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

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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

APPLICATIONS

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

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,263,424	09/11/2012	2006-666
United States Of America	Issued Patent	7,755,172	07/13/2010	2006-666

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- 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 Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- Method for Enhancing Growth of Semipolar Nitride Devices
- Ultraviolet Laser Diode on Nano-Porous AlGaN template
- 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
- Method for Growing High-Quality Group III-Nitride Crystals
- Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Growth of Group III-Nitride Crystals using Supercritical Ammonia and Nitrogen
- Methods for Fabricating III-Nitride Tunnel Junction Devices
- 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
- 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
- Tunable White Light Based on Polarization-Sensitive LEDs
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- 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
- Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- III-V Nitride Device Structures on Patterned Substrates
- Method for Increasing GaN Substrate Area in Nitride Devices
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- 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
- High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys
- 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

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