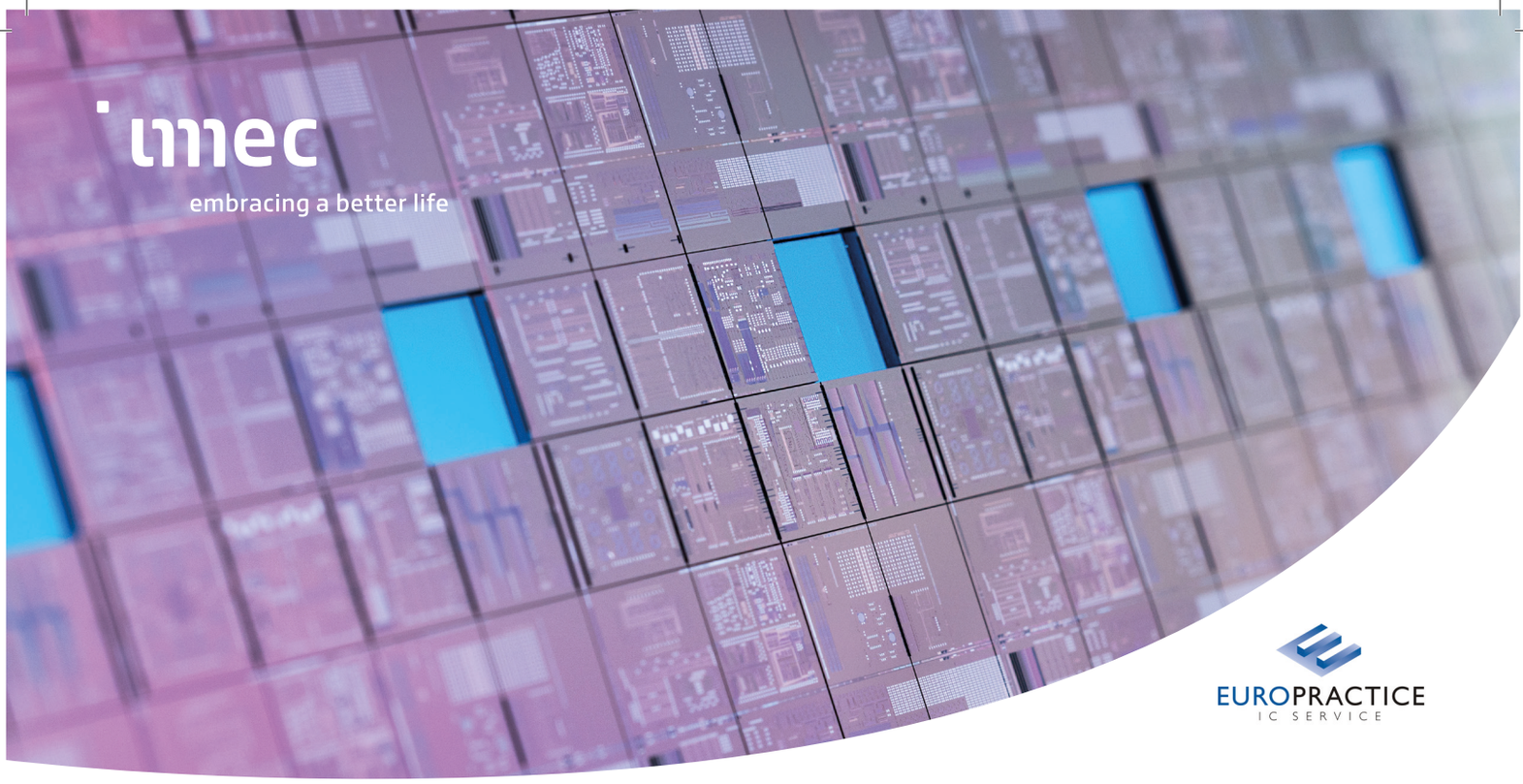


PHOTONIC INTEGRATED CIRCUIT PROTOTYPING AND SMALL VOLUME PRODUCTION

Imec provides access to Photonic Integrated Circuit (PIC) prototyping and small volume production based on imec's iSiPP50G silicon photonics platform. We turn your photonic ideas into reality at a single point of contact.

LOW-COST MPW AND DEDICATED MASK RUNS

To lower the cost of access, prototyping is implemented through a Multi-Project Wafer (MPW) service which allows shared mask, processing and engineering costs. MPW runs are available at fixed design registration, with two passive runs and three active runs (containing active elements such as modulators and photo-dectors) currently scheduled. For quantities larger than the 20-25 samples delivered in an MPW run, dedicated runs can be requested which return approximately 15, 200mm wafers.

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.

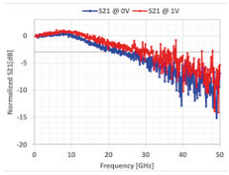
iSiPP50G DESIGN KIT

To enable user access, imec provides an extensive iSiPP50G process design kit (PDK). This kit includes process documentation, library performance, layout guidelines for custom, design and verification rules. The PDK is available upon signature of imec's Silicon Photonics Design Kit License Agreement (DKLA).

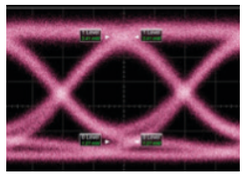
Modules	Description	Enabled devices
3 silicon patterning steps	3 etch depths in 220nm Si: 70nm, 160nm; 220nm (193 nm litho)	Strip/rib waveguides, various passive optical devices, silicon taper
Gate oxide and Poly-Silicon layer	1 etch depth: full poly etch (160nm) (193nm litho)	Advanced grating couplers, poly-Si waveguide
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, ...
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
Two-level metal interconnect	Cu-based two-level metallization	Standard CMOS interconnects
Aluminum passivation	Aluminium finish metallization	Standard CMOS interconnects
Deep trench	Deep trench to expose edge coupler facets	Edge couplers

50G TRAVELING-WAVE MACH-ZEHNDER MODULATOR (typical performance values)

Parameter		Typ.Value	Unit	Comments
Operation Wavelength		1550	nm	O-band designs also available
Electro-Optic Bandwidth (S21)	f3dB	24	GHz	at 0V bias
		37	GHz	at -2V bias
Modulation efficiency	Vπ	12	V	
Optical Insertion Loss	IL	-2.5	dB	Not including bias induced loss
Phase-Shifter Length	L	1.5	mm	
Termination Resistance	R_t	25	Ohm	Doped Si resistor

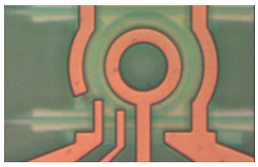


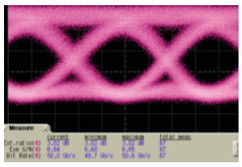
S21


50Gb/s, 2.5Vpp

50G Si RING MODULATOR (typical performance values)

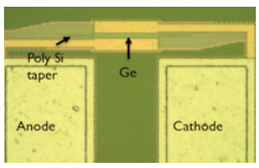
Parameter		Typ.Value	Unit	Comments
Quality Factor	Q	3000		
Electro-Optic Bandwidth (S21)	f3dB	45	GHz	0V bias
Static Transmitter Penalty	TP	10	dB	1.5Vpp drive swing
Diode Capacitance	Cj	20-30	fF	
Diode Series Resistance	Rs	~70	Ohm	
Ring Radius	R	5	um	


Microscope image

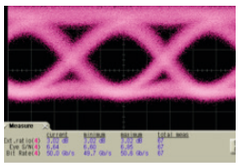

50Gb/s, 2.0Vpp

50G SiGe ELECTRO-ABSORPTION MODULATOR (typical performance values)

Parameter		Typ.Value	Unit	Comments
Operation Wavelength		~1560	nm	L-band version also available
Electro-Optic Bandwidth (S21)	f3dB	>50	GHz	at -1V bias
		>50	GHz	at -2V bias
Optical Insertion Loss	IL	-4.2	dB	
Device Length	L	40	um	

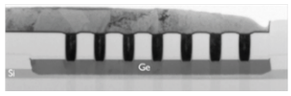


Microscope image

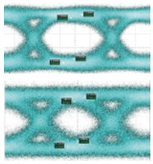

50Gb/s, 2.0Vpp

50G Ge PHOTODETECTOR (typical performance values)

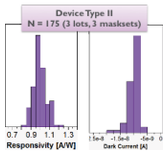
Parameter (type 1)		Typ.Value	Unit	Comments
Opto-Electrical Bandwidth	f3dB	>50GHz	GHz	C-band*
C-band Responsivity		~0.9	A/W	
O-band Responsivity		~0.85	A/W	Room temp, -1V bias
Dark Current	Id	<50	nA	
Parameter (type 2)		**Type.Value**	**Unit**	**Comments**
Opto-Electrical Bandwidth	f3dB	>25GHz	GHz	C-band*
C-band Responsivity		~1.0	A/W	
O-band Responsivity		~0.94	A/W	Room temp, -1V bias
Dark Current	Id	<50	nA	



TEM image


25Gb/s

50Gb/s

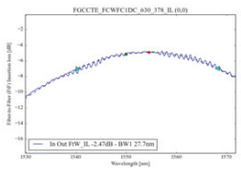


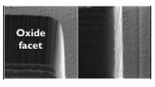
Statistics

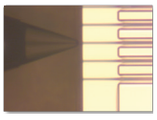
PASSIVES (typical performance values)

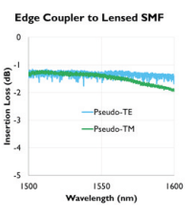
Single Mode Waveguides		Typ.Value	Unit	Comments
Strip Waveguide C-band		<1.4	dB/cm	450nm wide
Strip Waveguide O-band		<2.6	dB/cm	380nm wide
Rib Waveguide C-band		<0.6	dB/cm	650nm wide
Rib Waveguide O-band		<0.7	dB/cm	580nm wide
Thickness Control	3s	<4.5	nm	
Fiber Grating Couplers		**Type.Value**	**Unit**	**Comments**
Insertion Loss		2.5	dB	C-band*, TE, SMF
I dB Bandwidth		35	nm	C-band*, TE
Peak-λ within-wafer control	1s	<4	nm	
Fiber Edge Couplers		**Typ.Value**	**Unit**	**Comments**
Insertion Loss		<2	dB	C-band*, Lensed Fiber
I dB Bandwidth		>100	nm	C-band*
Polarization dependent loss		<0.5	dB	C-band*


Grating Coupler






Edge Coupler



* O-band versions available in PDK

CONTACT US

epsiphot@imec.be
T +32 16 28 82 05
www.europractice-ic.com