Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
Tech ID: 25976 / UC Case 2015-904-0

BACKGROUND

A commonly explored limitation of p-GaN is that it is a poor current spreading layer and that traditional p-contacts will increase operating voltages in III-nitride devices. The introduction of tunnel junctions solves these issues and expands the opportunities for new device designs. This technology seizes the opportunity increase the conductivity and efficiency of the p-GaN layer.

DESCRIPTION

Researchers at UC Santa Barbara have developed a hybrid growth method for III-nitride tunnel junction devices that uses metal-organic chemical vapor deposition (MOCVD) to grow one or more light-emitting or light-absorbing structures and ammonia-assisted or plasma-assisted molecular beam epitaxy (MBE) to grow one or more tunnel junctions. Unlike p-type gallium nitride (p-GaN) grown by MOCVD, p-GaN grown by MBE is conductive as grown, which allows for its use in a tunnel junction. Moreover, the doping limits of MBE materials are higher than MOCVD materials, which allows for better tunnel junctions that reduces the operating voltage of these devices and increases their efficiency while enabling new types of device structures. These tunnel junctions can also be used to incorporate multiple active regions into a single device. In addition, n-type GaN (n-GaN) can be used as a current spreading layer on both sides of the device, relaxing the requirement for a transparent conductive oxide (TCO) layer or a silver (Au) mirror.

ADVANTAGES

› Increased conductivity and efficiency of p-GaN layer
› Current spreading with GaN
› No requirement for a TCO or silver mirrors
› Simpler manufacturing process
› Reduced operating voltage

APPLICATIONS

› LEDs
› Laser Diodes
› EELDs
› VCSELs
› Solar cells

PATENT STATUS

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<td>Published Application</td>
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CATEGORIZED AS

› Energy
› Lighting
› Other
› Engineering
› Engineering
› Semiconductors
› Design and Fabrication

RELATED CASES

2015-904-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

› Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
› High Efficiency LED with Optimized Photonic Crystal Extractor
› Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
› Edge-Emitting Laser Diode with Via-Activated Tunnel Junction Contact
› Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
- Tunable White Light Based on Polarization-Sensitive LEDs
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- III-Nitride VCSEL with a High Indium Content Active Region
- Growth of High-Performance M-plane GaN Optical Devices
- Packaging Technique for the Fabrication of Polarized Light Emitting Diodes
- Improved Anisotropic Strain Control in Semipolar Nitride Devices
- High Light Extraction Efficiency III-Nitride LED
- Photoelectrochemical Etching for Chip Shaping Of LEDs
- III-V Nitride Device Structures on Patterned Substrates
- Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
- Method for Increasing GaN Substrate Area in Nitride Devices
- Burying Impurities And Defects In Regrown III-Nitride Structures
- Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
- Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate
- GaN-Based Thermoelectric Device for Micro-Power Generation
- Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- Improved Manufacturing of Semiconductor Lasers
- LED Device Structures with Minimized Light Re-Absorption
- Improved Light Extraction with Geometrically Tuned LED Arrays
- Growth of Planar Semi-Polar Gallium Nitride
- Nonpolar (Al, B, In, Ga)N Quantum Well Design
- UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys
- Defect Reduction of Non-Polar and Semi-Polar III-Nitrides
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)
- Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping
- Wafer Bonding for Embedding Active Regions with Relaxed Nanofeatures
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD