

**Low loss PICs:
From prototype to
volume**

LIGEN^{TEC}

Leader in low loss Silicon Nitride Integrated Photonics



EPFL



LIGEN^{TEC}

European PIC Company

European origin

Europe based



Global Reach

Headquarters in Lausanne (CH)

Originating from EPFL (Kippenberg Lab)



LIGEN^{TEC} HQ, Switzerland



LIGEN^{TEC} France

Benefits of Silicon Nitride

Large transparency window:

400 – 4'000 nm

Reference Silicon: 1'100 – 4'000 nm

Low propagation loss: < 1dB/m possible

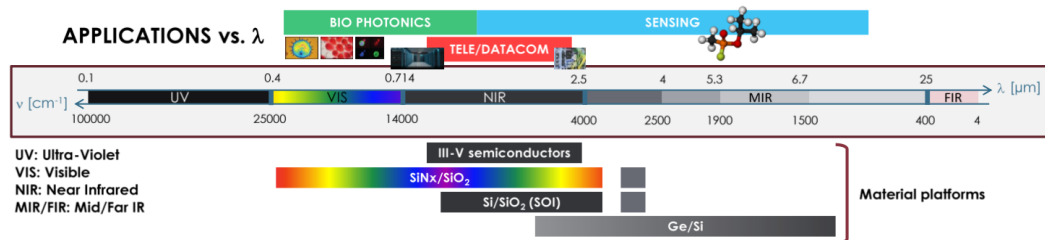
Reference Silicon: 2.5 to 1 dB/cm

High optical power: > 5 W per waveguide ($10^9\text{W}/\text{cm}^2$)

Reference Silicon: 0.1 W per waveguide

Scalable to volume

Non exotic material



Muñoz et. al., Sensors 2017, 17, 2088



required for many applications

Photonic Integration: Motivation for low loss PICs

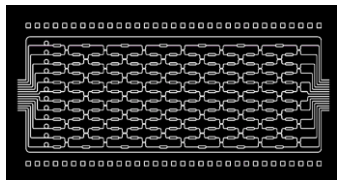
Why are losses important?



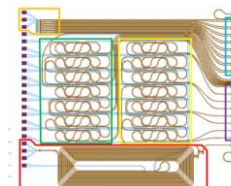
- Long delay lines require of 10s of cm
- Detection of photons coming back
- Phase noise is related to losses



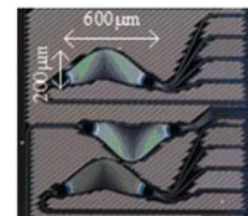
- Phase noise of AWGs is related to losses
- Tunable narrow linewidth lasers
- Narrow linewidth Filter



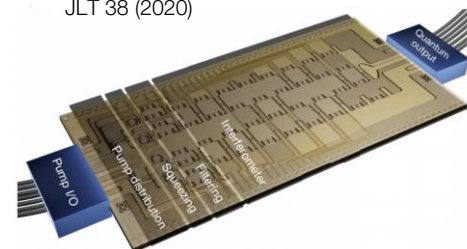
- Assymmetric MZI interferometers
- High Q ring resonators
- Every photon counts



Martin et al., JLT **36** (2018)



Cheung et al.,
JLT **38** (2020)



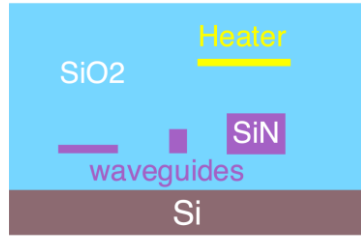
Arrazola et al., Nature **54** March 2021

A base to build on
Versatile Platform

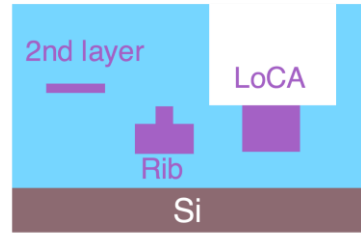


3+ thicknesses 10+ process modules Extensive PDK

800 nm

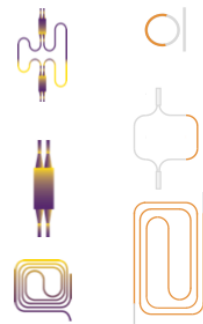
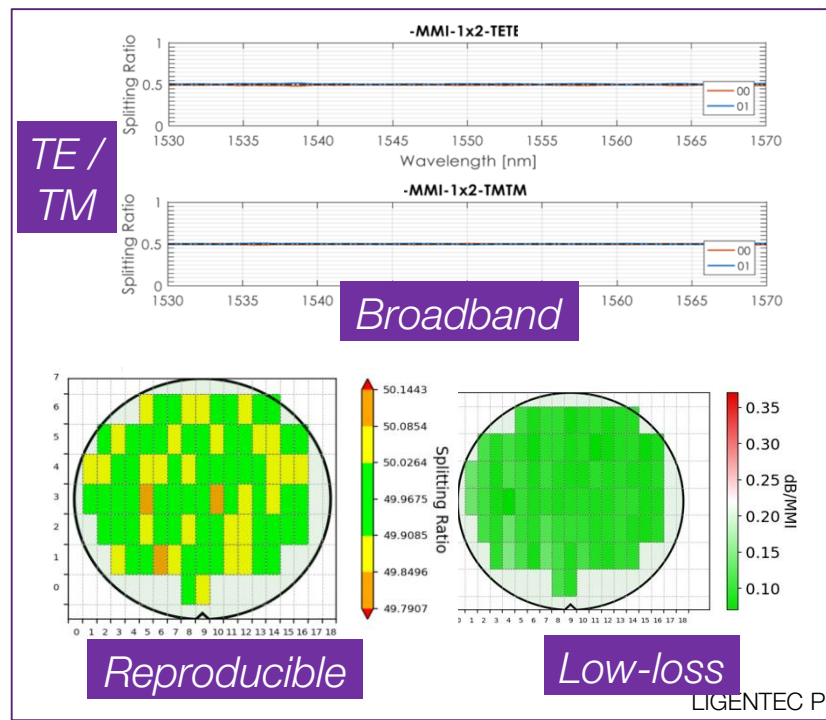


350 nm



150 nm

custom



Simplify the access to PIC technology
Seamless journey from Idea to Volumes



Entry: R&D & Prototyping

Open access, low barrier



Fast prototyping

- Established technology
- Fixed layer stack
- Extensive PDK
- **Regular MPW runs**
- Custom runs
- Design / layout support
- Characterization
- Packaging support

Optimize: Development

High flexibility & competence



Custom PIC Developments

- Engineering studies
- Layer stack adaptation
- Custom integrations

Ligentec Labs

- Early technology access

Manufacturing: Supply

Quality and guarantee



Pilot Fabrication

- Pilot and niche quantities

Volume Fabrication

- Large volumes
- High-capacity wafer fab
- Fully automated testing
- Automotive quality system

The next step – enhance the SiN PIC platform

SiN – The platform for monolithic & heterogeneous integration



Use SiN as base platform for general circuitry

- Comprehensive PDK
- Standard I/Os
- Scalable to volume

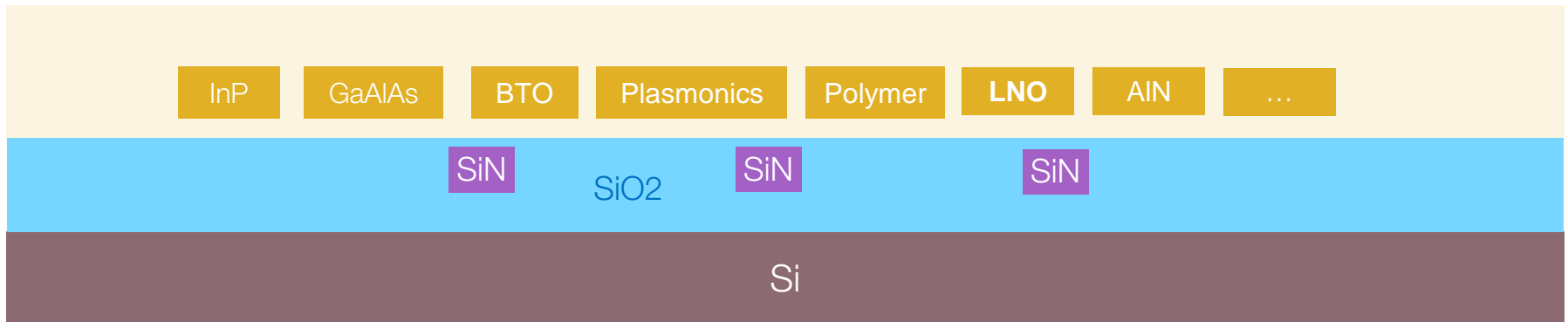
Add materials as required by application

OPTICA

100 GHz bandwidth, 1 volt integrated electro-optic Mach-Zehnder modulator at near-IR wavelengths

FORREST VALDEZ, VIPHRETUO MERE, AND SHAYAN MOOKHERJEA*

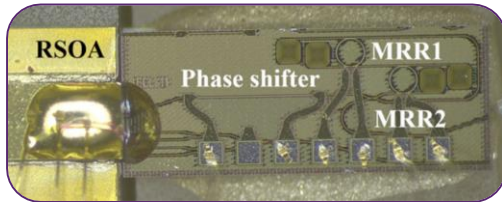
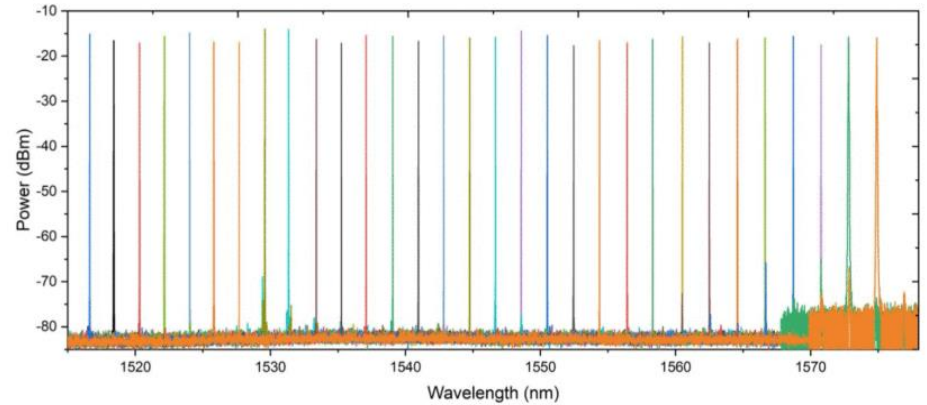
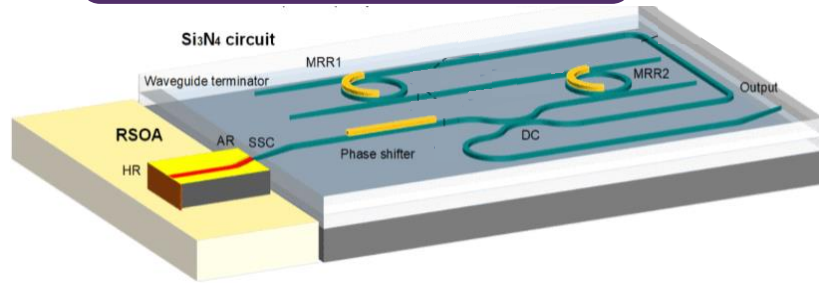
University of California, San Diego, Department of Electrical and Computer Engineering, La Jolla, California 92093-0407, USA
*smookherja@ucsd.edu



Hybrid Integration example

Tunable Narrow Linewidth Lasers

LIGENTEC design, layout and fabrication



Narrow Linewidth External Cavity Lasers

Linewidth: <3kHz

SMSR: -70dB

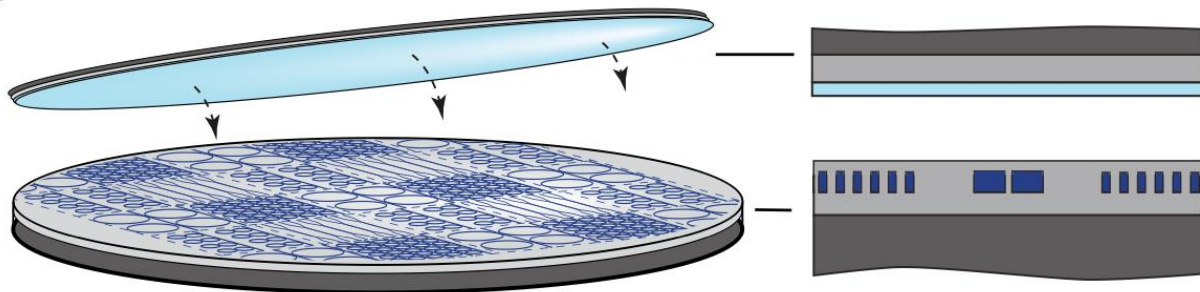
Max power: 34mW

Tuning: 58.5nm

Heterogenous Integration example

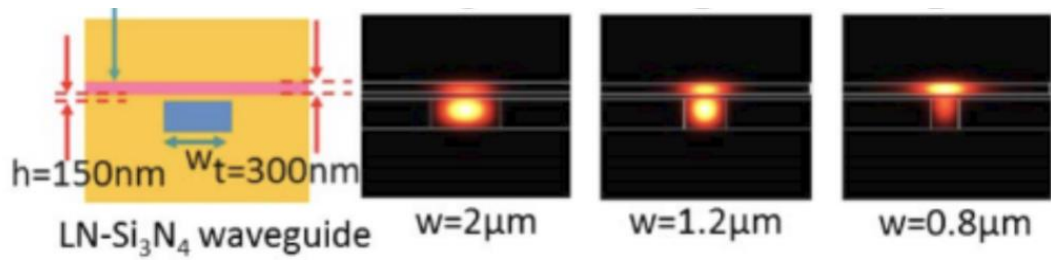
LNOI / SiN wafer level bonding

LiNbO₃



SiN

Enables early-stage engagement with our R&D team to access advanced technologies

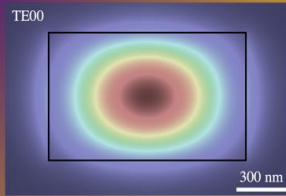


Summary

Low Loss SiN - Platform Overview



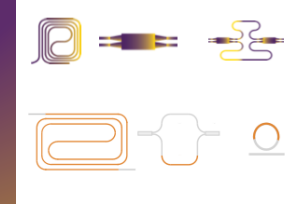
Low loss waveguides



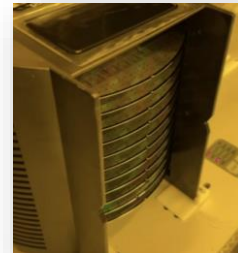
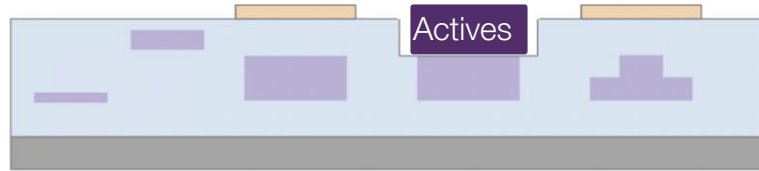
MPW / Dedicated runs
Short turn around

Flexible R&D line
Volume line

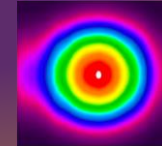
Extensive PDK



Actives Integration



Low loss optical I/O



MFD [μm]	9.7
M ²	1.06



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the world a better one!**

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ligentec.com/careers

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