JEPPIX : access to generic foundry processes for INP photonic integrated circuits

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JEPPIX : ACCESS TO GENERIC FOUNDRY PROCESSES FOR INP PHOTONIC INTEGRATED CIRCUITS

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Introduction

A generic foundry model in photonics enables design and fabrication of variety of different photonic devices, for versatile applications, using standardized high-performance foundry platforms. The choice of the design method is based on reusing standardized and parameterized photonic building blocks (BBs) [1]. These BBs form complex photonic integrated circuits (PICs) and as foundry-verified BB models allow for reduction of the design time and number of design (fab) cycles needed to achieve a required performance of prototype PIC devices. Among the BBs, considered as elementary components, a small set is sufficient to support a broad class of photonic functions. These BBs are: (1) passive waveguides, (2) semiconductor optical amplifiers (SOAs), (3) phase modulators, (4) polarization converters and a few other components. In the generic model the entry costs for a generic standardized process are mainly restricted to design costs, since the fabrication costs are shared by participating in so-called multi-project wafer (MPW) runs.

Multi-project wafer run

Access to the generic foundries is available via MPW runs. In this way, the costs of fabrication of photonic ICs are reduced by more than an order of magnitude and come within reach for SMEs, research institutes and universities. The reduction of processing costs is achieved by costs-sharing among many application users participating in one fab cycle, and by reusing standardized and parameterized photonic components. The participants of MPW runs design their circuits following the design rules of the foundry and using BBs provided by the foundry. Figure 1 shows an indium phosphide (InP) MPW realized in the COBRA process. The MPW combines 12 different application specific photonic IC designs, for a number of applications, fabricated using the same processes.

Figure 1. Example of a Multi-Project Wafer (MPW), *left*. Size of a single chip is a few mm², *right*. The foundry or a broker combines all designs on one wafer and runs a generic fabrication process without knowing or needing to know the design details. In this way the foundry is, so called, “application blind”.

JePPIX platforms for photonic ICs

In JePPIX [2] Europe’s key players in the field of InP-based photonic integration technology are cooperating on the development of a generic foundry model using generic integration processes. Presently a number of large R&D projects are running, developing both the generic foundry technologies, and the infrastructure to make them accessible at low cost for a broad range of companies: design tools, component libraries, generic packaging technology and generic test equipment. Among photonic foundries that offer generic manufacturing services and access to their facilities via MPW runs, three InP-based integration technologies are leading: Fraunhofer HHI [3], Oclaro [4], and SMART Photonics [5]. Access to these technologies, as well as to TriPleX [6] platform, is provided within JePPIX.

For the recently started semi-commercial InP-based MPW runs [7], the entry costs are between 5000 € for a small chip and up to 40,000 € for a large PIC that can integrate up to several hundred components, including passives, lasers, optical amplifiers, 10 Gb/s modulators and 40 Gb/s detectors. These costs are very competitive, when compared to advanced silicon photonics MPW runs, while offering more functionality (on-chip integrated optical amplifiers and lasers). At the present price level these costs are very attractive for integrating complex sub-circuits containing larger numbers of photonic components, making them much cheaper, more compact and rigid than their alternatives based on discrete components. As the entry costs are affordable for most SMEs, we expect a rapid expansion in the application of PICs and increase in applying PICs in novel or improved products.

Summary

The approach of generic foundry model opens new market directions for companies specialized in PICs design, development and prototyping, based on a fabless business model. It brings application of Photonic ICs in novel or improved products within reach for both SMEs and larger companies that do not own a cleanroom fab. The low entry costs of a generic model make it attractive for introducing photonic ICs also to non-telecom markets, like: medical and bio-imaging [8], optical data-handling [9], fiber sensor readouts [11], THz applications [12]. Examples of photonic ICs fabricated via MPW runs on InP-based platforms are presented in Figure. 2.

Figure 2. Examples of InP photonic ICs fabricated in MPW runs: (a) optical pulse shaper [8], (b) delay interferometer [9], (c) multichannel transmitter [10], (d) wavelength meter for sensing [11].

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