Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
Tech ID: 21908 / UC Case 2004-636-0

BRIEF DESCRIPTION

A novel method of growing highly planar, fully transparent and specular m-plane gallium nitride (GaN) films.

BACKGROUND

Current nitride technology for electronic and optoelectronic devices employs nitride films grown along the polar c-direction. However, conventional c-plane quantum well structures in III-nitride based optoelectronic and electronic devices suffer from the undesirable quantum-confined Stark effect (QCSE), due to the existence of strong piezoelectric effects and spontaneous polarizations. Thus, there is a need for an efficient approach to eliminating the spontaneous and piezoelectric polarization effects in GaN optoelectronic devices.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel method of growing highly planar, fully transparent and specular m-plane gallium nitride (GaN) films. The method provides for a significant reduction in structural defect densities via a lateral overgrowth technique. As a result of this invention, it is now possible to grow high-quality, thick non-polar m-plane GaN films that may be subsequently used as substrates for the growth of improved electronic and optoelectronic devices by a variety of growth techniques.

ADVANTAGES

▶ Substantial improvement in (GaN) film quality
▶ Reduced dislocation and stacking fault densities

APPLICATIONS

▶ Fabrication of GaN Films
▶ GaN optoelectronic devices

This technology is available for a non-exclusive license.

PATENT STATUS

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<td>United States Of America</td>
<td>Issued Patent</td>
<td>7,208,393</td>
<td>04/24/2007</td>
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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
▶ Edge-Emitting Laser Diode with Via-Activated Tunnel Junction Contact
▶ Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique

Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation

Gallium-containing MicroLEDs for Displays

High Speed Indium Gallium Nitride Multi-Quantum Well (InGaN MQW) Photodetector

Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)

Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals

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

Phosphor-Free White Light Source

Volumetric Hole Injection with Intentional V-Defects

Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure

Low Temperature Deposition of Magnesium Doped Nitride Films

Transparent Mirrorless (TML) LEDs

Improved GaN Substrates Prepared with Ammonothermal Growth

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

Method for Growing Self-Assembled Quantum Dot Lattices

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

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

High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices

Method for Growing High-Quality Group III-Nitride Crystals

Near-Infrared, Flip-Chip, TCO-Clad, InGaN Quantum Dot Laser Diode

Incorporating Temperature-Sensitive Layers in III-N Devices

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

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

(AI, In,Ga, B)N Device Structures

Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs

Methods for Fabricating III-Nitride Tunnel Junction Devices

3D Hole Injectors for InAlGaN Light-Emitting Diodes

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

In-Situ Methods Of Preventing Interfacial Impurities And Dry Etch-Induced Damage In Regrown III-Nitride Structures

Enhanced Hole Injection by P-Type Active Region and Lateral Injection in InAlGaN LEDs

Improved Manufacturing of Solid State Lasers via Patternning of Photonic Crystals

Solid Solution Phosphors for Use in Solid State White Lighting Applications

Multifaceted III-Nitride Surface-Emitting Laser

Tunable White Light Based on Polarization-Sensitive LEDs

Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
III-Nitride VCSEL with a High Indium Content Active Region

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

Photoelectrochemical Etching for Chip Shaping Of LEDs

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

Burying Impurities And Defects In Regrown III-Nitride Structures

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

Improved Manufacturing of Semiconductor Lasers

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

III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

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