Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
Tech ID: 24137 / UC Case 2010-804-0

BRIEF DESCRIPTION
A new method of improving performance of group-III nitride devices by limiting the strain-relaxation on crystal substrates.

BACKGROUND
The usefulness of group-III nitrides such as gallium nitride (GaN) and its alloys has been well established for its use in the fabrication of optoelectronic and high-powered electronic devices. Given recent trends in industry standards, it is desirable to produce ultra-bright LEDs and LDs in regions beyond the blue region and in the green region. The problem with producing LEDs and LDs in the green regions by epitaxy is due to the complications in producing high-quality, high-in-composition crystals. When high-in-composition crystal structures are grown on a strained substrate layer, this causes misfit dislocations which degrade device performance.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a new method of improving performance of group-III nitride devices by limiting the strain-relaxation on crystal substrates. Limiting the strain-relaxation on group-III nitride substrates is achieved through a novel process of patterning the substrate with a specialized film which reduces the pre-existing thread dislocations before growth of the subsequent layers. By reducing these pre-existing thread dislocations, less misfit dislocation will result during layer growth and will allow for the growth of thicker/higher in composition layers of III-nitride alloy eplayers.

ADVANTAGES
- Reduced strain on device layers
- Reduced thread and misfit dislocations
- High thickness/composition group-III nitride stacking
- Reduced complications of lattice mismatch
- Improved device performance

APPLICATIONS
- UV and Green Region LEDs and LDs
- Group-III Nitride Materials
- Optoelectronics and Electronic Devices

PATENT STATUS

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<th>Country</th>
<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>8,853,669</td>
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OTHER INFORMATION
KEYWORDS
indSSL, indLED, LED, substrate patterning, III-nitride

CATEGORIZED AS
- Energy
- Lighting
- Semiconductors
  - Design and Fabrication

RELATED CASES
2010-804-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
- Fabrication Of High Quality P-Type GaN and Alloys by Preventing Hydrogen Incorporation
- 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, 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,Ga,In,B)N Films via MOCVD
Device Structure for High Efficiency LED
Nitride-Based LED with Optimized Efficiency
GaN-Based Thermoelectric Device for Micro-Power Generation
Hybrid Inorganic Light-Emitting Devices
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
Method for Making a High Performance Vertical Cavity Surface Emitting Laser
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
Enhancement Of Thermoelectric Properties Through Polarization Engineering
(In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
Oxyfluoride 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
Semi-polar-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
Method for Modifying Growth Conditions for Ammonothermal GaN Growth
Defect Reduction in GaN films using in-situ SiNx Nanomask
Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
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
Doping in III-Nitride Devices for Effective Polarization Field Screening
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) Lift-off Technique
Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaAlN Alloys
Low-Drift 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
Reactor with Carbon Fiber Materials for Improved III-Nitride Growth
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
Method for Improved Surface of (Ga,Al,Ga)N Films on Nonpolar or Semipolar Substrates
Improved Anisotropic Strain Control in Semipolar Nitride Devices
High Light Extraction III-Nitride LEDs with Zinc Oxide
High-Efficiency Nitride-Based Nanorod LEDs
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
Improved Device Performance from Current Apertured Vertical Field Effect Transistors by PEC Etching
System for High-Temperature Solution Crystal Growth
Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices