Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface

Tech ID: 24136 / UC Case 2009-742-0

BRIEF DESCRIPTION

An efficient method to significantly reduce defects in non-polar and semi-polar group-III nitride films.

BACKGROUND

The usefulness of non-polar and semi-polar 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 there is considerable interest in the growth of nonpolar (a- and m-plane) GaN based epitaxial films. The problems associated with the growth of these nonpolar GaN based films is characterized by high defect density, reduced carrier mobility, and low reliability which all contribute to an overall lower efficiency. However, high performance devices can be achieved by eliminating these defects by improving the structural quality of the nonpolar GaN films.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed an efficient method to significantly reduce defects in non-polar and semi-polar group-III nitride films. Through the use of in-situ SiNx as a nanomask when growing GaN substrates, researchers have demonstrated reduced stacking fault density, reduced thread dislocation density, reduced surface roughness, reduced sub-micron pits, and increased luminescence. Compared to the lateral epitaxial overgrowth (LEO) technique, this invention has the advantage of being a simple process that avoids contamination characteristic of the ex-situ process used in LEO. Unlike LEO, this new process also facilitates nanometer scale lateral epitaxial overgrowth at the open pores of the film which reduces the differences between the wing and window regions of film which has adverse effects on devices if untreated. All structure improvements contribute to an overall reduction of defects uniformly across the film which significantly increases the efficiency of the material.

ADVANTAGES

- Uniform defect reduction across film
- Highly efficient process capable of being done on the nanometer scale
- Improved performance of semi-polar and non-polar group-III nitride based devices
- Highly adaptable and easily controllable process

APPLICATIONS

- LDs and LEDs
- Group-III nitride materials
- High powered electronic and optoelectronic devices

PATENT STATUS

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CONTACT

University of California, Santa Barbara Office of Technology & Industry Alliances
dobis@tia.ucsb.edu
tel: View Phone Number.

INVENTORS

- Chakraborty, Arpan
- DenBaars, Steven P.
- Nakamura, Shuji
- Ohta, Hiroaki
- Speck, James S.
- Tyagi, Anurag
- Wu, Feng
- Young, Erin C.

OTHER INFORMATION

KEYWORDS
indSSL, indLED, LED, group-III nitrides, misfit dislocation

CATEGORIZED AS

- Engineering
- Energy
- Lighting
- Semiconductors
- Design and Fabrication

RELATED CASES
2009-742-0
ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
- Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
- Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
- Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation
- III-Nitride-Based Devices Grown With Relaxed Active Region
- 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
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- Size-Independent Forward Voltage Micro-LED with an Epitaxial Tunnel Junction
- Method for Enhancing Growth of Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Nonpolar III-Nitride LEDs With Long Wavelength Emission
- 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
- Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs
- Selective-Area Mesoporous Semiconductors And Devices For Optoelectronic And Photonic Applications
- Engineering of V-Defects for Efficient III-Nitride LEDs
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- Method for Growing High-Quality Group III-Nitride Crystals
- Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
- Oxyfluoride 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
- 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
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- Low-Droop LED Structure on GaN Semi-polar Substrates
- Contact Architectures for Tunnel Junction Devices
- 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
- Improved Manufacturing of Solid State Lasers via Patterning of Photonic Crystals
- High Efficiency III-Nitride Devices with Smooth Relaxed InGaN Buffer and Strain Compliant Template
- Multifaceted III-Nitride Surface-Emitting Laser
- Tunable White Light Based on Polarization-Sensitive LEDs
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN

United States Of America
Issued Patent
9,159,553
10/13/2015
2009-742
- 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
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
- Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD