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 results in significant performance improvements in photonic devices.

DESCRIPTION

Researchers at the University of California, Santa Barbara have incorporated strain engineering into electronic and photonic nitride heterostructures, resulting in an upward movement of the light hole band and formation of holes with a relative mass less than electrons. This technology enables significant improvement to the performance of hole-based transistors and enables the fabrication of integrated circuits combining electron and hole-based transistors. In addition, the technology enables improvements to the performance of optoelectronic devices such as LEDs, but especially lasers, through a significant reduction in the threshold carrier density. By utilizing strain as proposed by this technology, the performance of all p-type and n-type III-nitride electronic devices can be enhanced.

ADVANTAGES

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

APPLICATIONS

- III-nitride materials
- Materials in all polarities and crystal planes
- Push-pull amplifiers
- Wideband amplifiers
- Mixed signal architectures
- Laser diodes
- LEDs

PATENT STATUS

CONTACT

Pasquale S. Ferrari
ferrari@tia.ucsb.edu
tel: .

INVENTORS

- Ahmadi, Elaheh
- Gupta, Chirag
- Keller, Stacia
- Mishra, Umesh K.
- Tsukada, Yusuke

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

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

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
- ▶ (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