Achieving “Active P-Type Layer/Layers” In III-Nitride Epitaxial Or Device Structures Having Buried P-Type Layers
Tech ID: 28948 / UC Case 2016-770-0

BRIEF DESCRIPTION
Researchers at the University of California, Santa Barbara have created both surface and buried p-type regions without the need for doping the materials with an acceptor.

BACKGROUND
Vertical GaN power devices have gained increased attention, due to their potential to provide higher breakdown voltage without increasing specific on-resistance. As a result, numerous vertical GaN power devices and transistors have been demonstrated in recent years. However, these devices suffer from the inefficiency of dopant based p-type doping in buried p-GaN layers. For example, the p-type doped concentration cannot be increased sufficiently in U-MOSFET type devices, because p-type GaN layer is located close to the channel. The design of these devices, their growth, and fabrication space is severely impeded.

DESCRIPTION
Researchers at the University of California, Santa Barbara have created both surface and buried p-type regions without the need for doping the materials with an acceptor. A III-Nitride active region on a polar substrate comprises graded polar materials and has a polar orientation. Holes in a hole supply region above the active region are driven into the active region by a piezoelectric and/or spontaneous polarization field generated by the composition and grading of the active region. Devices enabled include LEDs without acceptor doping in the active p-type region (p-region) and buried active p-regions and devices based on this availability, such as tunnel junction based LEDs and lasers, and vertical electronic devices that need buried p-regions, such as CAVETs, MOSFETs and super-junction devices.

ADVANTAGES
▶ No need for growth of high quality p-regions
▶ No need for acceptor doping in the active p-region and buried active p-regions
▶ Reduces the temperature of the device stack making it desirable for devices that prefer a low thermal budget such as green lasers

APPLICATIONS
▶ LEDs
▶ Lasers

PATENT STATUS

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<td>Published Application</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ High-Quality N-Face GaN, InN, AlN by MOCVD
▶ Defect Reduction in GaN films using in-situ SiNx Nanomask
▶ Laser Diode With Tunnel Junction Contact Surface Grating
▶ High Mobility Group-III Nitride Transistors with Strained Channels
- A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
- Fabrication of Relaxed Semiconductor Films without Crystal Defects
- Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
- Methods for Locally Changing the Electric Field Distribution in Electron Devices
- Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode
- Incorporating Temperature-Sensitive Layers in III-N Devices
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- Enabling Epitaxial Growth On Thin Substrates
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
- Novel Current-Blocking Layer in High-Power Current Aperture Vertical Electron Transistors (CAVETs)
- III-N Transistor With Stepped Cap Layers
- Polarization-Doped Field Effect Transistors with Increased Performance
- Wafer Bonding for Embedding Active Regions with Relaxed Nanofeatures
- III-N Based Material Structures and Circuit Modules Based on Strain Management