Eliminating Misfit Dislocations with In-Situ Compliant Substrate Formation

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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 hetero-structure 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**
  - Engineering
  - Other
  - Robotics and Automation
- **Optics and Photonics**
  - All Optics and Photonics
- **Energy**
  - Other
- **Transportation**
  - Automotive

RELATED CASES

PATENT STATUS

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-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
- 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-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
- 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
- A Method To Lift-Off Nitride Materials With Electrochemical Etch
- 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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