(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
Tech ID: 23146 / UC Case 2013-329-0

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.
ADDlITIONAL 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
- Flexible Arrays of MicroLEDs using the Photooelectrochemical (PEC) Liftoff Technique
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- Achieving "Active P-Type Layer/Layers" In III-Nitride Epitaxial Or Device Structures Having Buried P-Type Layers
- Gallium-containing MicroLEDs for Displays
- 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
- 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
- Device Structures Utilizing Barrier Enhancement Conductive Materials on N-polar III-N
- Transparent Mirrorless (TML) LEDs
- Laser Diode With Tunnel Junction Contact Surface Grating
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
- High Mobility Group-III Nitride Transistors with Strained Channels
- 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
- Incorporating Temperature-Sensitive Layers in III-N Devices
- Controlling Linearity in N-Polar GaN MISHEMTs
- Oxyfluoride Phosphors for Use in White Light LEDs
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- Enabling Epitaxial Growth On Thin Substrates
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
- N-polar III-N Semiconductor Device Structures Enabled by Wet Chemistry
- Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
- (Al, In,Ga, B)N Device Structures
- 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
- Formation of Transparent Integrated MicroLED Displays
- 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
- 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 (CAVETs)
- Improved Manufacturing of Solid State Lasers via Patterned of Photonic Crystals
- III-N Transistor With Stepped Cap Layers
- Solid Solution Phosphors for Use in Solid State White Lighting Applications
- 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
- Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
- Method for Increasing GaN Substrate Area in Nitride Devices
- 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
- Polarization-Doped Field Effect Transistors with Increased Performance
- Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- 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
- 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 Nanostructures
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD
- III-N Based Material Structures and Circuit Modules Based on Strain Management