

Picture Source: imec

## imec SI-PHOTONICS AND SIN-PHOTONICS PROTOTYPING AND VOLUME PRODUCTION

**EUROPRACTICE-IC provides Multi-Project-Wafer prototyping and Volume Production services of imec Silicon Photonics and Silicon Nitride Photonics.**

### Why EUROPRACTICE?

- ▶ Affordable and easy access to Prototyping and Small Volume Production services for academia and industry.
- ▶ MPW (Multi-Project-Wafer) runs for various technologies, including ASICs, Photonics, MEMS and GaN.
- ▶ Advanced packaging, system integration solutions and test services.

### Why imec Photonics?

- ▶ Cost-effective, highly reproducible and CMOS compatible fabrication.
- ▶ Regularly scheduled MPW runs and dedicated mask runs.
- ▶ Complete PDKs including technology details, design and layout rules, and a library of building block components.
- ▶ World-leading research and innovation hub in nanoelectronics and digital technologies headquartered in Belgium.

### Technology Highlights

#### Si-Photonics iSiPP50G

The platform enables cost-effective silicon photonic ICs for:

- ▶ High-performance optical transceivers (50Gb/s and beyond) for datacom, telecom and access networks
- ▶ Optical sensing (gas, pressure, strain) and read-out ICs
- ▶ Biomolecule detection, drug development, point-of-care diagnostics

The iSiPP50G platform co-integrates a wide variety of passive and active components to support a wide range of optical transceiver architectures at data rates of 25Gb/s or 50Gb/s. The offered integrated components include low-loss waveguides, efficient vertical grating or broadband edge couplers, high-speed silicon electro-optic modulators, high-speed silicon-germanium electro-absorption modulators and high-speed germanium waveguide photo-detectors. iSiPP50G offers state-of-the-art performance, design flexibility and superior CD and thickness control. It is a fixed process technology (130nm) with a validated device library.

#### Si-Photonics Passives+

imec Si-Photonics Passives+ technology is a subset of iSiPP50G technology. The device layer of SOI wafers is etched at three different depths to enable integration of different photonic functions. A patterned poly-Silicon layer improves the performance of grating couplers for out-of-plane coupling to fibers and a deep etched trench at an edge of the chips, combined with edge-coupler components, provides optical access, with a broader optical bandwidth. In addition, a layer for metal-based heaters enables thermal tuning of the optical functions. Electrical access to the metal heaters is established through two additional levels of metal interconnect.

## SiN-Photonics BioPIX150 / BioPIX300

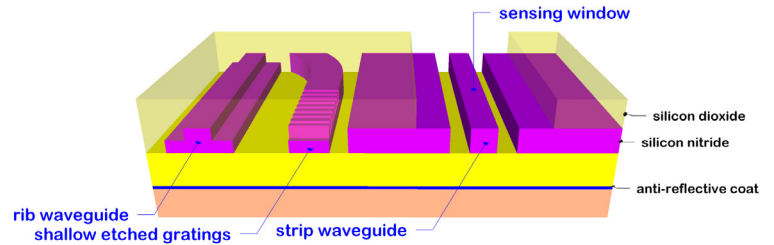
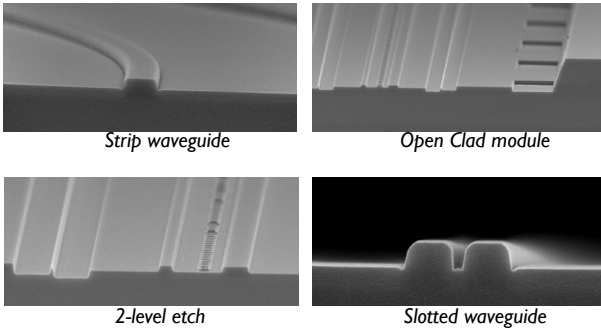


BioPIX is imec's silicon nitride (SiN) photonics platform. SiN, deposited through a low temperature PECVD method, forms the core waveguiding layer on which the photonics platform is based. It is optimized for the applications in the wavelength range covering the visible and near-infrared spectrum, such as on-chip implementation of tomography, microscopy, spectrometry, beam steering, point-of-care diagnostics and optical sensing.

The BioPIX technology has been developed and validated through 6 early-access MPWs in the EU-funded project PIX4life and is available in two different technology flavors:

- ▶ BioPIX150, based on 150nm thick SiN, for applications in the wavelength range of 400nm – 700nm.
- ▶ BioPIX300, based on 300nm thick SiN, for applications in the wavelength range of 700nm – 1000nm.

### Waveguide based devices on BioPIX300



### Technology Details

Silicon Photonics			Silicon Nitride Photonics		
Modules	Description	Enabled devices	Modules	Description	Enabled devices
3silicon patterning steps	3 etch depths in 220nm Si: 70nm, 160nm; 220nm (193 nm litho)	Strip/rib waveguides, various passive optical devices, silicon taper	2 SiN patterning steps each	2 etch depths for each flavor: 90 & 150nm (BioPIX150) 150 & 300nm (BioPIX300)	Strip/rib waveguides, shallow/deep gratings
Gate oxide and Poly-Silicon layer	1 etch depth: full poly etch (160nm) (193nm litho)	Advanced grating couplers, poly-Si waveguide	2 SiN thickness flavors	2 SiN thicknesses: 150nm (BioPIX150) 300nm (BioPIX300)	2 flavors optimized for wavelengths 300 – 1000nm
Metal heater	Metal layer for heaters	Metal heaters	Metal heater	TiN metal lines for resistive heating	Thermo-optic tuners/modulators
Two-level metal interconnect	Cu-based two-level metallization	Standard CMOS interconnects	Metal interconnect	Al metal lines and pads for interconnects	Interconnects, probe/bond -pads
Deep trench	Deep trench to expose edge coupler facets	Edge couplers	Deep trench	Deep trench to expose edge coupler facets	Edge couplers
Ion implantation in Si	8 implants levels: 4x n-type and 4x p-type	Si carrier depletion, injection and accumulation devices, Ge Photodectors, doped Si resistors, ...	Clad oxide removal	Exposure of waveguides for sensing by removing local clad SiO2	Micro-channels for evanescent sensing
Ge module	100% Ge(Si) RPCVD selective epitaxial growth & 2x implants levels	Ge Photodectors Ge(Si) EA modulator			
Silicide tungsten contact module	Ohmic contacts to doped silicon	Standard CMOS contacts plugs			
Aluminium passivation	Aluminium finish metallization	Standard CMOS interconnects			

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