

Challenges and Opportunities for Photonic Integrated Circuits and Applications: Visit us at: www.phix.com

(The first digital meeting of the IVAM Focus Group Photonics : Tuesday, June 29, 2021 from 2:00 pm to 4:00 pm.)

Dr. Albert Hasper (CEO-PHIX)



PHOTONIC ASSEMBLY



Contents:

Part 1:

- Intro Thomas Dietrich
- PHIX short intro
- Why Photonics Focus group?
- Status and outlook of Photonics
- Challenges and Opportunities

Part 2:

Input from the group: What should the focus group do?
 survey

2





PHIX Mission

PHIX is to become a world leader foundry in packaging and assembly of Photonic Integrated Circuits (PIC's) by supplying PIC based components and modules in scalable production volumes.

- Founded in 2017
- Started operations in 2018
- Specialized in hybrid PIC assembly and fiber array interfacing



Photonic Packaging (What we do)









Competencies and capabilities



- Product design for assembly:
- Manufacturing:
 - Die preparation
 - Die alignment and bonding
 - Electrical interfacing
 - Thermal Packaging
 - Polarization Maintaining Fiber Arrays
 - High Power interfaces
 - Free Space packaging
 - Hybrid assembly
- Capital equipment sourcing.





Product

Process

PHIX: Value Proposition:

Independent Back-End Photonics Assembly Foundry:

- ✓ Access to broad packaging and assembly expertise & processes → First Time Right. → Quality
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- ✓ Short time to Market (TTM) at lower cost. → Timing
- \heartsuit Scalable volume from prototype to volume production \rightarrow Flexibility

Offering design engineering services:

- Supporting vertically integrated approach which is required to successfully introduce emerging technologies.
- ☑ Characterization package CPS standard
- ☑ PHIX Assembly Design Kit integrated in Synopsis SW

Technology:

- ✓ Broad process portfolio to assemble all PIC technologies
- ☑ Unique process of co-packaging multiple PIC technologies in one product.
- ☑ Unique process for multifiber to chip interfacing.

European based:

- Photonics is defined by EC as key enabling technology (KET).
- Strong Furopean and Dutch infrastructure including SW, Chip Design, chip manufacturing and applications.
- Sespecting and protecting our customers' IP and Know-how













PHIX approach to automation

- Start with the <u>end product</u> in mind
- Consider options for product design, manufacturing process and manufacturing equipment <u>in parallel</u>
- Consider <u>total costs</u> when optimizing parameters



PHIX Roadmap



PHOTONICS IVAM.



PHIX key-competences:







Design Manufactured module





Examples of PIC Modules









Hybrid PIC packages with DC and RF electrical interfaces

- Hybrid integration multiple InP and TriPleX PICs
- RF modulation (InP)
- Detector arrays (InP)
- Gain chips (InP)
- Dedicated electronics connection
- Accessibility to PICs for characterization purposes





Biosensor application



Ultra sensitive sensor arrays

- Label-free refractive index sensing for disposable applications
- Multiple MRR and/or MZI sensor arrays
- Flip-chip assembly of VCSEL's and detector arrays through grating couplers









Tunable laser application













Characterization Package Standard











Characterization Package Standard:

- Modular package approach for stand alone functional PIC characterization
- Capable of addressing several form factors and interfaces
- Applicable for edge-connected optical fiber interfaces
- Up to 32 fibers in and out
- Up to 300 electrical contacts
- Chip design guidelines available for compatibility with CPS





Summary:

- PHIX is your worldwide partner for scalable production needs for the packaging and assembly of Photonic Integrated Circuits (PIC's).
- PHIX covers the whole supply chain from :
 - 1. Design
 - 2. Prototype-production
 - 3. Scale-up production
 - 4. Volume Production







Why Photonic Focus group?

- To create an European cross border business network that shares insights on the Photonic Industry
- To generate ideas to become stronger
- Act as source of suppliers / customers → create group of "billable friends"
- Accelerate the Integrated Photonic industry by working together to create a competitive edge
- How do we differentiate with other photonic networks?
- Why do we want to work together, and what should be the outcome?



Questions to consider during the discussion ?

- How do we differentiate with other photonic networks?
- Why do we want to work together, and what should be the outcome?
- What kind of events/activities are important for the focus group?



PHOTONICS

VAM.



Status and outlook of (Integrated) Photonics: Some trends





The importance of the integrated Photonics is related with its applications in different market segments and activities:

The GAGR of the Photonic Markets is about 40% (*)

(*) Compound annual growth rate (CAGR)





20



Optical transceivers market in 2024 16 \$Bn







LiDAR market increase with 113% CAGR to 1.7\$Bn in 2025











Photonics in Europe is a Key Enabling Technology:

- Strategic importance
- Keep R&D, innovation and industrial capacity in Europe

Global economical impact:

- Lead by cost & performance
- Keep volume production in Europe



Advanced Photonic Integrated Circuits

Opens: Est. June 2021 Deadline: Est. September 2021 Budget: €38.4m total €3-5m project. TRL 2/3 -> 4/: HORIZON-CL4-2021-DIGITAL-EMERGING-01-07: Advanced Photonic Integrated Circuits (RIA)

- Expected outcome
 - New generations of photonic integrated circuits and devices
 - Strengthening industrial capability of photonic device fabrication by integration and miniaturisation of technologies
 - Lowering the barrier to the use of advanced or innovative photogic integration technologies for companies, in particular hightech SMEs
 - Providing European strategic autonomy in Photonic Integrated Circuits and related manufacturing processing
- Scope
 - New paradigms to extend the functionalities of optical components through design, integration, fabrication, assembly and
 packaging techniques including the co-integration of photonic and electronic components.
 - Augmented with new functions and performance enhancements, requiring in many cases the development of new materials and innovative device structures.
- Challenges
 - Mastering epitaxial material growth and processing on large wafers
 - Broadband ("white") light sources and high sensitivity photodetectors (including arrays)



- High-efficiency semiconductor lasers across many wavelength bands,
- Incorporation of new building blocks such as magneto-optic elements for non-reciprocal functionality could also be included.

Projects should demonstrate the developed integration technologies in at least two application oriented use cases and establish integration platforms, which help potential user companies with their uptake



24

The application integrated photonics is in line with the macro trends and will lead to an expected yearly market grow of > 30%

Macro-Trends

Strong growth of data traffic (i.e. Artificial Intelligence) leads to more energy usage, whereby data-centers must be more **energy efficient**

IoT will ask for faster and more energy efficient **connections** of many **applications**

Introduction of **self driving cars** need more **radar** and **LIDAR** solutions

Increase of need of healthcare needs **more medical** - **technological innovation**

Applications of PIC's

- Integrated photonic transceivers
- Integrated photonic beamforming 5G
- Integrated LIDAR systems
- Integrated scanners, disposables, and medical sensors









Challenges & Opportunities







- How we ensure that the development in Europe leads to a Photonic European Industry?
- How to manage High Volume and High Mix Manufacturing?
- How do we accelerate the New Product Development & a risk free New Product Introduction?
- How do we keep competitive and cost efficient?





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