

BiCMOS Process Integrated Silicon-Germanium Avalanche Photodiode

Conventional manufacturing for semiconductor photodetectors limit performance and design

SiGe APDs are composed of silicon and germanium (SiGe) and use an avalanche photodiode (APD) to detect light. They are used in a wide variety of industries, and they are continuously being improved upon. Current technologies are produced alongside conventional silicon products, and as a result their design possibilities are constricted and their raw performance is lower.

New technology can be manufactured in a silicon foundry

Researchers at the Georgia Institute of Technology have developed a new design for SiGe APDs that can be manufactured in a low-cost silicon foundry, allowing these constraints to be bypassed. This results in a single chip with a full optical receiver subsystem, along with supporting transimpedance and limiting amplifiers, and decision and clock recovery circuits. This solution also reduces parasitic series spreading resistance, improves uniformity of electric field across the active junction area, and mitigates edge breakdown and trap-assisted-tunneling based dark current.

The invention is a new design for a semiconductor photodetector that operates based on the principle of avalanche multiplication to detect light signals. The photodetector can be made using existing semiconductor foundry processes and is capable of supporting a full optical receiver subsystem, with all requisite supporting electronics. The innovation improves carrier mobility and electric field uniformity.

Summary Bullets

- The invention introduces a novel semiconductor photodetector design, leveraging the principle of avalanche multiplication to detect light signals effectively.
- It enables cost-effective high-volume production through the utilization of existing semiconductor foundry processes, bypassing traditional constraints.
- This innovative design supports the integration of a complete optical receiver subsystem onto a single chip, thereby enhancing performance and streamlining production processes.

Solution Advantages

- Allows production to be high-volume, high-yield, and low-cost by using existing semiconductor foundry processes for manufacturing
- Supports a full optical receiver subsystem and all supporting electronics on a single chip
- Higher raw performance than current technologies
- Improved carrier mobility and electric field uniformity

Potential Commercial Applications

- Advanced semiconductors and electronics
- Optical communications systems; photonics and optoelectronics
- LiDAR (Light Detection and Ranging)
- High-speed data transmission devices
- Medical imaging
- Industrial automation systems

Inventors

- John Cressler
Regents' Professor - Georgia Tech School of Electrical and Computer Engineering

IP Status

<p>The patent has been filed.</p>:

Publications

[Zero-Process-Change SiGe Heterojunction Avalanche Photodiode for High-Speed, High-Gain Detection Near the Silicon Band Edge](#), IEEE Electron Device Letters, - 2021

Images

Visit the Technology here:

[BiCMOS Process Integrated Silicon-Germanium Avalanche Photodiode](#)

<https://s3.sandbox.research.gatech.edu//print/pdf/node/4323>