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

2021-889-0

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- III-Nitride-Based Vertical Cavity Surface Emitting Laser (VCSEL) with a Dielectric P-Side Lens
- Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
- Methods to Produce and Recycle Substates for III-Nitride Materials with Electrochemical Etching
- Improved Reliability & Enhanced Performance of III-Nitride Tunnel Junction Optoelectronic Devices
- (In,Ga,Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
- Thermally Stable, Laser-Driven White Lighting Device
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Novel Multilayer Structure for High-Efficiency UV and Far-UV Light-Emitting Devices
- A Method To Lift-Off Nitride Materials With Electrochemical Etch
- High-Intensity Solid State White Laser Diode
- Nitride Based Ultraviolet LED with an Ultraviolet Transparent Contact
- Epitaxial Light Control Features in Light Emitting Diodes
- High-Efficiency Vertical Cavity Surface Emitting Laser Fabrication
- A Wafer-Scale, Low Defect Density Strain Relaxed Template for III-Nitride-Based High Efficiency and High-Power Devices
- High-Efficiency and High-Power III-Nitride Devices Grown on or Above a Strain Relaxed Template
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture

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