High Performance LIDAR enabled by Heterogeneously Integrated Silicon Photonics

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August 2023

The Need for Silicon Photonics
Technical and commercial considerations

Benefits of FMCW

- Increase range
  - Transmit power limited by eye safety
  - Improve receive sensitivity of homodyne receivers
- Interference tolerance
  - Coherent vs non-coherent noise
- Additional information
  - Velocity as well as position

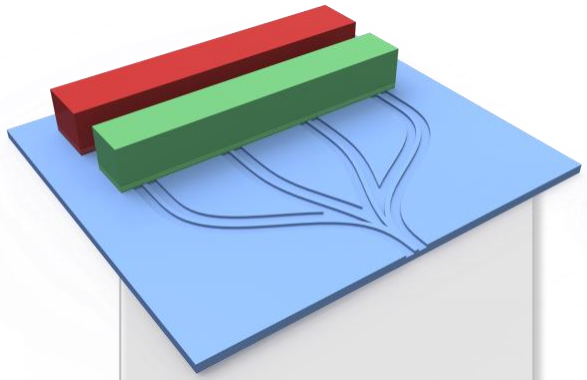
Challenges

- Complexity compared to ToF
- Higher technical specs
- Increased amount of data and DSP

FMCW LIDAR Requirements

- High Quality Lightsource
  - ~10kHz linewidth
- Phase control
  - n x π phase shift, GHz Chirp rates
- High Optical Power
  - >1W in O Band and C Band
- All Solid State
  - High reliability and environmentally robust
  - Minimal power consumption and thermal control
- Cost and Scale
  - Wafer scale processing and test at high volume
  - Simple and short supply chain with no margin stacking

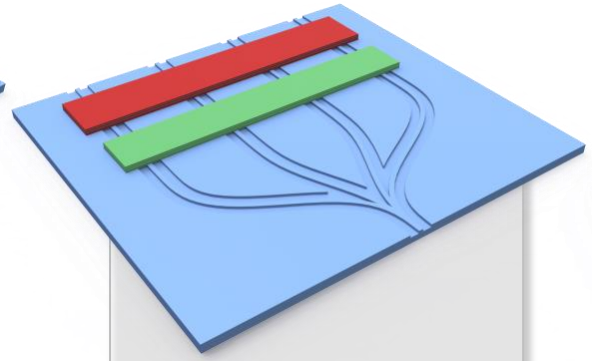
Heterogeneous Integration:
Adding III-V materials into a silicon process



Die Placement on Patterned SiPh Wafer

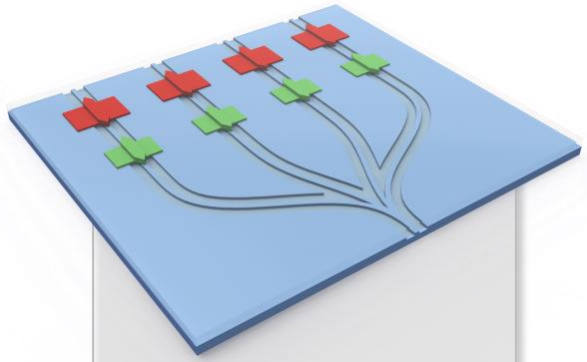
Mature Si & SiN photonics passives

Integration of multiple III-V Materials



Substrate Removal

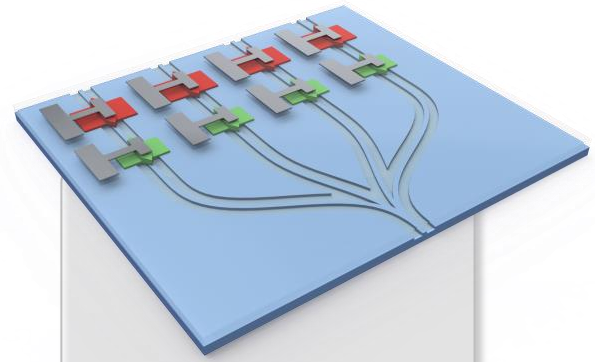
Reduced topology for standard foundry processing



III-V Processing

Active materials defined by lithography

No critical alignment



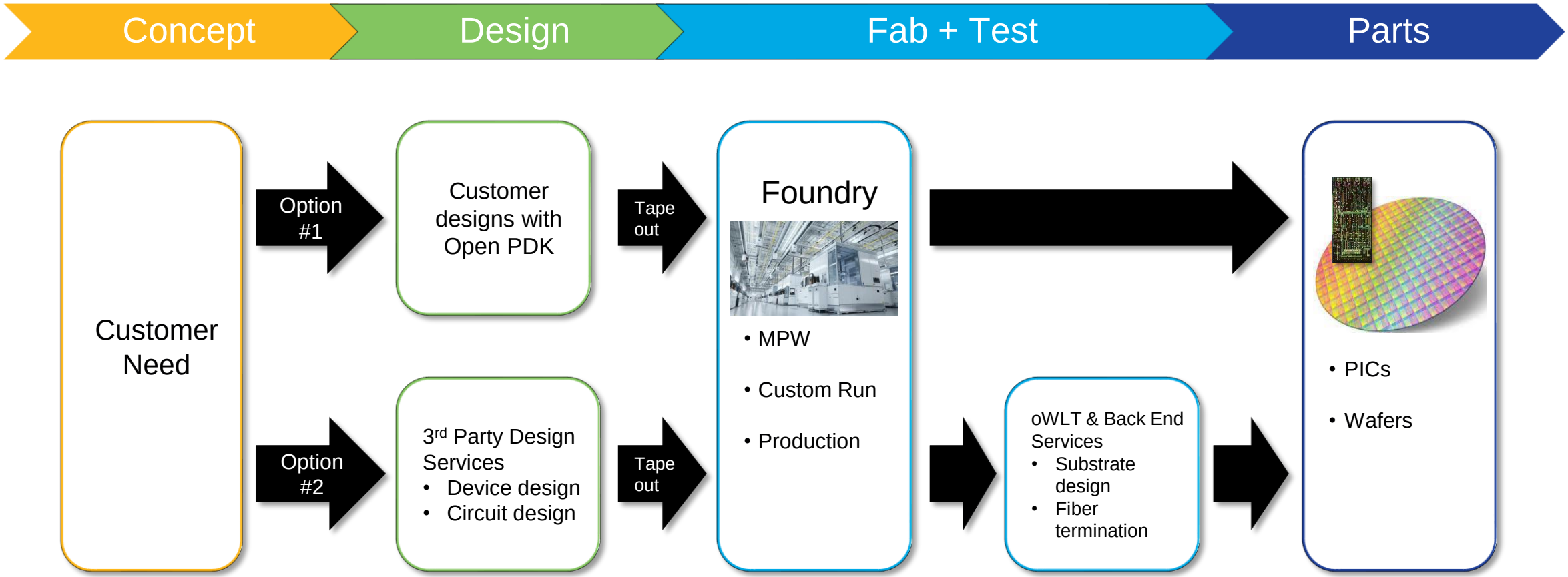
Interconnect

Hermetic at Chip Scale

Wafer scale processing

Open Foundry Model

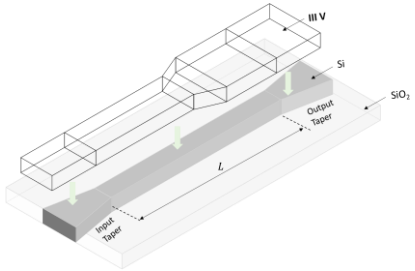
From Concept to Product



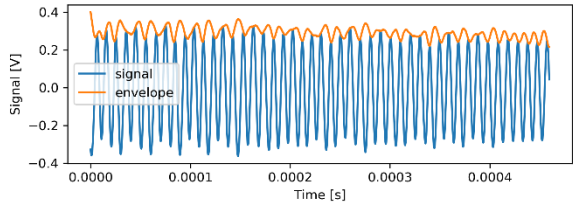
- Ecosystem exists to turn a bare die into a packaged product

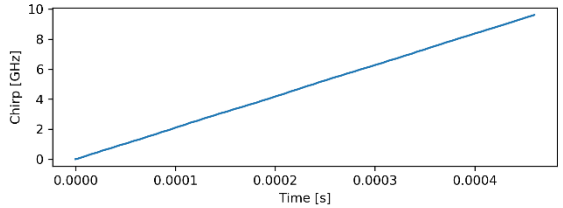
Why OpenLight Solution for LIDAR?

- High Power handling in silicon waveguide
  - 500nm waveguide layer allows power in waveguide >100mW without TPA issues
- On chip gain with high output power scalable to arrays
  - Up to 20dBm per device
  - 32 device SOA array with <500FIT
- High Quality Tunable Ring Laser (TRL) source
  - O Band and C Band with 15dBm o/p power
  - Widely tunable across 20-40nm
  - Linewidth <10KHz with low RIN and high SMSR
  - MHz FM rate with 10s GHz chirp
  - External phase modulator option
- Dual port DFB for efficiency and simplified control
  - >10% WPE with 15mW per port

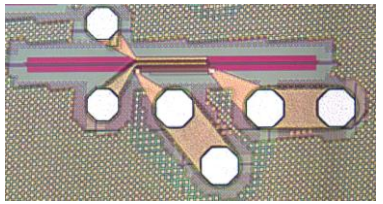


High Power SOA design





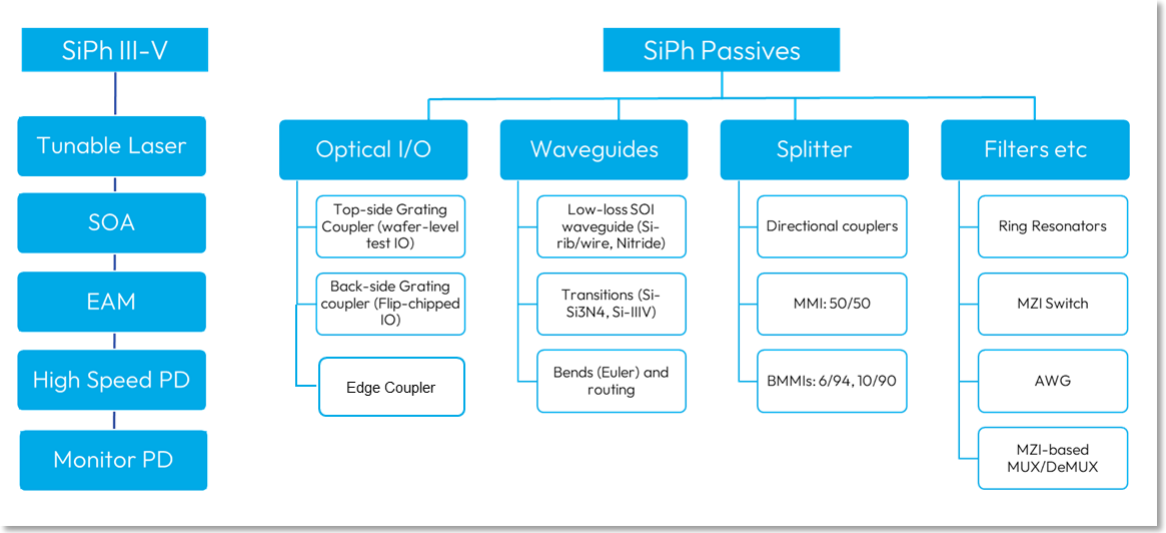
Laser Chirp profiles



Phase modulator showing signal and (optional) heater pads

OpenLight Process Design Kit (PDK)

All the Components Needed to Build Your Photonics IC



SYNOPSYS® LUCEDA cadence®

capability	OptoCompiler v.2.1.x	IPKISS v1.0	Cadence photonics v.2.7.x
Tech files	Yes	Yes	Yes
Create schematic	Yes	No	No
Run circuit simulations	Yes	No	No
Schematic Driven Layout (SDL)	Yes	No	No
Layout circuits (fixed device cells)	Yes	Yes	No
Layout circuits (device p-cells)	Yes	No	No
Run DRC	Yes	Yes	Yes
Run LVS	Yes	No	No

- For all design kits, customers can import GDS layout cells to be used in their design

Complete Platform of Passives and Active Devices

- Standard passive device library
- Unique offering adds active devices – tunable laser, optical amplifier, photo detectors
- Integration eliminates barrier to entry – no need to source & package separate lasers
- OpenLight platform enables very low loss between active components and Si waveguides

Summary

- Heterogeneously Integrated Silicon Photonics is a good candidate for commercialization of High Performance LIDAR
- Open PDKs and Open Foundry models offer the lowest possible cost without margin stacking
- Low barrier to entry either through advanced SW tools or 3rd party design services
- OpenLights PDK has many LIDAR specific features and is ready for adoption by customers large and small

OpenLight™

Thank You

www.openlightphotonics.com

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