(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance

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BRIEF DESCRIPTION

A novel invention to enable the fabrication of (In,Ga,Al)N optoelectronic devices with thick active layers containing a high concentration of indium (In).

BACKGROUND

Currently, the fabrication of heterojunctions for optoelectronic devices is limited to the combination of layers with either the same lattice constants or layers where the thickness of the lattice mismatched layers did not exceed its critical thickness. However, thick active regions are attractive for light emitting diodes (LEDs) with significantly reduced droop and solar cells requiring thick active regions for efficient absorption. Moreover, LED development is restricted by the green gap due to deep green LED sources being difficult to produce.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel invention to enable the fabrication of (In,Ga,Al)N optoelectronic devices with thick active layers containing a high concentration of indium (In). The In content of the active region can be increased while maintaining a low lattice mismatch between the active region and the current carrying layers, mitigating deterioration of device performance in the green gap. Consequently, relaxed (In,Ga,Al)N films with a lattice constant between GaN and InN can be fabricated on GaN layers of all orientations, including (0001) c-plane GaN.

ADVANTAGES

- Improved performance of existing devices which require a combination of layers with large lattice mismatch
- Mitigation of defect formation in active layers
- Increase the thickness of the active layers

APPLICATIONS

- LEDs
- Solar Cells

This technology is available for licensing.
ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- III-Nitride-Based Devices Grown With Relaxed Active Region
- Achieving “Active P-Type Layer/Layers” In III-Nitride Epitaxial Or Device Structures Having Buried P-Type Layers
- High-Quality N-Face GaN, InN, AlN by MOCVD
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Defect Reduction in GaN films using in-situ SiNx Nanomask
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- Group III Nitride-Based High Electron Mobility Transistor (Hemt) With Barrier/Space Layer
- Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
- Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
- A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
- Method for Enhancing Growth of Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- Fabrication of Relaxed Semiconductor Films without Crystal Defects
- Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
- Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
- Methods for Locally Changing the Electric Field Distribution in Electron Devices
- Increased Light Extraction with Multistep Deposition of ZnO on GaN
- Selective-Area Mesoporous Semiconductors And Devices For Optoelectronic And Photonic Applications
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- Oxynitride Phosphors for Use in White Light LEDs
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- Thermally Stable, Laser-Driven White Lighting Device
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
- Highly Compact, High-Index Dielectric Nanostructures for Deep-Ultraviolet Devices
- Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
- GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- Low-Droop LED Structure on GaN Semi-polar Substrates
- Contact Architectures for Tunnel Junction Devices
- Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
- Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
- Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance
- III-Nitride-Based Devices Grown On Thin Template On Thermally Decomposed Material
- Growth of Semipolar III-V Nitride Films with Lower Defect Density
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Novel Current-Blocking Layer in High-Power Current Aperture Vertical Electron Transistors (CAVEs)
- Improved Manufacturing of Solid State Lasers via Patternning of Photonic Crystals
- III-N Transistor With Stepped Cap Layers
- High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
- Tunable White Light Based on Polarization-Sensitive LEDs
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- 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
III-V Nitride Device Structures on Patterned Substrates
Activation of P-Type Layers of Tunnel Junctions in Micro-LEDs
Method for Increasing GaN Substrate Area in Nitride Devices
Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
GaN-Based Thermoelectric Device for Micro-Power Generation
Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
LED Device Structures with Minimized Light Re-Absorption
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
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD
III-N Based Material Structures and Circuit Modules Based on Strain Management