



# Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface

Tech ID: 24136 / UC Case 2009-742-0

## BRIEF DESCRIPTION

An efficient method to significantly reduce defects in non-polar and semi-polar group-III nitride films.

## BACKGROUND

The usefulness of non-polar and semi-polar 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 there is considerable interest in the growth of nonpolar (a- and m-plane) GaN based epitaxial films. The problems associated with the growth of these nonpolar GaN based films is characterized by high defect density, reduced carrier mobility, and low reliability which all contribute to an overall lower efficiency. However, high performance devices can be achieved by eliminating these defects by improving the structural quality of the nonpolar GaN films.

## DESCRIPTION

Researchers at the University of California, Santa Barbara have developed an efficient method to significantly reduce defects in non-polar and semi-polar group-III nitride films. Through the use of in-situ SiNx as a nanomask when growing GaN substrates, researchers have demonstrated reduced stacking fault density, reduced thread dislocation density, reduced surface roughness, reduced sub-micron pits, and increased luminescence. Compared to the lateral epitaxial overgrowth (LEO) technique, this invention has the advantage of being a simple process that avoids contamination characteristic of the ex-situ process used in LEO. Unlike LEO, this new process also facilitates nanometer scale lateral epitaxial overgrowth at the open pores of the film which reduces the differences between the wing and window regions of film which has adverse effects on devices if untreated. All structure improvements contribute to an overall reduction of defects uniformly across the film which significantly increases the efficiency of the material.

## ADVANTAGES

## CONTACT

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## INVENTORS

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## OTHER INFORMATION

### KEYWORDS

indSSL, indLED, LED, group-III nitrides, misfit dislocation

### CATEGORIZED AS

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

### RELATED CASES

2009-742-0

- ▶ Uniform defect reduction across film
- ▶ Highly efficient process capable of being done on the nanometer scale
- ▶ Improved performance of semi-polar and non-polar group-III nitride based devices
- ▶ Highly adaptable and easily controllable process

APPLICATIONS

- ▶ LDs and LEDs
- ▶ Group-III nitride materials
- ▶ High powered electronic and optoelectronic devices

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,159,553	10/13/2015	2009-742

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
- ▶ 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

