European manufacturing platform for Photonic Integrated Circuits

EuroPIC Newsletter

December 2010

The EuroPIC programme is a three year, collaborative research project, targeted towards SMEs, which started on 1st August 2009. It aims bring into existence the first industrially based, generic InP foundry for low cost photonic integration.

SEVENTH FRAMEWORK PROGRAMME

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In this, the third EuroPIC newsletter, we look at a complementary project with which EuroPIC is cooperating, and then to other applications. First, another of the ePIXnet platforms for "Si Photonics" is described by our guest contributor, Laurent Fulbert of CEA-LETI, and Coordinator of the HELIOS project. HELIOS, an ICT project, and EuroPIC are already co-operating on the integration of software designs tools. Si-Photonics and InP photonics platforms perform differently and different cost/performance trade-offs too. They offer complementary approaches to the expanding the global photonics market. In our second article, a profile of EuroPIC partner FiberSensing describes their particular applications and products, and an interest in integration technology which is typical of many in the EuroPIC user group.

InP and Si Integrated Photonics: Competition and Symbiosis

Photonic integration technologies are of key importance for realisation of the low-cost and high-performance components required in any part of the communication network. As in the microelectronics industry model, design standardization and process standardization are mandatory for cost sharing and for the large investments required to develop a powerful integration technology.

The integrating project HELIOS (pHotonics ELectronics functional Integration on CMOS, http://www.helios-project.eu/) gathers 19 European partners and aims at combining a photonic layer with a CMOS circuit by different innovative integration means. Photonics/electronics convergence will be addressed at the process level and also at the design level as HELIOS helps develop an adequate design environment.

This four-year project includes the development of such essential building blocks as fast modulators, photo-detectors, passive waveguides and I/O couplers; technologies which will be progressively transferred to foundries and made available though ePIXfab *(http://www.epixfab.eu/photonfab/)* during the life of the project. Further, efficient sources (silicon-based and heterogeneous integration of III-V on silicon), and eventually the combination and packaging of these building blocks are addressed for the demonstration of complex functions to meet a variety of industrial needs.

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An SME working with EuroPIC

blocks for the demonstration of complex functions to address a variety of industrial needs. These include a 40GBit/s modulator on an Electronic IC, a 16x10 GBit/s transceiver for WDM-PON applications, a photonic DQPSK - 10GBit/s wireless (at 60GHz) transmission system, and a mixed analogue and digital transceiver module for multi-function antennas

Whatever technology platform is used for photonic integration (silicon, InP, dielectric PLC), there are common challenges that HELIOS, EuroPIC and others face together. These concern, in particular everything that happens before chip manufacturing (i.e. modelling and design) or after (i.e. packaging and tests), where opportunities of cooperation between the two communities are numerous.

Photonic integration is an opportunity for the European photonics community. Europe has key assets in photonics R&D and can lead the race and there is no doubt that EuroPIC and HELIOS will contribute to the deployment of the technology at industrial scale.

Laurent Fulbert

SME Involvement in EuroPIC: FiberSensing's experience and motivation

The FiberSensing team at its Porto premises

FiberSensing is a spin-off company from the Institute for Systems and Computer Engineering of the University of Porto. The company is devoted to the development and production of optical Fiber Bragg-Grating-based (FBG) sensor systems for advanced monitoring applications. It develops, commercializes and supports products (sensors, readout units and software packages) and services (complete solutions) for instrumentation. The main markets are monitoring of structural integrity in civil, geotechnical, energy, aerospace, naval and automotive engineering applications.

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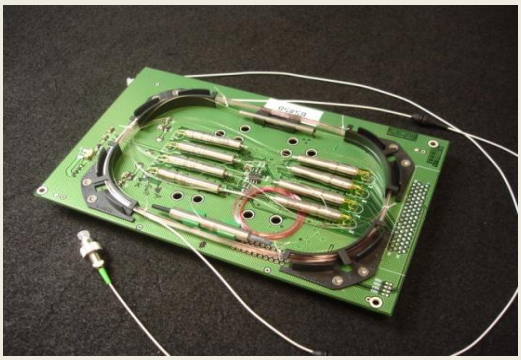
FiberSensing and EuroPIC, integrating the BraggSCOPE

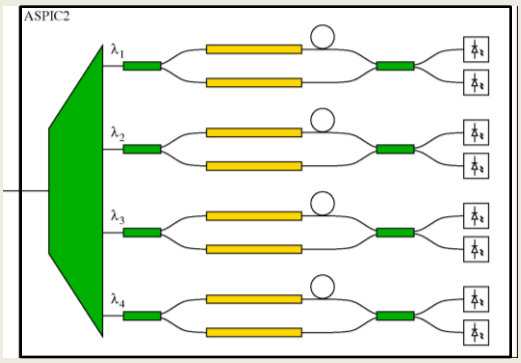
FiberSensing currently employs 35 people, of which ten are devoted to new product development, and is continuously involved in R&D activities aimed at closing the innovation cycle for ensuring the generation of new products and delivering market competitiveness.

FBG sensors have a number of valuable attributes, including small size, light weight, and the ability to be deployed in harsh environments regardless of weather, temperature, or pressure. FBG sensors are also passive; they are not electrically powered making them safe even for use around explosives or potentially hazardous environments. FBG sensors are inherently immune to electromagnetic interference and provide high sensitivity regardless of operating conditions.

The mass market introduction of the FBG technology has been slowed by the higher costs as compared to conventional monitoring solutions, limiting to niche applications, where the technology benefits have been maximized, and the cost is a second order factor. Within FBG monitoring technology, the cost of the sensor itself is rather similar to the cost of conventional electronic sensors, and it is the data acquisition equipment that actually accounts for the greatest cost difference. This obstacle must be overcome by achieving a low-cost, high-performance interrogation unit for FBG sensors before mass market insertion can take place.



FiberSensing's BraggSCOPE™ opto-electronic board



The proposed ASPIC scheme

As part of the continuous product development and improvement process at FiberSensing, one of the approaches is now to try to integrate most of the currently-employed individual photonic components into a single photonic chip. Such a unit would, therefore, improve performance in terms of temperature and vibration operation and would also have a reduced mass. Furthermore, the replacement of discrete components by a single optical chip is expected to greatly cut manufacturing

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EuroPIC User Group is the key to the success of EuroPIC

costs, thus reducing the final equipment price and allowing for mass market introduction. This would both improve the company's competitive position and increase sales volume, opening up new markets.

Monitoring of a high-speed railway bridge. In all,207 FBG sensors, including temperature, strain, load cells, tilt and acceleration

A first step towards this integration approach is to achieve a photonic chip which will integrate the filtering-based optoelectronic module of the company's proprietary BraggSCOPE technology; currently achieved by discrete thin-film filters. Up to now, access to photonic integration technology has been prohibitively expensive for a small company like ours.

SME Involvement in photonic integration

As for most SMEs, FiberSensing has neither the economic nor the human resources to embark in the long and complex process of designing, fabricating and testing an application specific photonic integrated chip (ASPIC). It is here that the development of a foundry concept, be it in InP based or Si-based technology, and the participation/ integration in a platform User Group can be of invaluable help in providing a fast and reasonable cost access to specifically designed PICs. Such access should in fact not only include the integration platform itself, but also the ASPIC design warehouses and the packaging services. In such approach, the SMEs would just provide the required specifications and the photonic design in terms of general building blocks as inputs to the platform, and they would see little to no necessity in terms of required internal knowledge on integrated photonic technology.

There are still issues to be solved, both technical issues such as…

- Will ASPICs provide the same performance as discrete components?
- How many draft designs will be needed until we get it working correctly?
- What is the reliability and reproducibility of these chips?,
- Will the packaging be able to withstand some of our tough environmental constraints?

and intellectual property issues. Nonetheless, we firmly believe that the foundry concept is the best way to implement cost-effective integrated photonic technology.

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