Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD

Tech ID: 21821 / UC Case 2006-178-0

BRIEF DESCRIPTION


BACKGROUND

Existing methods of producing semipolar nitride films are extremely cumbersome and yield areas too small for device fabrication, thus there is a need for a new method that overcomes these obstacles in order to take advantage of the performance benefits of using semipolar nitride films.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a method for enhancing growth of semipolar (Al,In,Ga,B)N films via metalorganic chemical vapor deposition (MOCVD). This method involves growth of nitride films on the semipolar {11 22} plane to overcome performance limitations associated with the polar c-plane, thus increasing device efficiencies.

It yields samples grown on 2-inch diameter substrates, compared with areas of a few micrometers accomplished using existing methods. This method also results in a planar film surface, few surface undulations, and a reduced number of crystallographic defects, all necessary features to support application to state-of-the-art nitride semipolar electronic devices.

ADVANTAGES

▶ Large available surface area (samples grown on 2-inch diameter substrates, compared to areas on the order of a few micrometers achieved by prior art)
▶ Increased device efficiencies compared to c-plane devices
▶ Planar film surface
▶ Minimized surface undulations and crystallographic defects

APPLICATIONS

▶ High-Performance Nitride-Based Optoelectronics and Semiconductor Devices

This technology is available for licensing. See below for a selection of the patents and patent applications related to this invention.

Please inquire for full patent portfolio status.

PATENT STATUS

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<td>Issued Patent</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
▶ Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
▶ Nonpolar (Al, B, In, Ga)N Quantum Well Design
Improved Manufacturing of Semiconductor Lasers

Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN

Etching Technique for the Fabrication of Thin (Al, In, Ga)N Layers

GaN-Based Thermoelectric Device for Micro-Power Generation

Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films

Method for Growing High-Quality Group III-Nitride Crystals

Growth of Planar Semi-Polar Gallium Nitride

Defect Reduction of Non-Polar and Semi-Polar III-Nitrides

MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride

Lateral Growth Method for Defect Reduction of Semipolar Nitride Films

Low Temperature Deposition of Magnesium Doped Nitride Films

Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals

Improved Manufacturing of Solid State Lasers via Patterning of Photonic Crystals

Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure

Phosphor-Free White Light Source

Single or Multi-Color High Efficiency LED by Growth Over a Patterned Substrate

High Efficiency LED with Optimized Photonic Crystal Extractor

Packaging Technique for the Fabrication of Polarized Light Emitting Diodes

LED Device Structures with Minimized Light Re-Absorption

(In,Ga)AlN Optoelectronic Devices with Thicker Active Layers for Improved Performance

Oxyfluoride Phosphors for Use in White Light LEDs

III-V Nitride Device Structures on Patterned Substrates

Growth of Semipolar III-V Nitride Films with Lower Defect Density

Improved GaN Substrates Prepared with Ammonothermal Growth

Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation

Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance

Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration

Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures

Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes

Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs

Defect Reduction in GaN films using in-situ SiNx Nanomask

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

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

Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping

High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes

Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)

Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)

Nonpolar III-Nitride LEDs With Long Wavelength Emission

Method for Increasing GaN Substrate Area in Nitride Devices

Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Lift-off Technique

Optimization of Laser Bar Orientation for Nonpolar Laser Diodes

UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaN Alloys

Low-Droop LED Structure on GaN Semi-polar Substrates

Improved Fabrication of Nonpolar InGaN Thin Films, Heterostructures, and Devices

Growth of High-Performance M-plane GaN Optical Devices

Method for Enhancing Growth of Semipolar Nitride Devices

Transparent Mirrorless (TML) LEDs

Solid Solution Phosphors for Use in Solid State White Lighting Applications

Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices

Planar, Nonpolar M-Plane III-Nitride Films Grown on Miscut Substrates

High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices

High Light Extraction Efficiency III-Nitride LED

Tunable White Light Based on Polarization-Sensitive LEDs

Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates

Improved Anisotropic Strain Control in Semipolar Nitride Devices

III-Nitride Tunnel Junction with Modified Interface
Enhanced Light Extraction LED with a Tunnel Junction Contact Wafer Bonded to a Conductive Oxide
Increased Light Extraction with Multistep Deposition of ZnO on GaN
Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
Contact Architectures for Tunnel Junction Devices
Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
Methods for Fabricating III-Nitride Tunnel Junction Devices
Multifaceted III-Nitride Surface-Emitting Laser
Reduction in Leakage Current and Increase in Efficiency of III-Nitride MicroLEDs
Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
Continuous Fluidic Printing Of MicroLEDs
Creating and Releasing Nanoscale Light Emitting Devices from Their Growth Substrates
Colloidal Lithography-Enabled Creation of Metasurface-Integrated MicroLEDs and Devices
Efficient Implementation of a Tunnel Junction Contact on a Nitride-Based Edge-Emitting Laser Diode
Wafer Bonding for Embedding Active Regions with Relaxed Nanofeatures
Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
Enhancement of Semi-Polar Gallium Nitride Surface Morphology in Photo-Electrochemical Undercut Etching
Transparency Vertical Cavity Surface Emitting Laser for Augmented and Mixed Reality Displays
Control Of Photoelectrochemical Etch Parameters For Minimization of Interfacial Roughness of Light Emitting Device Structures
Distributed Feedback Laser with Transparent Conducting Oxide Grating