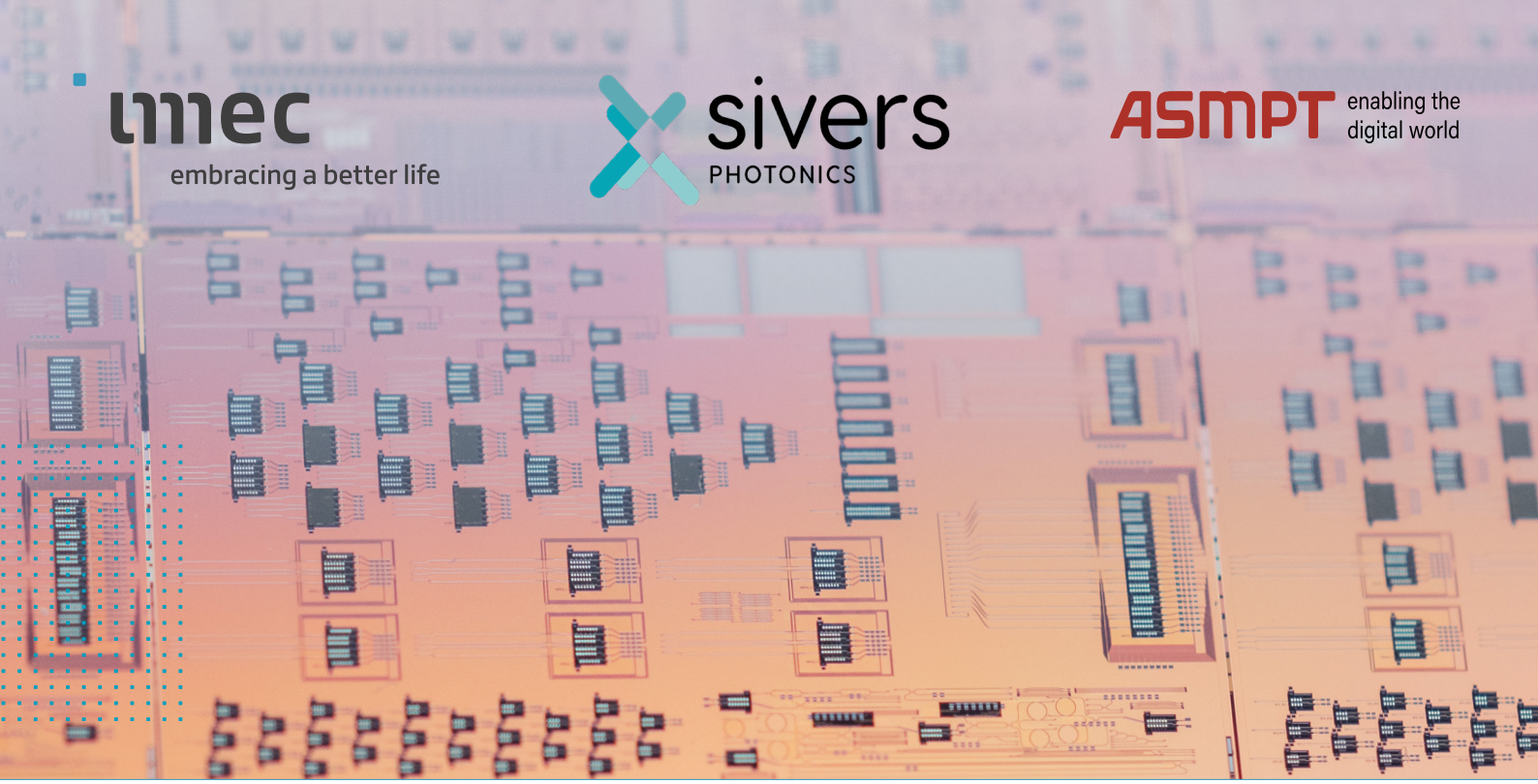
imec
embracing a better life

sivers PHOTONICS

ASMPT enabling the digital world



High precision III-V laser flip-chip assembly for Silicon Photonics

Imec is extending the capability of its silicon photonics platform 'iSiPP' with validated interfaces for hybrid laser integration, enabling high-throughput wafer-scale flip-chip assembly of III-V lasers and amplifiers. Working together with development partners Sivers Photonics and ASMPT, reference interface designs and assembly processes have been created for flip-chip bonding DFB lasers from Sivers' InP 100 product platform, with sub 0.5-µm precision, enabling reproducible coupling losses below 2dB and waveguide-coupled power as high as 40mW. This technology is now accessible for pathfinding and early product development through prototyping runs, targeting a broad range of applications including optical communications, optical 3D sensing (LiDAR), biophotonics, high-precision metrology, gas sensing and more.

Technologies

Silicon photonics platform - imec

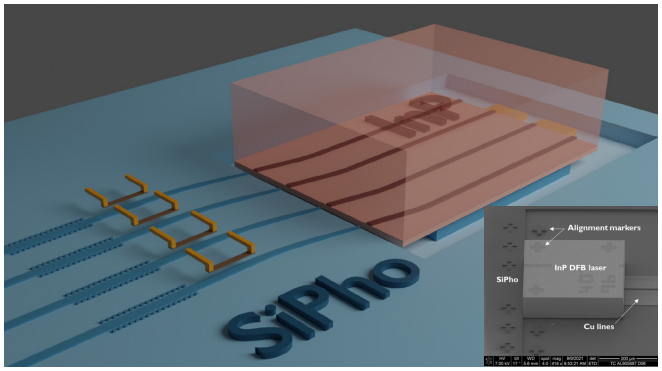
- Imec's silicon photonics technology 'iSiPP' is available on 200 and 300mm wafer sizes, including a wide range of active and passive devices.
- The interface for flip-chip DFB laser integration has been developed in imec's **iSiPP200N** platform. In addition to high-speed electro-optic Si modulators, high-bandwidth Ge photodetectors and efficient thermo-optic heaters, this platform includes highly uniform **LPCVD SiN waveguides**, enabling low-loss SiN waveguides with accurate phase control, enabling the synthesis of high-quality, precise filters and complex circuits.

InP laser technology - Sivers Photonics

- Finished laser dies operating in the O-band and C-band wavelength ranges are designed, manufactured and tested by imec's partner Sivers Photonics, ensuring high yield.

Distributed Feedback (DFB) laser chips bonded on imec's wafers deliver up to 40mW of optical power coupled to waveguide.

- Arrays of reflective semiconductor amplifiers (RSOAs) are also available to realize extended optical cavity diode lasers (ECDLs) with silicon nitride mirrors for O-band and C-band operations.



Artist impression of an ECDL array. Inset: scanning electron microscope (SEM) picture of a bonded DFB laser from Sivers Photonics.

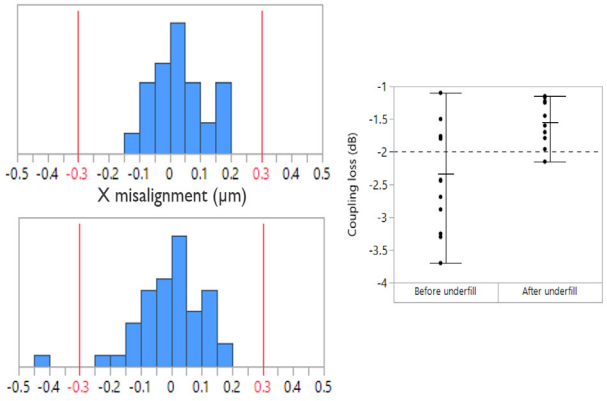
Flip chip laser assembly - ASMPT

- Laser integration is done at wafer scale using the high-precision AMICRA NANO flip-chip bonding tool from ASMPT, with an in-plane alignment capability below 200nm (3σ).
- After the flip-chip bonding process and interface design optimization, imec and ASMPT have achieved reproducible post-bonding x-y alignment accuracies of better than 300nm and vertical alignment accuracy of better than 150nm.
- The coupling loss between the InP DFB laser facet and the SiN waveguide is consistently better than -2dB, with up to 40mW of optical power coupled into the silicon photonics PIC.

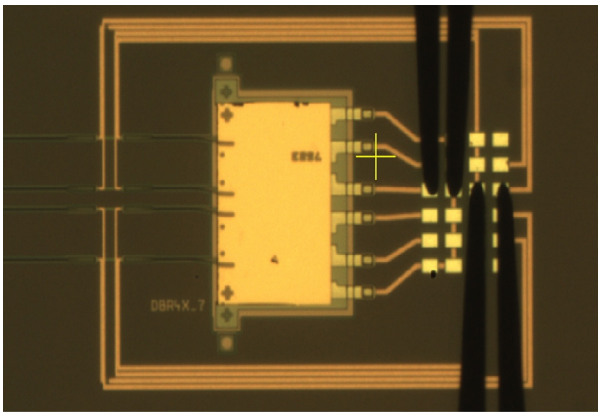
ASMPT's AMICRA NANO tool

Hybrid laser integration tailored to your application

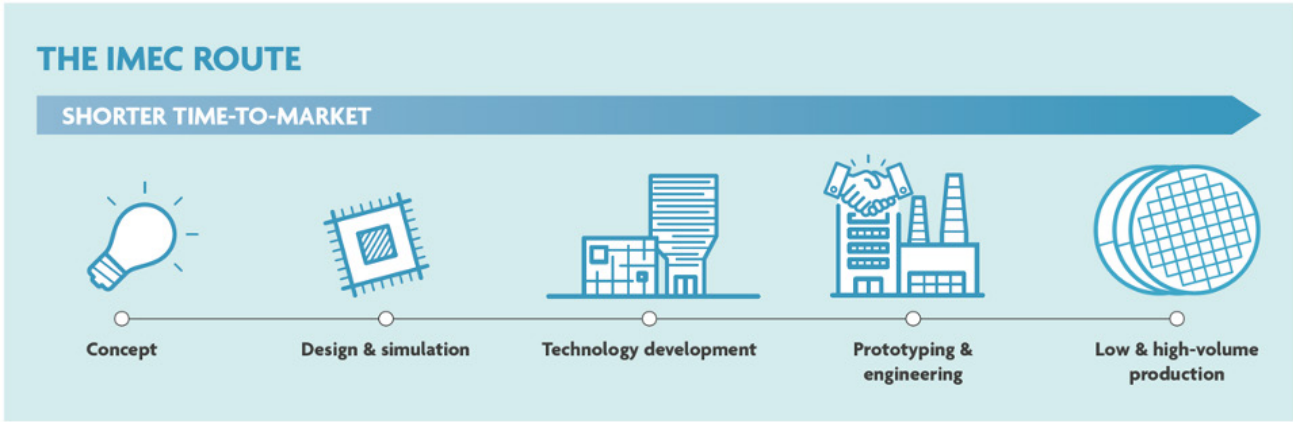
- The combined technology enables you to add multiple infrared light sources to your PIC design, with reference designs available in the O- and C-band. Upon request, additional wavelengths can be considered, addressing the fields of optical communications, sensors, computing, or LiDAR applications.



Left: misalignment measurements along x and y axis showing a 3σ alignment accuracy below 300 nm. Right: Laser/SiN waveguide coupling loss before and after epoxy underfill for different SiN tip widths.



Microscope picture of a four-channel InP RSOA chip from Sivers Photonics integrated into an iSiPP200N wafer.



CONTACT US

WWW.CONTACTIMEC.COM

WWW.SIVERS-SEMICONDUCTORS.COM/SIVERS-PHOTONICS

WWW.AMICRA.SEMI.ASMPT.COM