

# SILICON NITRIDE (SiN) PHOTONICS PLATFORMS WITH EXTREMELY LOW PROPAGATION LOSS

Imec offers two SiN photonics platforms with both high temperature (LPCVD) and low temperature (PECVD) options. By using imec's SiN photonics platforms you can develop innovative components for your future products. A key feature of high temperature SiN photonics is the extremely low waveguide loss and tight process control on full 8-inch wafers. Low temperature SiN photonics has the advantage of low loss and the possibility to post-process SiN photonics on top of CMOS wafers (for e.g. imagers).

Imec supplies SiN photonic chips to several OEMs.

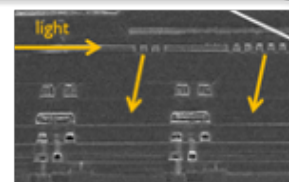
## High temperature SiN (LPCVD)

- Extremely low loss waveguide (<math><0.1\text{ dB}</math> down to - Tight process control on 200 mm wafer ( $\sim 1\text{ nm}$  over wafer)
- High power handling (Watt-range)
- Wide wavelength range (405 nm up to 2500 nm)
- Building blocks (GC, EC, RR, DC, heater, LC, ...)



## Low temperature SiN (PECVD)

- Un-detectable auto-fluorescence (spectrometer)
- Compatible with CMOS imager process
- High power handling (Watt-range)
- Wide wavelength range (405 nm up to 2500 nm)
- Low loss waveguide ( $\leq 2\text{ dB/cm}$ )



## HIGH TEMPERATURE SiN PHOTONICS PLATFORM

- > 4 years in volume as product

### Applications:

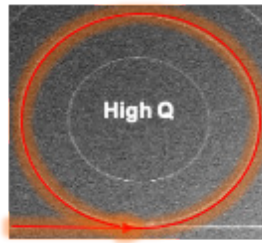
- Quantum domain (QKD, QC, QS)
- Bio (Spectrometer, Raman, Visible laser)
- Communication (Transceiver, Space)
- Special lasers (MLL, dual comb, etc.)
- Microwave photonic (5G, radar)
- Sensing (Lidar, radar, Gas, pressure sensor)

### Key features:

- Wavelength coverage from visible to SWIR (400 to 2500 nm)
- Extremely Low propagation (<0.1 dB/cm) loss thanks to:
  - Annealing of silicon nitride
  - Very Low waveguide sidewall roughness
  - LPCVD stoichiometric film
  - Hydrogen content control
  - Refractive index uniformity
  - Very tight thickness uniformity
- Shallow & full SiN etch



Left: Extremely low loss SiN rib waveguide Right: High quality factor SiN ring resonator; (LPCVD)



## LOW TEMPERATURE SiN PHOTONICS PLATFORM

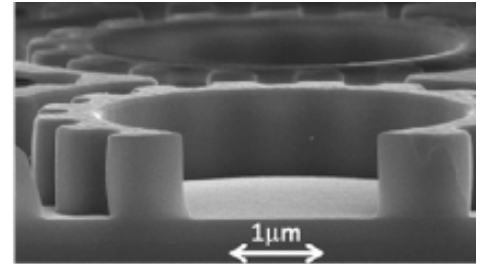
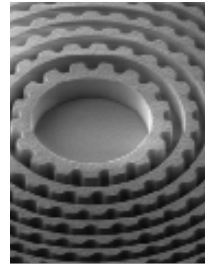
- Photonics based sensor (in the visible) in volume manufacturing

### Applications:

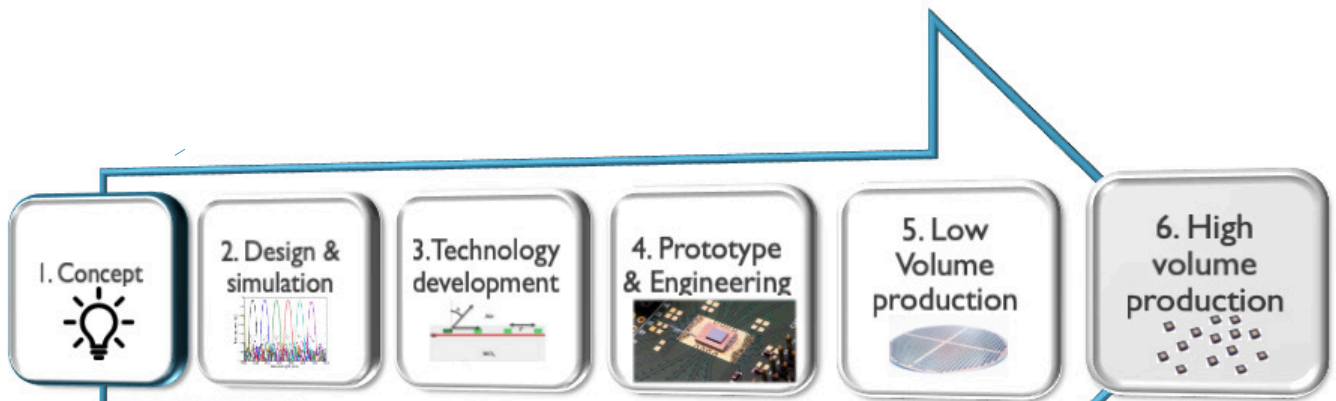
- Stand-alone Photonics-based Sensors
  - For lifescience applications
- Integrated photonics on CMOS (imager)
- Flat optics (e.g. Fresnel phase plate lenses (FPPL))
- LIDAR (optical beam forming)
- Spectrometer / Life science applications

### Key features:

- Wide spectrum range (400, 780nm, 905nm, ...)
- Low propagation loss (<2 dB/cm)
- Undetectable auto-fluorescence (AF):
  - Ideal for spectroscopy applications
- Possibility to post-process it on top of CMOS (e.g. imager)
  - Low temperature process



Fresnel phase plate lenses (FPPL) (PECVD)



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