PHOTONICS PUBLIC PRIVATE PARTNERSHIP

Monolithic cointegration of QD-based InP on SiN as a versatile platform for the demonstration of high performance and low cost PIC transmitters

ICT-MOICANA fact sheet

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Project website:
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Consortium:

- Aristotle University of Thessaloniki (GR)
- Univeritat Kassel (DE)
- Technion – Israel Institute of Technology (IL)
- Ligentec SA (CH)
- III - V lab (F)
- Mellanox Technologies Ltd (IL)
- ADVA Optical Networking SE (DE)
- VLC Photonics sociedad limitada (SP)

THE CHALLENGE

The wide-spread adoption of optical transceivers in a broad range of application domains is urgently calling for a low-cost and large volume manufacturing integration technology that can meet the different specifications required in every application sector and urgently scale up to serve the growing telecom and datacom markets. Current commercial silicon photonic transceiver modules have, however, still not escaped from the need for complex and expensive hybrid integration substrates, since they rely on externally coupled InP laser sources within the assembly. However this approach induces additional cost-increasing factors coming from the redundant testing for the pre- and post-coupled laser photonic chips.

MISSION STATEMENT

MOICANA aims to produce the technological background for the epitaxy of InP Quantum Dots (QDs) directly on Si by Selective Area Growth prior synergizing InP QD structures with the best-in-class, in terms of losses and temperature sensitivity, in a CMOS fab, i.e. the SiN waveguide technology. Through this platform MOICANA aims to shape the necessary framework for the delivery of a low-cost and large volume manufacturing monolithic InP QD-on-SiN PIC transmitters, highlighting its versatile and scalable perspectives and its broad market take-up credentials through the demonstrations of a whole new series of cooler-less, energy-efficient and high-performance single-channel and WDM transmitter modules for

Data Center Interconnects, for 5G Mobile fronthaul and for coherent communication applications.

OBJECTIVES

MOICANA will invest in the best-in-class materials for the active and passive photonic functions, synergizing InP QD laser structures and the SiN waveguide platform. It will grow InP QD layers directly on Si substrates, aiming at the fabrication and deployment of a whole new series of transmitter modules as monolithically integrated PICs. A novel InP-to-SiN interface will allow efficient coupling between the two types of waveguides for maximum power transfer. The core objectives of ICT-MOICANA are:

- ➔ Deploy the process for heterogeneous epitaxy of InP QD on Si towards Selective Area Growth (SAG) on SiN technology
- ➔ Design and develop a monolithic integration process for InP QDs on SiN
- ➔ Design and fabricate InP-to-SiN coupling interfaces
- ➔ Develop and demonstrate a 25Gb/s monolithically integrated InP QD-on-SiN Directly Modulated Laser (DML)
- ➔ Develop and demonstrate a monolithically integrated InP QD External Modulated Laser (EML) on SiN
- ➔ Develop and demonstrate a monolithically integrated tunable wavelength coherence source
- ➔ Design and develop a series of WDM temperature-tolerant monolithic PIC prototype transmitters
- ➔ Validate the monolithic SiN-based PIC Transmitter platform in a wide range of applications
- ➔ Generation of Process Desing Kits (PDK) software library for rapid deployment

TARGET TECHNOLOGY BREAKTROUGHS

Integration platform: *MOICANA* aims to release an ultra-low cost, versatile and scalable transmitter platform by blending the best-in- class active and passive photonic materials into a monolithically integrated PIC platform. It intends to synergize the high-quality InP QD laser characteristics with the scalability, versatility and low propagation loss properties of SiN waveguide technology through a monolithic integration process that can ensure high yield and large volume manufacturing at the lowest possible cost.

InP-to-SiN interface: *MOICANA* will realize for the first time a low-loss, while ensuring minimum backreflection optical coupling interface between the InP QD active structures and the SiN waveguide in order to optically bridge the two monolithically integrated material platforms. The seamless light propagation between the active-passive structures on the transmitters PICs guarantee high fiber coupled power at minimum driving current for the laser souces.

QD-InP based active elements with superior performance: MOICANA will develop a wide group of QD InP based active elements: i) directly Modulated FP lasers, low-linewidth high output power DFB lasers, linear low linewidth electro-optic modulators and SOAs. These modules will exhibit superior performance even at temperatures reaching up to 80^0C due to the attributes of QD-InP layer stack. This feature will allow the implementation of wide DWDM transmitters without the need to place a Thermo-Electric Cooler(TEC) in the assembly, leading to lower overall cost from single type of III-V material epitaxy, simplified packaging and reduced power consumption. Additionally, the high modal gain from the QDs enables high output power from small active volume devices, reducing substantially the requirements for current/voltage supply.

Large portfolio of PIC transmitters: *MOICANA* targets the fabrication and deployment of a large portfolio of QD InP transmitters with breakthrough performance. The PIC transmitters targeted in are: i) 1λ- and 4λ- Directly Modulated Lasers packaged in an SFP28 and QSFP28 format capable to deliver 25Gbps and 100Gbps data streams respectively, ii) 1λ- and 4λ- Externally Modulated Lasers with up to 28Gbaud channel capacity, iii) 1λ-Externally Modulated Lasers with a 7Gbaud bandwidth signal modulated in the 57-64GHz band and iv) a coherent tunable laser source.

Evaluation in real scenarios: *MOICANA's* monolithic SiN transmitter technology platform will be validated in a wide range of applications, setting the scene for exploiting its low-cost and large volume manufacturing credentials towards rapidly penetrating a range of relevant high-volume markets including among others Data Center Interconnects links, inter-DC coherent communications, next-generation 100GbE access and in 5G fronthauling.