Hybrid integration of nonlinear crystals on silicon photonics for communication and sensing

Early Career Faculty Award (ECF): Topic 1 - Integrated Photonic Sensors and Science Instrument Subsystems

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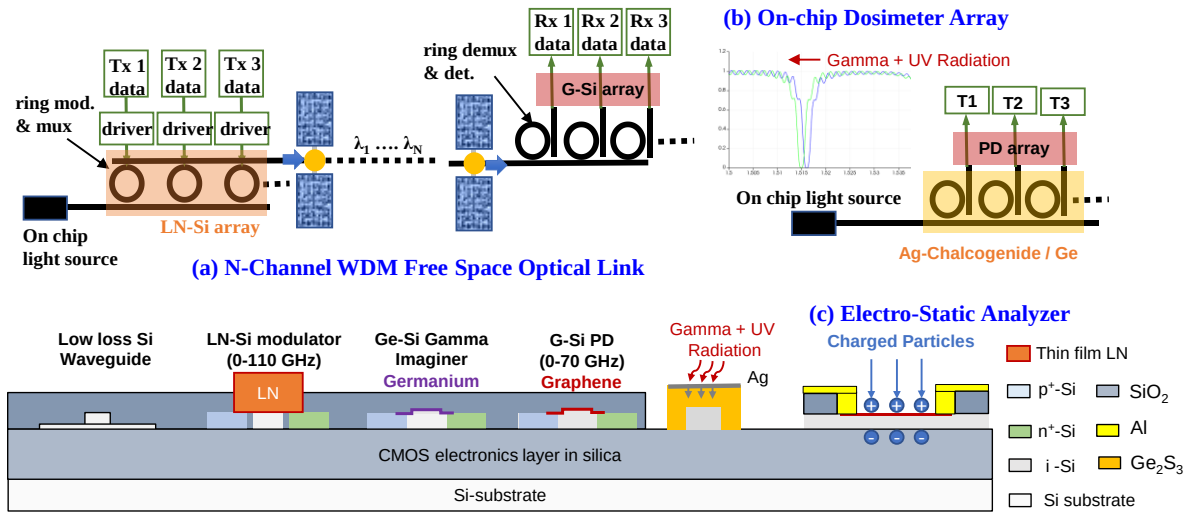
Research Objectives

Miniaturized multi-functional photonic sensor system

- Integrated sensor array system for plasma detection
- Real-time dosimeter for Gamma ray and UV radiation
- Real-time electro-static analyzer for electrons, protons and ions
- Improve TRL from 1 to 2 at the end of the project

Light-weight N-channel WDM free space optical link

- 110 GHz per channel photonic transmitter
- 70 GHz per channel photonic receiver
- Low cost, efficient, light-weight, radiation hardness evaluation



Hybrid integration on a silicon nanophotonic platform for (a) high-speed space communication, (b) Ionization radiation detection and (c) charged particle detection

Approach

Silicon photonic substrate defined components and subsystems

- Nano-manufactory platform provided by CMOS foundry
- Lithography/patterning free integration of hybrid materials
- Full control of photonic/electronic coupling to active layer by CMOS processed devices

Material engineering for hybrid integrated active layers

- Engineered carrier transport on Van der Waals interface to silicon
- Integrated high speed LN-Si modulator, Graphene-S photodetector
- Electro-static charge controlled conductivity in 2D materials
- Refractive index modification through radiation induced diffusion of silver in to chalcogenide cladding material

Design/layout automation tools for on-chip system design

Potential Impact

Low cost, miniaturized sensor array providing innovative instrumentation for Heliophysics

- ***Low power and wearable real time radiation monitor*** protecting astronaut/space craft engines from radiation damage
- ***Light-weight and high speed communication*** to establish ground-to-satellite or satellite-to-International Space Station links
- ***Expected for 3U CubeSat deployment*** through local ground station at Goddard Space Flight Center in five years