



Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning

Tech ID: 24137 / UC Case 2010-804-0

BRIEF DESCRIPTION

A new method of improving performance of group-III nitride devices by limiting the strain-relaxation on crystal substrates.

BACKGROUND

The usefulness of group-III nitrides such as gallium nitride (GaN) and its alloys has been well established for its use in the fabrication of optoelectronic and high-powered electronic devices. Given recent trends in industry standards, it is desirable to produce ultra-bright LEDs and LDs in regions beyond the blue region and in the green region. The problem with producing LEDs and LDs in the green regions by epitaxy is due to the complications in producing high-quality, high-in-composition crystals. When high-in-composition crystal structures are grown on a strained substrate layer, this causes misfit dislocations which degrade device performance.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a new method of improving performance of group-III nitride devices by limiting the strain-relaxation on crystal substrates. Limiting the strain-relaxation on group-III nitride substrates is achieved through a novel process of patterning the substrate with a specialized film which reduces the pre-existing thread dislocations before growth of the subsequent layers. By reducing these pre-existing thread dislocations, less misfit dislocation will result during layer growth and will allow for the growth of thicker/higher in composition layers of III-nitride alloy epilayers.

ADVANTAGES

- ▶ Reduced strain on device layers
- ▶ Reduced thread and misfit dislocations
- ▶ High thickness/composition group-III nitride stacking

CONTACT

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

INVENTORS

- ▶ [DenBaars, Steven P.](#)
- ▶ [Nakamura, Shuji](#)
- ▶ [Speck, James S.](#)
- ▶ [Tyagi, Anurag](#)

OTHER INFORMATION

KEYWORDS

indSSL, indLED, LED,
substrate patterning, III-nitride,
indfeat, indenergy

CATEGORIZED AS

- ▶ **Energy**
 - ▶ [Lighting](#)
- ▶ **Semiconductors**
 - ▶ [Design and Fabrication](#)

RELATED CASES

2010-804-0

- ▶ Reduced complications of lattice mismatch
- ▶ Improved device performance

APPLICATIONS

- ▶ UV and Green Region LEDs and LDs
- ▶ Group-III Nitride Materials
- ▶ Optoelectronics and Electronic Devices

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,853,669	10/07/2014	2010-804

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
- ▶ 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
- ▶ Method for Enhancing Growth of Semipolar Nitride Devices
- ▶ Ultraviolet Laser Diode on Nano-Porous AlGaIn 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 InGaIn 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
- ▶ 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
- ▶ 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

