Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices

Tech ID: 25247 / UC Case 2005-668-0

BRIEF DESCRIPTION

A method to grow semipolar (Ga, Al, In, B)N thin films, heterostructures, and devices on suitable substrates or planar templates in which a large area of the semipolar film is parallel to the substrate surface.

BACKGROUND

The usefulness of gallium nitride (GaN) and its ternary and quaternary compounds incorporating aluminum and indium has been well established for fabrication of visible and ultraviolet optoelectronic devices. Current nitride technology for these devices uses nitride films grown along the polar c-direction; however, quantum-well active regions in devices suffer from the quantum-confined Stark effect (QCSE). One way to combat the issue is to grow films on semipolar planes of GaN in order to improve device performance by reduce polarization effects and increasing the efficiency of optical transitions.

DESCRIPTION

Researchers at UC Santa Barbara have developed a method to grow semipolar (Ga, Al, In, B)N thin films, heterostructures, and devices on suitable substrates or planar templates in which a large area of the semipolar film is parallel to the substrate surface. The method uses vapor phase epitaxy, such as metalorganic chemical vapor deposition (MOCVD), in order to grow the semipolar structures. Additionally, this technique alters the crystal growth orientation in order to reduce polarization effects in nitride thin films. This method is stable, energy efficient and cost-effective.

ADVANTAGES

- Reduces the negative impact of polarization
- Improved device efficiency
- Improved crystal growth orientation

APPLICATIONS

- LEDs and Laser Diodes (LDs)
- Semiconductors

PATENT STATUS

Country	Type	Number	Dated	Case

CONTACT

University of California, Santa Barbara Office of Technology & Industry Alliances
padilla@tia.ucsb.edu
tel: 805-893-2073.

INVENTORS

- Baker, Troy J.
- Chakraborty, Arpan
- DenBaars, Steven P.
- Farrell, Robert M.
- Haskell, Benjamin A.
- Mishra, Umesh K.
- Nakamura, Shuji
- Pattison, Paul M.
- Sharma, Rajat
- Speck, James S.

OTHER INFORMATION

KEYWORDS

indssl, indled, MOCVD, thin films

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Energy**
  - Lighting
- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2005-668-0

United States Of America	Issued Patent	10,529,892	01/07/2020	2005-668
United States Of America	Issued Patent	9,793,435	10/17/2017	2005-668
United States Of America	Issued Patent	9,231,376	01/05/2016	2005-668
United States Of America	Issued Patent	8,686,466	04/01/2014	2005-668
United States Of America	Issued Patent	7,846,757	12/07/2010	2005-668

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- 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 Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- High-Quality N-Face GaN, InN, AlN by MOCVD
- Aluminum-cladding-free Nonpolar III-Nitride LEDs and LDs
- 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
- Implantable Light Irradiation Device For Photodynamic Therapy
- 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
- A Structure For Increasing Mobility In A High-Electron-Mobility Transistor
- Method for Enhancing Growth of Semipolar Nitride Devices
- Ultraviolet Laser Diode on Nano-Porous AlGaN template
- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- 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
- Methods for Locally Changing the Electric Field Distribution in Electron Devices
- 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
- (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
- GaN-based Vertical Metal Oxide Semiconductor and Junction Field Effect Transistors
- 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
- Novel Current-Blocking Layer in High-Power Current Aperture Vertical Electron Transistors (CAVETs)
- Iii-N Transistor With Stepped Cap Layers
- 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
- 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
- III-N Based Material Structures and Circuit Modules Based on Strain Management

University of California, Santa Barbara
Office of Technology & Industry Alliances
342 Lagoon Road, ,Santa Barbara,CA 93106-2055 |
www.tia.ucsb.edu
Tel: 805-893-2073 | Fax: 805.893.5236 | padilla@tia.ucsb.edu