III-N Based Material Structures and Circuit Modules Based on Strain Management

Tech ID: 31884 / UC Case 2017-99F-0

BACKGROUND

Current state-of-the-art optoelectronic devices are based on either lattice-matched or biaxially strained wurtzite III-nitride materials. Their performance is limited by the low hole conductivity in group-III nitride materials, which is due in part to the high relative hole mass in nitrides, resulting in a very low hole mobility. Decreasing the holes' effective mass provides for higher hole mobility, resulting in significant performance improvements in photonic devices, suggesting a need for new methods to increase hole mobility.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel approach to incorporate strain into III-Nitride photonic and electronic heterostructures. This strain causes an upward shift in the light hole band, producing holes with a mass lower than that of electrons, which results in increased hole mobility and reduced electron scattering. The innovation enables enhanced performance of p-type and n-type III-Nitride devices, including reduced threshold carrier density in lasers and LEDs, as well as enabling the fabrication of GaN-based CMOS integrated circuits combining electron and hole transistors. Furthermore, this technique is applicable to materials beyond III-Nitride materials in all polarities and crystal planes.

Patent: https://patents.google.com/patent/US12230678

ADVANTAGES

- Hole Mobility increased by 4x in initial experiments
- Enables GaN based CMOS
- High Frequency and high current devices

APPLICATIONS

- III-nitride materials in various polarities and crystal planes
- Push-pull and wideband amplifiers
- Mixed signal electronic architectures
- Laser diodes and LEDs with improved efficiency
- High performance GaN-based CMOS integrated circuits

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OTHER INFORMATION

KEYWORDS

strain management, circuit modules, transistors, laser diode, LEDs, amplifiers

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2017-99F-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,230,678	02/18/2025	2017-99F

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
- Iii-N Transistor With Stepped Cap Layers

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