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Optimization of Laser Bar Orientation for Nonpolar Laser Diodes

Tech ID: 24986 / UC Case 2007-425-0

BRIEF DESCRIPTION

A method for the growth and fabrication of nonpolar laser diodes.

BACKGROUND

Growing nitride laser diodes along the polar c-direction causes a polarization-induced electric field that causes a large effective hold mass that is detrimental to performance. Alternatively, growing nitride thin films along a nonpolar axis offers a means of eliminating polarization effects and reducing the effective hole mass in device structures. These changes should help to decrease the current densities necessary to generate optical gain in nitride laser diodes. In particular, nonpolar nitride laser bars should be properly oriented with regards to the planes of semiconductor crystals in order to achieve the aforementioned benefits.

DESCRIPTION

Researchers at UC Santa Barbara have developed a method for the growth and fabrication of nonpolar laser diodes. The structures can be grown either directly on free-standing nonpolar substrates or on nonpolar template layers pre-deposited on a foreign substrate. Many growth techniques are suitable for the method, including metalorganic chemical vapor deposition (MOCVD), hydride vapor phase epitaxy (HVPE), and molecular beam epitaxy (MBE). For m-plane nitride laser diodes, optical gain is maximized when laser bars are oriented along the c-axis and minimized for laser bars oriented along the a-axis; for a-plane devices, optical gain is maximized for laser bars oriented along the c-axis and minimized when oriented along the m-axis. This in-plane, orientation-dependent gain is a phenomenon that is currently unique to nonpolar nitride laser diodes.

ADVANTAGES

- Superior manufacturability of nitride laser diodes
- Improved device performance through elimination of polarization-induced electric fields and reduction of effective hole mass
- Decreased current densities necessary to generate optical gain
- Less heat generation, longer device lifetimes, and higher production yields

APPLICATIONS

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OTHER INFORMATION

KEYWORDS

indssl, indled, laser diode, MBE, MOCVD, HVPE, indfeat

CATEGORIZED AS

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

RELATED CASES

2007-425-0

- Solid-state lighting systems, including projection displays
- High-resolution printers
- High-density optical data storage systems
- Optical sensing

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,588,260	11/19/2013	2007-425
United States Of America	Issued Patent	7,839,903	11/23/2010	2007-425

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
- 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
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- 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
- 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
- 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
- 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

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