Improved GaN Substrates Prepared with Ammonothermal Growth
Tech ID: 23650 / UC Case 2006-666-0

BRIEF DESCRIPTION
A method for growing m-plane GaN using an ammonothermal growth technique.

BACKGROUND
The usefulness of gallium nitride (GaN) and its alloys has been well established for its use in the fabrication of optoelectronic and high-powered electronic devices. Most commercially available GaN-based devices are grown on conventional c-plane surfaces. The use of c-plane surfaces has disadvantages, which limit the performance of resulting devices. Recent studies have pointed out several benefits and advantages of growing m-plane devices. Despite these benefits, current technology is limited due to poor smoothness of m-plane surfaces.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed a method for growing m-plane GaN using an ammonothermal growth technique. Using this method, m-plane growth results in smoother surfaces than c-plane growth. M-plane growth has associated benefits such as p-type doping and inverted polarization charge. High p-type conductivity improves device efficiency, while transistors grown on m-plane GaN overcome high gate leakage problems of traditional GaN transistors. M-plane optical devices also experience higher emission efficiency due to the absence of a polarization field, and their optically active layer usually has higher Indium incorporation, allowing for longer wavelength emission. This novel method also reduces processing steps because flip-chip bonding and de-bonding steps are no longer needed to expose the m-plane of the growth.

ADVANTAGES
- Smoother substrate surface
- Improved device efficiency

APPLICATIONS
- LEDs and Laser Diodes
- High Electron Mobility Transistors (HEMTs)
- Power switching devices

PATENT STATUS

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<tr>
<th>Country</th>
<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
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OTHER INFORMATION
KEYWORDS
indssl, indammono, ammonothermal, ceniEE, indbulk, indfeat

CATEGORIZED AS
- Engineering
- Energy
- Lighting
- Optics and Photonics
- All Optics and Photonics
- Semiconductors
- Design and Fabrication

RELATED CASES
2006-666-0
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
- Improved Manufacturing of Semiconductor Lasers
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- 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
- 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 Group III-Nitride Crystals using Supercritical Ammonia and Nitrogen
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure
- Phosphor-Free White Light Source
- Packaging Technique for the Fabrication of Polarized Light Emitting Diodes
- LED Device Structures with Minimized Light Re-Absorption
- III-V Nitride Device Structures on Patterned Substrates
- Growth of Semipolar III-V Nitride Films with Lower Defect Density
- 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
- 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
- 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 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 AlInGaN Alloys
- 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
- 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
- Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
- Improved Anisotropic Strain Control in Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- 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
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Efficient Implementation of a Tunnel Junction Contact on a Nitride-Based Edge-Emitting Laser Diode
Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
Distributed Feedback Laser with Transparent Conducting Oxide Grating