Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
Tech ID: 25605 / UC Case 2009-429-0

BRIEF DESCRIPTION
A method for improving the growth morphology of (Ga,Al,In,B)N thin films on nonpolar or semipolar (Ga,Al,In,B)N substrates that uses an inert carrier gas such as N₂.

BACKGROUND
The usefulness of gallium nitride (GaN) and its alloys of (Ga,Al,In,B)N has been well established in the fields of visible and ultraviolet optoelectronic devices and high power electronic devices. Most of these thin films, heterostructures and devices are grown along the c-direction, which can lead to polarization discontinuities that are formed at the surface level. The growth direction coincides with the alignment of these polarization fields. One approach to decreasing the polarization effects and improving surface smoothness is to grow the devices on nonpolar or semipolar planes of the crystal.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a method for improving the growth morphology of (Ga,Al,In,B)N thin films on nonpolar or semipolar (Ga,Al,In,B)N substrates that uses an inert carrier gas such as N₂. These smooth (Ga,Al,In,B)N thin films can be used in the growth of high performance nonpolar or semipolar nitride LEDs and LDs. Improved surface morphology can lead to a number of advantages for nonpolar or semipolar nitride device manufacturers, including, but not limited to, better uniformity in thickness, composition, doping, electrical properties, and luminescence characteristics of individual layers in a given device.

ADVANTAGES
- Improved device performance
- Reductions in polarization-induced electric fields and effective hole mass

APPLICATIONS
- LEDs
- Laser diodes (LDs)

PATENT STATUS
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<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,795,430</td>
<td>08/05/2014</td>
<td>2009-429</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
- Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
- Nonpolar (Al, B, In, Ga)N Quantum Well Design
- Improved Manufacturing of Semiconductor Lasers
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD
- GaN-Based Thermoelectric Device for Micro-Power Generation
- Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
- Method for Growing High-Quality Group III-Nitride Crystals
- Growth of Planar Semi-Polar Gallium Nitride
- Defect Reduction of Non-Polar and Semi-Polar III-Nitrides
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Improved Manufacturing of Solid State Lasers via Patternning of Photonic Crystals
- Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure
- Phosphor-Free White Light Source
- Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate
- High Efficiency LED with Optimized Photonic Crystal Extractor
- Packaging Technique for the Fabrication of Polarized Light Emitting Diodes
- LED Device Structures with Minimized Light Re-Absorption
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- Oxide Fluoride Phosphors for Use in White Light LEDs
- III-V Nitride Device Structures on Patterned Substrates
- Growth of Semipolar III-V Nitride Films with Lower Defect Density
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
- Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance
- Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
- Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
- Photoelectrochemical Etching for Chip Shaping Of LEDs
- Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
- Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs
- Defect Reduction in GaN films using in-situ SiNx Nanomask
- Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
- Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping
- High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)
- Nonpolar III-Nitride LEDs With Long Wavelength Emission
- Method for Growing Self-Assembled Quantum Dot Lattices
- Method for Increasing GaN Substrate Area in Nitride Devices
- Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaAlloys
- Low-Droop LED Structure on GaN semi-polar substrates
- Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices
- Growth of High-Performance M-plane GaN Optical Devices
- Method for Enhancing Growth of Semipolar Nitride Devices
- Transparent Mirrorless (TML) LEDs
- Solid Solution Phosphors for Use in Solid State White Lighting Applications
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- Planar, Nonpolar M-Plane III-Nitride Films Grown on Miscut Substrates
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- High Light Extraction Efficiency III-Nitride LED
- Tunable White Light Based on Polarization-Sensitive LEDs
- Improved Anisotropic Strain Control in Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- Increased Light Extraction with Multistep Deposition of ZnO on GaN
- Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- Contact Architectures for Tunnel Junction Devices
Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
Methods for Fabricating III-Nitride Tunnel Junction Devices
Multifaceted III-Nitride Surface-Emitting Laser
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
High Speed Indium Gallium Nitride Multi-Quantum Well (InGaN MQW) Photodetector
Distributed Feedback Laser with Transparent Conducting Oxide Grating
Eliminating Plasma Damage for Beta-Phase Gallium Oxide Transistors
Retaining Injection Efficiency and Optical Properties of Laser Diodes with Built-in Polarization Fields
Laser Diode With Tunnel Junction Contact Surface Grating
III-Nitride Tunnel Junction LED with High Wall Plug Efficiency