GaN Interlayer Design to Fully Eliminate V-Pits from InGaN Pseudo-Substrates

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BACKGROUND

Current GaN-based LEDs suffer from a lattice mismatch between the GaN buffer layer and the InGaN quantum wells (QWs), causing them to experience a low efficiency. In addition, low miscibility of Indium in InGaN, alloy fluctuations, and phase separation demands require a lower growth temperature of InGaN QWs which results in defects and material deterioration. Although c-plane InGaN pseudo-substrates afford the opportunity to provide an alternative platform for long-wavelength-emitting optical devices, the main challenge in growing such InGaN pseudo-substrates is the formation of V-pits as they are detrimental for subsequent material growth and device fabrication.

DESCRIPTION

Researchers at the University of California, Santa Barbara have designed a GaN interlayer that completely eliminates V-pits from InGaN pseudo-substrates. In this technology, buffer layers comprised of InGaN layers and GaN interlayers are grown on the InGaN pseudo-substrate. Growth parameters for the InGaN layers and GaN interlayers work to enhance Ga atom diffusion to the V-pits on sidewalls of the InGaN pseudo-substrate.

ADVANTAGES

▷ Elimination of V-pits
▷ Enhanced Ga atom diffusion

APPLICATIONS

▷ LEDs
▷ Blue Laser Diodes

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
▷ Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
▷ 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
▷ 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
▷ Size-Independent Forward Voltage Micro-LED with an Epitaxial Junction
▷ Method for Enhancing Growth of Semipolar Nitride Devices
▷ III-Nitride Tunnel Junction with Modified Interface
▷ Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
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
Oxynitride Phosphors for Use in White Light LEDs
Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
Methods for Fabricating III-Nitride Tunnel Junction Devices
Low-Droop LED Structure on GaN Semi-polar Substrates
Contact Architectures for Tunnel Junction Devices
Semipolar-LED/LED 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
Improved Manufacturing of Solid State Lasers via Patterning of Photonic Crystals
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
Activation of P-Type Layers of Tunnel Junctions in Micro-LEDs
Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
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
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
LED Device Structures with Minimized Light Re-Absorption
Multicolor III-Nitride LED or Micro-LED Displays Using Wafer Bonding
Growth of Planar Semi-Polar Gallium Nitride
Nonpolar (A, 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