Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation

Tech ID: 32661 / UC Case 2021-889-0

BACKGROUND

Growing AlGaAs- or AlInGaP-based LEDs on GaAs requires lattice-matched conditions, meaning the lattice constant of the device layers must be adjusted to match that of the substrate. If this requirement isn’t met, the result is a lattice mismatch which causes misfit dislocations in the AlGaAs or AlInGaP layers. These dislocations cause poor device performance in key areas such as device lifetime and efficiency. All III-V compound-based devices using a heterostructure face this obstacle, and overcoming this technological barrier would encourage significant progress in the development of the many devices that employ heterostructures.

DESCRIPTION

Researchers at the University of California, Santa Barbara have minimized or entirely prevented the formation of misfit dislocations at the interface of the heterostructure of III-V compound-based devices — even those grown under large lattice mismatch conditions. Unlike traditional methods of growing GaAs on a Si substrate, GaAs is grown on or above a decomposition stop layer of a thin flexible Si layer, where the GaAs is partially relaxed or free relaxed without the formation of misfit dislocations. Thus, both device lifetime and efficiency are improved drastically, with the opportunity to develop novel devices because the heterostructure is grown under a relatively large lattice mismatch condition. This technology enhances the performance and crystal quality of all III-V and II-VI compound-based devices for applications in automobiles, optical integrated circuits (ICs), power grids, computers, robots, smartphones, displays, and more.

ADVANTAGES

▶ Minimizes or entirely prevents the formation of misfit dislocations
▶ Wider available emission wavelength range
▶ Fabricated with common methods

APPLICATIONS

▶ III-V compound devices
▶ LED
▶ Laser diodes
▶ Electronics

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OTHER INFORMATION

KEYWORDS

Laser diodes, LED, misfit dislocation, lattice, III-V compound-based, AlInGaP, AlGaAs, noble device, heterostructure, optical integrated circuits, power grids, computers, crystal quality, wavelength range

CATEGORIZED AS

▶ Engineering
▶ Other
▶ Robotics and Automation
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▶ All Optics and Photonics
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▶ Other
▶ Transportation
▶ Automotive

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Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- Aluminum-cladding-free Nonpolar III-Nitrite 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 SiN 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 Nitrite Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- 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
- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Nonpolar III-Nitrite 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
- 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
- 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
- Group III-N Light Emitting Devices Enhanced By Stress From Post-Growth Deposited Films
- 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