Our group focuses on optoelectronic devices and photonic integrated circuits and their applications in fiber optic communication systems and microwave photonics. Recent work includes the development of high-speed high-power photodiodes for photonic microwave generation, radar transmit and receive applications, and optical communications. Other projects are focused on simulation, design, fabrication, and characterization of Indium phosphide-based photonic integrated circuits on a silicon photonic-electronic platform.
**High-Speed Optoelectronic Devices**

Driven by the ever-increasing demand for higher capacity in optical communication systems optoelectronic components continue to play a crucial role in evolving fiber optic systems as they are required to operate at higher and higher speed and at an increasingly higher spectral efficiency. High-speed applications in microwave photonics, including RF optical links, oscillators, and radar, call for integrated high-performance devices with higher bandwidth, better power handling capability, and higher linearity to improve signal-to-noise ratio and spur-free dynamic range. To meet future requirements of these applications photonic integrated circuits (PICs) combining optical, optoelectronic and eventually electronic functionalities on a single chip will become more and more important. Our research is focused on the development of optoelectronic devices and technologies that enable new applications and advances in a wide range of photonic systems. Our work includes the development of state-of-the-art high-speed high-efficiency waveguide photodetectors, integrated optical coherent receivers, high-power photodiodes and arrays, and large dynamic range detectors.

**InP-Based Photonic Integrated Circuits on Silicon Photonic-Electronic Platforms**

Heterogeneous integration of III-V material on silicon is a promising approach to realize high-performance optoelectronic devices on a silicon photonics platform. Owing to their material properties, Indium phosphide-based photodiodes (PDs) allow for complex bandgap engineering and have the potential to achieve low dark current, high saturation current and wideband absorption over C- and L-bands. We have demonstrated discrete InP-based modified uni-traveling carrier PDs that have achieved record-high saturation current and high linearity. In collaboration with UC Santa Barbara and Aurrion Inc., we have been using wafer-bonding technology to integrate this type of photodiode on Silicon-on-insulator waveguides. The goal of this work is to enable high-performance photonic integrated circuits on a versatile Silicon photonic-electronic platform.

**RECENT RESEARCH DEVELOPMENTS**

- In collaboration with UC Santa Barbara and Aurrion Inc. we demonstrated the first Indium phosphide-based high-power high-speed optical receiver heterogeneously integrated on Silicon.
- Developed integrated distributed traveling wave photodetector for sub-Terahertz applications up to 300 GHz.
- Fundamental research on non-linear mechanisms in photodiodes that led to photodiodes with the highest linearity and output power to date.

**RECENT GRANTS**

- Archom Technology – Integrated Optoelectronic Photoreceiver Modules

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**SEAS Research Information**

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