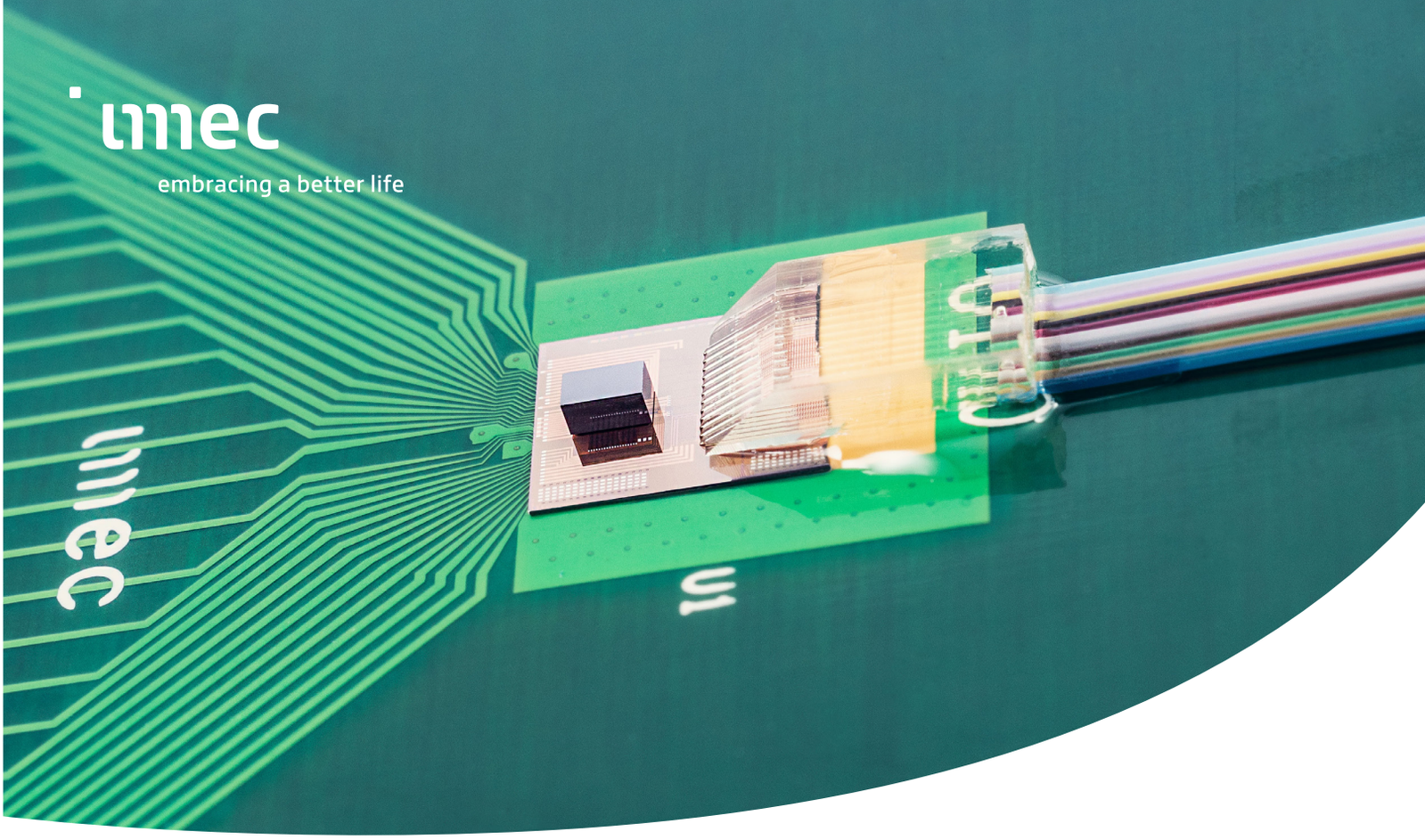
imec
embracing a better life



IMEC'S SILICON PHOTONICS PLATFORM SERVICES

With a state-of-the-art integrated silicon photonics platform, imec is your ideal development partner in realizing your advanced optical interconnect and sensing applications. The platform is available for companies and universities through various business models.

First, in the frame of its collaborative R&D program on Optical I/O, imec and its partners develop the next-generation silicon photonics technology for multi-Tb/s short-reach optical interconnects.

Second, imec offers its integrated silicon photonics iSiPP50G platform to multiple partners at fixed tape-in dates, through regular multiproject wafer (MPW) runs (see our leaflet on iSiPP50G).

Third, imec offers a dedicated and flexible silicon photonics prototyping and production services, specifically tuned to the needs of a single partner, on both 200mm and 300mm wafers (referred to as iSiPP200 and iSiPP300, see this leaflet). This service extends the iSiPP50G offering with process customization options.

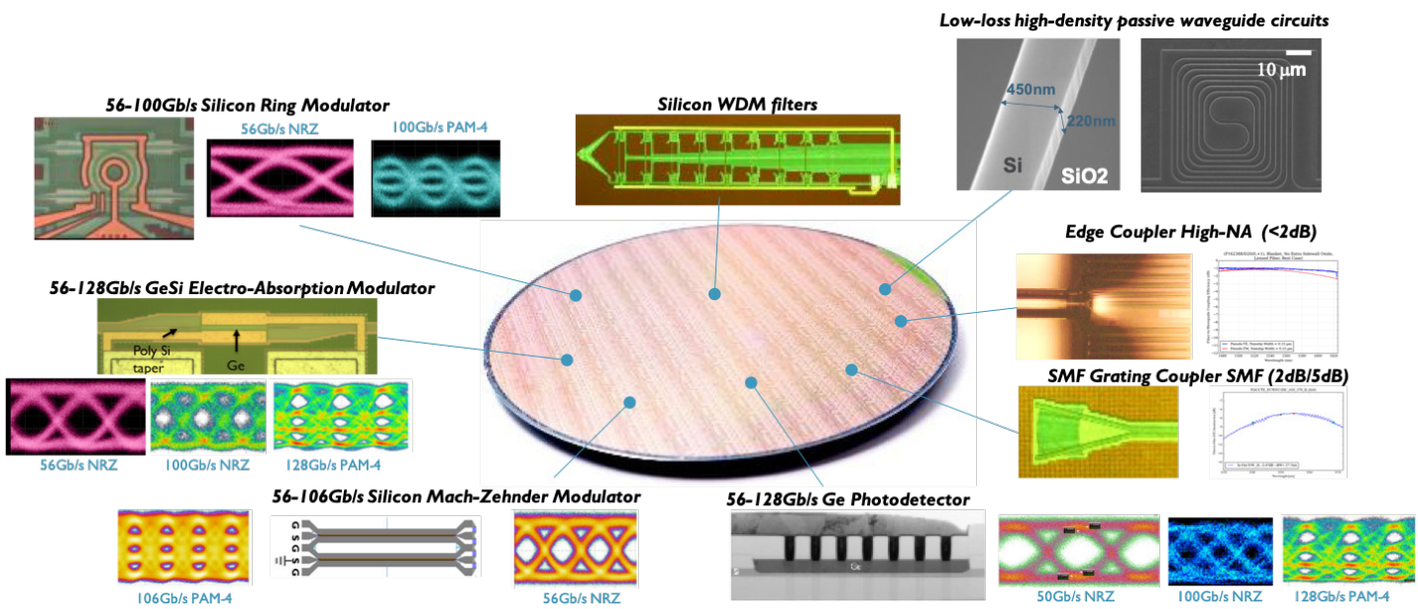
And last we offer design services; our experts in circuit and system design can also help you leverage the iSiPP PDK and develop application specific designs to enable faster time to market and complement or supplement your internal design teams.

BUILD YOUR OWN PROTOTYPE WITH iSiPP200 OR iSiPP300

Imec's 50G silicon photonics platform co-integrates a wide variety of passive and active 50Gbd building blocks in a single platform. The platform targets cost-effective, high-performance 50Gb/s NRZ and 100Gb/s PAM-4 optical link solutions for telecom and datacom. The key components such as the Mach-Zehnder modulators, the monitor photodetector, the high-bandwidth photodetector and the thermo-optic phase shifters have passed successfully reliability qualification.

The versatility of the platform also enables other integrated photonics applications, such as coherent LiDAR, bio-sensing, quantum optics, artificial intelligence etc.

Custom designs are made by our fabless partners, who send their GDS tape to imec. A silicon validated process design kit (PDK) is available, which is supported by various EDA tools. After design verification, processing is available on either 200mm (iSiPP200) or 300mm (iSiPP300) wafers – with iSiPP300 providing additional benefits (see below). As part of the integration flow, iSiPP50G standard modules as well as extra module options are offered. At the end of the process, the individual building blocks are tested using process control module tests on a fully-automated wafer-scale tester.



Imec's versatile 50G+ silicon photonics platform

iSiPP200: PROCESSING ON 200MM WAFERS

- Based on 220nm silicon/2000nm buried oxide (BoX) SOI wafers
- Standard iSiPP50G modules, extended with optional specialty modules and optimized processes
- Optional modules: silicon nitride (SiN) or silicon oxide nitride (SiON) edge couplers, local undercut (UCUT) for thermal insulation
- Optimized processes for silicon waveguides, Mach-Zehnder modulator phase shifters and silicon ring modulators
- Underbump metallic for flip-chip assemblies
- Process can be tailored to the customer's needs
- Leverage process knowledge to design application specific circuits
- Prototyping and low-volume processing on 200mm using imec's industry compatible fabrication facilities

iSiPP300: PROCESSING ON 300MM WAFERS

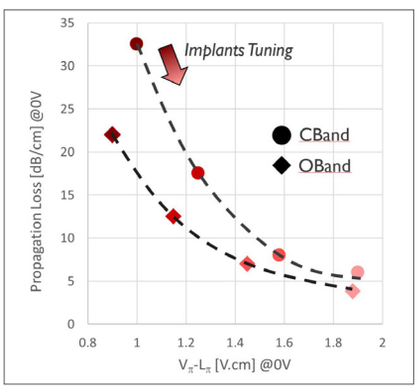
- Extends iSiPP200 offering with additional features
- Additional benefits:
  - High-precision waveguides through advanced lithography (193nm immersion)
  - Advanced packaging options (e.g. through-silicon vias (TSVs) and micro-bumps for dense 3D system integration)
  - Higher performance values for a range of devices
- Prototyping and low-volume processing on 300mm using imec's fabrication facilities

NEW WAVEGUIDE EXPOSING PROCESS

- New process for exposing the silicon waveguide after BEOL formation
- Enables waveguide-based sensing
- Low impact on waveguide propagation loss (~1.5dB/cm)

OPTIMIZED MACH-ZEHNDER MODULATOR PHASE SHIFTER

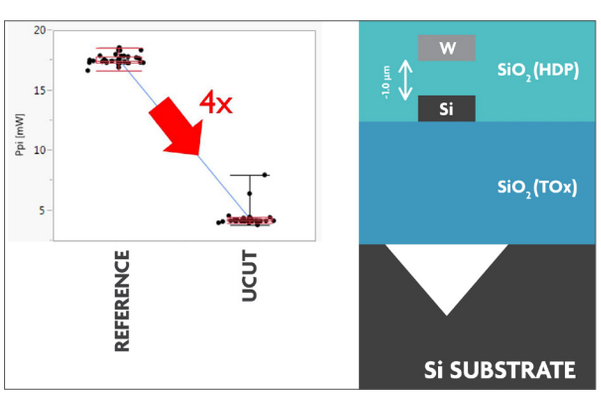
- P-n phase shifter tuned to desired efficiency-loss tradeoffs by adjusting implant process conditions (C-band vs. O-band)



- Optimized p-n phase shifter design reduces series resistance and increases bandwidth:
  - Electro-optical bandwidth at -1V: 37GHz (1.5mm long traveling-wave MZM)
  - No impact on other device characteristics

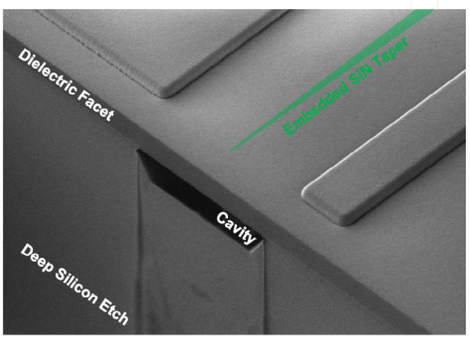
SEALED LOCAL SUBSTRATE UNDERCUT

- 4x improved power efficiency of integrated metal heaters (Pπ ~ 4mW)
- Cavity sealed and passivated similarly to the rest of the photonics components



SILICON-NITRIDE FIBER EDGE COUPLERS

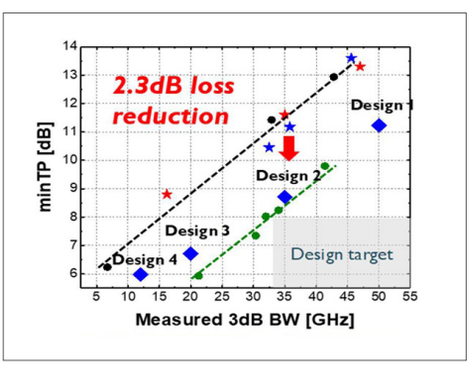
- SiN edge coupler combined with undercut
- Fiber-to-waveguide coupling to single-mode fiber below 2.5dB in C-band
- Fiber-to-waveguide coupling to single-mode fiber below 3.0dB in O-band

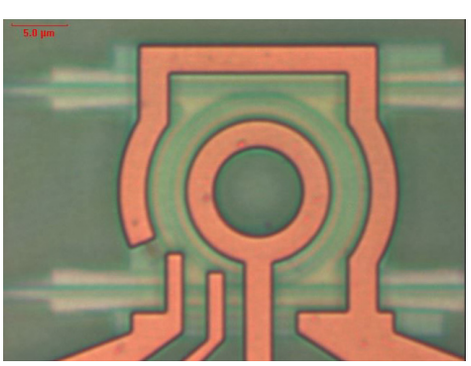


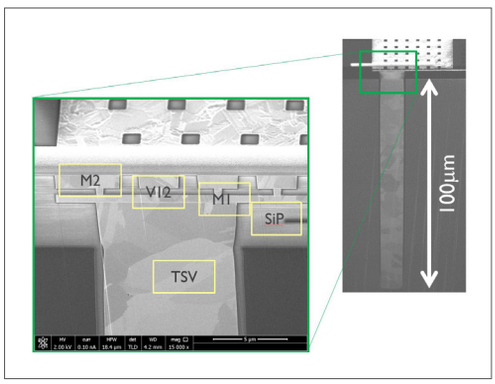
LOW-SWING HIGH-SPEED RING MODULATOR

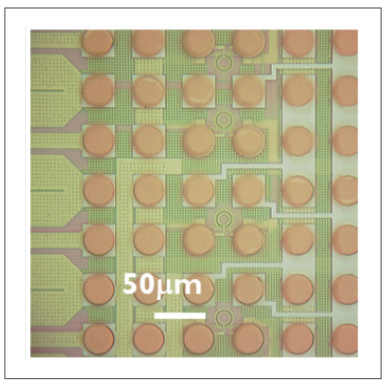
Improved Si ring modulator design and process supports

- 35GHz electro-optical bandwidth
- <9dB transmitter penalty TP at 1Vpp drive swing (TP = 2PIN/OMA)







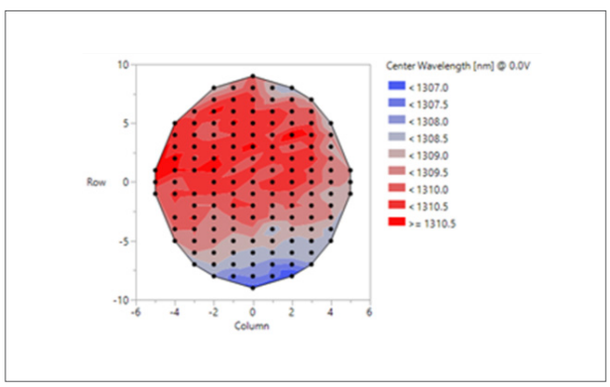


300MM PLATFORM: TSV INTEGRATION

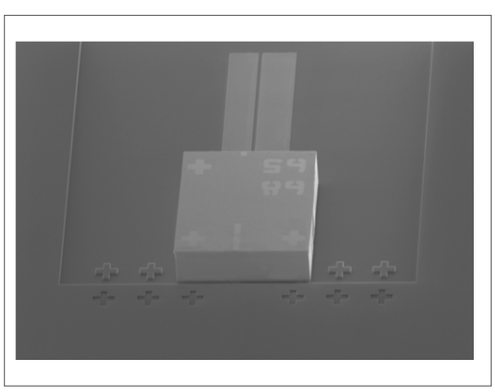
- Possibility to integrate 10µmx100µm through-silicon Cu vias
- Together with front-side under bump metallic and back-side RDL and Cu pillar
- TSV enables 50Gb/s NRZ operation

IMPROVED SILICON WAVEGUIDE PROCESS - DIMENSIONAL CONTROL

- Improved patterning (high fidelity, HiFi) process
- Improved variability of the waveguide width:
  - 200mm platform: 5x within-wafer variability improvement to 1nm (1σ)
  - 300mm platform: variability as low as 0.8nm (1σ)
- Variability of the waveguide thickness:
  - 200mm platform: 0.7nm (1σ)
  - 300mm platform: 0.3nm (1σ)



Microring Modulator Resonant WavelengthWafer-scale distribution (300mm, 1-σ = 0.9nm)



Scanning electron-microscope image of an InP DFB laser assembled on a Si Photonics chip

HYBRID LASER INTEGRATION

- Collaboration with CST Global (UK) to extend imec's silicon photonics portfolio with flip-chip integrated InP light sources (DFB, RSOA)
- Interfaces for hybrid laser integration to become available through iSiPP200 prototyping services by the first half of 2021

CONTACT US

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