated optics



EPIC’s PIC value chain

Foundry

Silicon Photonics

imec

VTT

cea leti

ihp

AMO

Indium Phosphide

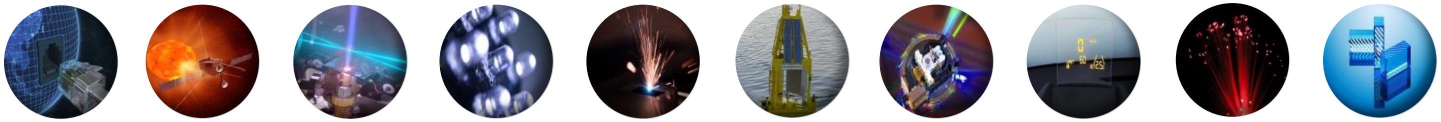
SMART Photonics
III-V foundry services

OCLARO

Fraunhofer
Heinrich Hertz Institute

TripleX

LioniX
OUR CHIPS ENABLE YOUR PRODUCTS



EPIC's PIC value chain

Characterization/Test Service

VLC PHOTONICS

Fraunhofer Heinrich Hertz Institute

Packaging Service

Technobis ipps

Tyndall National Institute Instituid Náisiúnta

AIFOTEC fiberoptics

XiO photonics Excellence in integrated optics

optocap

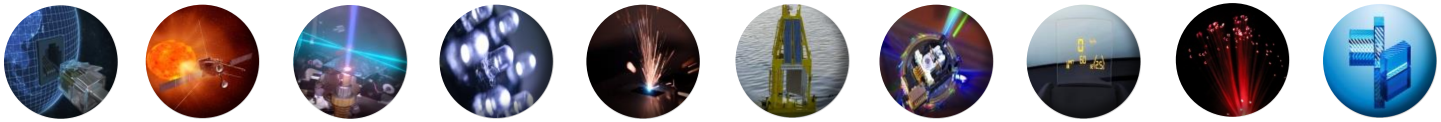
LINKRA®

BAY PHOTONICS LTD

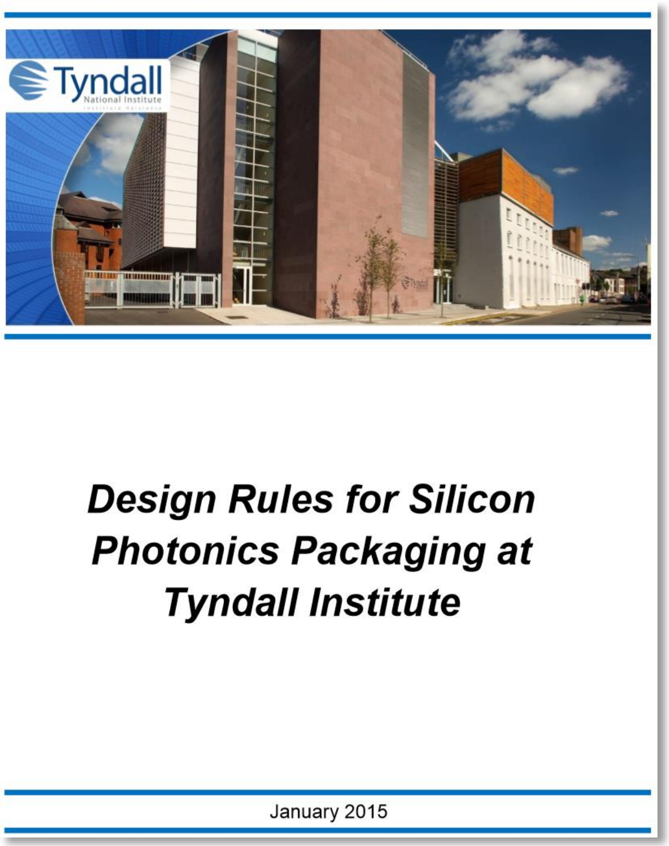
Packaging, Assembly & Test Equipment

ficonTEC

nanosystec PRECISION AUTOMATION



PIC Packaging Design Rules



Tyndall National Institute

Design Rules for Silicon Photonics Packaging at Tyndall Institute

January 2015

INTEGRATED PHOTONICS PACKAGING SERVICES

Technobis ipps

Packaging of integrated electro-optical components

Technobis ipps provides custom packaging services. Where Generic Packaging allows easy accessible assessment of chip functionality and performance, customizing provides dedicated and high performance ASPIC packages, suitable for volume production.

Custom packages are specifically designed for interfacing, thermal stability, cost efficiency, power consumption and other environmental or usage conditions, like high sampling speeds (KHz, MHz or GHz), extreme measurement resolutions, channel multiplexing (optical switching), non-standard ASPIC dimensions and wire bonding conditions, etc.

Contact

Dario Lo Cascio

dario.locascio@technobis.com

Standard & Custom Packaging Service for ASPICs

Technobis ipps is now available as your industrial partner in the Application Specific Photonic Integrated Circuit (ASPIC) supply chain. Improve the final performance of your ASPIC and accelerate your product development by making use of our ASPIC services:

- Packaging
- Thermal management
- Front-end electronics

A series of generic solutions, mainly for use during the test and development phase of the ASPIC, are at disposition to accommodate ASPICs of different size with few to many electrical and optical in- and outputs. These packages can act as the starting point for a custom, application specific, package for which we can offer front-end electronics design.

Strong, long-term cooperation with Tyndall Institute regarding design, manufacturing and processing of ASPIC packages, combined with our knowhow on Integrated Photonics technology makes us an ideal partner for your advanced ASPIC packaging, now and in the future.

EPIC's PIC value chain

PIC brockering service

InP and TripleX

JePPIX

Silicon Photonics

EUROPRACTICE

Manufacturing and test Equipment

Positioning

PI

Test

yelo Test Systems

Semicon

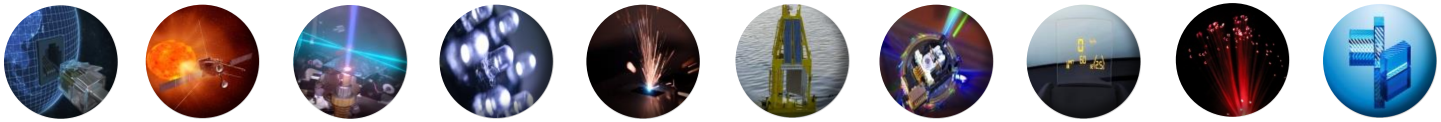
EVG®

SÜSS MicroOptics

3D printing

Multiphoton Optics®

nanoscribe



PICs4All: EU H2020 Innovation Support Action

- **Bridges the gap** between technology and market
- **Helps to assess** the benefits of applying Photonic ICs in your products

- **European Network of Experts in Photonics**

  Application Support Centers in:

TU/e Technische Universiteit Eindhoven University of Technology Where innovation starts

UNIVERSIDAD POLITECNICA DE VALENCIA

TELECOM ParisTech

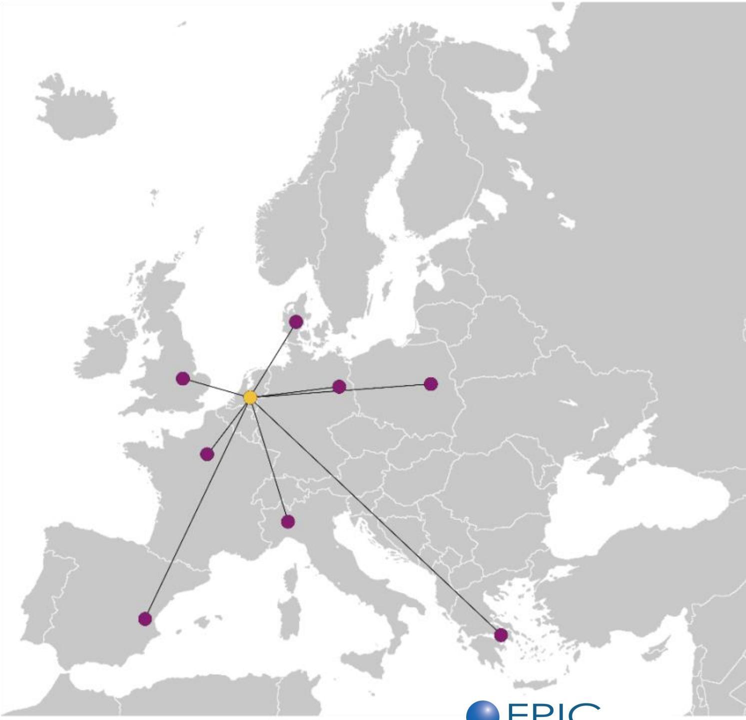
UNIVERSITY OF CAMBRIDGE

National Technical University of Athens

AARHUS UNIVERSITY

POLITECNICO DI MILANO

Technische Universität Berlin

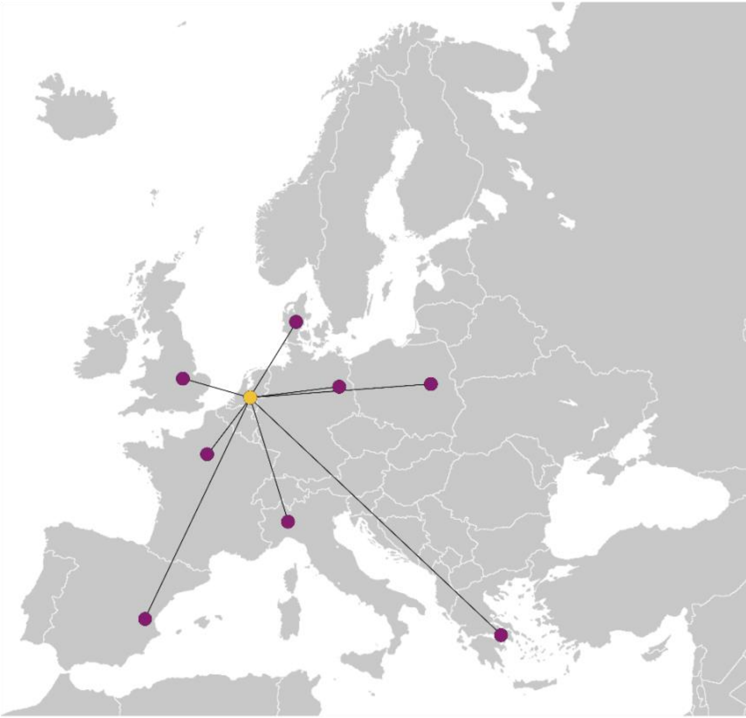


Berenschot

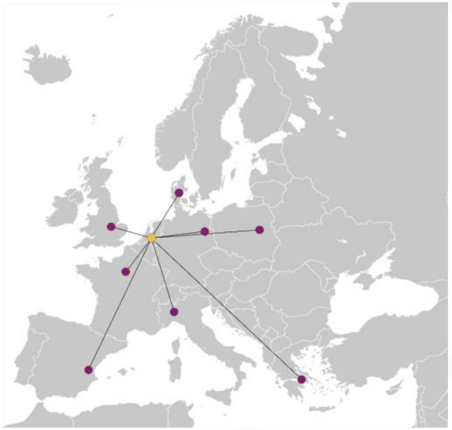
EPIC European Photonics Industry Consortium

How can they help you?

- ✓ Expertize in PIC technology platforms
  - InP, Si, SiN, Polymer
- ✓ Technical skills in photonic integration
  - Modelling & Design
  - Prototyping & Fabrication
  - Measurement & Testing
  - Packaging & Assembly
- ✓ Guide to free and (semi-)commercial capabilities
  - Access to CAD/design software tools
  - Prototyping & Fabrication (clean-room facilities)
  - Measurement & Testing (labs)
  - Packaging & Assembly



Who will help you?



1. Eindhoven University of Technology:
   Katarzyna (k.lawniczuk@tue.nl)
2. University of Cambridge:
   Adrian (aw300@ucam.uk)
3. Universitat Politècnica de València:
   Pascual (pmunoz@iteam.upv.es)
4. Politecnico di Milano:
   Daniele (daniele.melati@polimi.it)
5. Warsaw University of Technology:
   Stanislaw (S.Stopinski@imio.pw.edu.pl)
6. Technische Universität Berlin:
   Moritz (moritz.baier@hhi.fraunhofer.de)
7. Aarhus University:
   Martijn (mheck@eng.au.dk)
8. Telecom ParisTech:
   Kevin (kevin.schires@telecom-paristech.fr)
9. National Technical University of Athens:
   Paraskevas (pbakop@mail.ntua.gr)

EPIC's PIC value chain

Component and subsystems

EFFECT PHOTONICS

HUAWEI

FINISAR

ALPES LASERS

EXALOS The bright light source company

BB Photonics

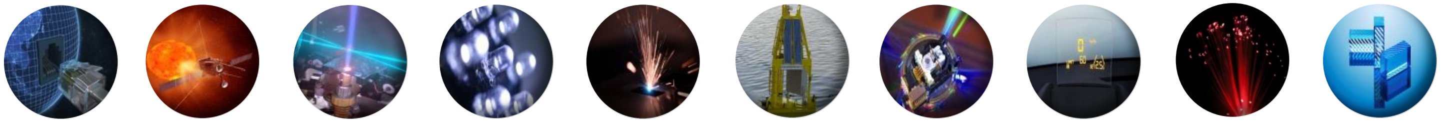
INNOLUME

VLOC SYSTEM S.A.

SOFRADIR

IBM

Rockley PHOTONICS



EU funded pilot lines
(for prototyping and small series production)

Silicon Nitride

PIX4life

Mid Infrared

Midinfrared photonics devices fabrication

MIRPHAB

for chemical sensing and spectroscopy

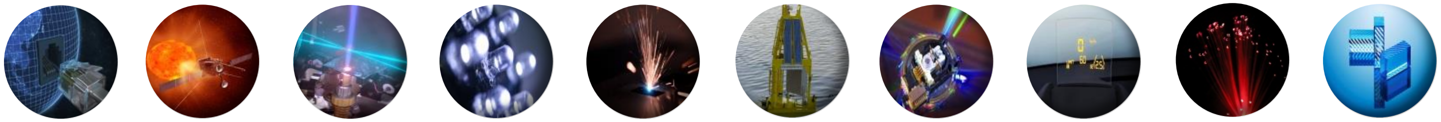
PI-SCALE

SHAPING THE FUTURE IN OLED LIGHTING

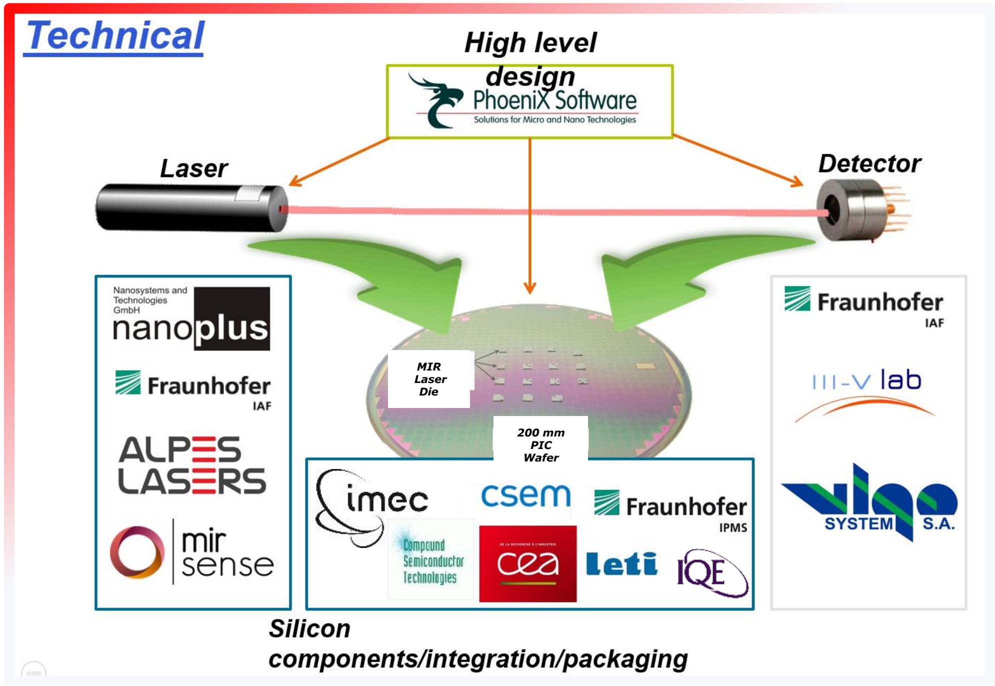
… and a new one in PIC packaging starting very soon

PHOTONICS21

PHOTONICS PUBLIC PRIVATE PARTNERSHIP



Technical



High level design

PhoeniX Software
Solutions for Micro and Nano Technologies

Laser

Detector

MIR Laser Die

200 mm PIC Wafer

Nanosystems and Technologies GmbH nanoplus
Fraunhofer IAF
ALPES LASERS
mirsense

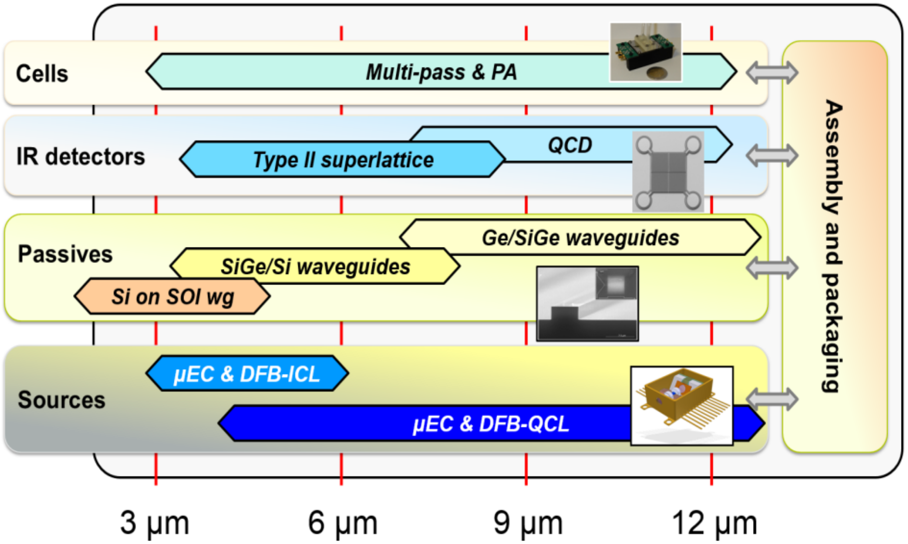
imec
csem
Fraunhofer IPMS
Compound Semiconductor Technologies
cea
leti
IQE

Fraunhofer IAF
III-V lab
VIGO SYSTEM S.A.

Silicon components/integration/packaging

Support & Demo

EPIC European Photonics Industry Consortium
Tematys
BOSCH Invented for life
CASCADE TECHNOLOGIES
QUANTARED TECHNOLOGIES
norsk elektro optikk



Cells

Multi-pass & PA

IR detectors

Type II superlattice

QCD

Passives

Ge/SiGe waveguides

SiGe/Si waveguides

Si on SOI wg

Sources

µEC & DFB-ICL

µEC & DFB-QCL

Assembly and packaging

3 µm

6 µm

9 µm

12 µm

- *MIRPHAB is a pilot line for* ***prototyping and production of Mid-IR devices*** *for the detection of chemicals in gas and liquids*

- *MIRPHAB offers* ***open access to design, prototyping and fabrication*** *of miniaturized photonics devices*

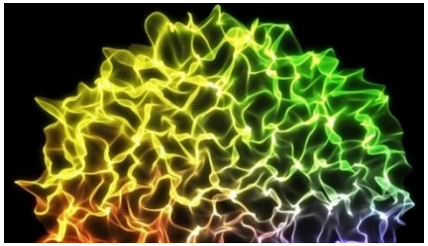
- *MIRPHAB brings together 18 leading organisations all* ***committed to deploy new products swiftly in the market*** *and achieve prompt take up in the environmental and chemical sensing areas*

MIRPHAB OPEN ACCESS

- *Target:*
  - Analytical MIR sensing for European Industry;
- *Access:*
  - Proposal submission via MIRPHAB webserver;
  - www.mirphab.eu;
- *MIRPHAB support:*
  - Two proposals granted per call with up to 230 K€ in services for design and prototyping;

Calendar of Calls:

- Call 1: 31/12/16;
- Call 2: 30/09/17
- Call 3: 30/04/18
- Call 4: 31/12/18
- Call 5: 30/06/19



280 members companies

www.epic-assoc.com/membership/epic-members