Method for Growing High-Quality Group III-Nitride Crystals

Tech ID: 21909 / UC Case 2005-339-0

BRIEF DESCRIPTION

A novel method for growing group III-nitride crystals in supercritical ammonia.

BACKGROUND

The growth of a bulk crystal of a group III-nitride (such as GaN, AlN, and LiN) presents some difficulties, since group III-nitrides have a high melting point and high nitrogen vapor pressure at high temperature. Some methods, such as high-pressure high-temperature synthesis and sodium flux, have been used to obtain bulk group III-nitride crystals. However, the crystal shape obtained by these methods is a thin platelet because these methods are based on a melt of group III metal, in which nitrogen has very low solubility and a low diffusion coefficient.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a novel method for growing group III-nitride crystals in supercritical ammonia. The group III-nitride bulk crystal is grown in an autoclave in supercritical ammonia using a source material or nutrient and a seed crystal. The supercritical ammonia provides for high solubility of the source materials and high transport speed of dissolved precursors. This method uses an internal chamber equipped with a pressure releasing device that enables the safe filling of ammonia and an exact balancing of the pressure inside and outside the internal chamber. The present invention suppresses the generation of particles from the source material and prevents the adhesion of the particles from the source material on the seed crystals. Thus, this invention produces high quality group III-nitride crystals and reduces production costs, since the source materials and nutrients are recyclable.

ADVANTAGES

- Allows the production of high-quality group III-nitride crystals
- Impurities are prevented from being incorporated into grown crystals
- Lower production costs (source materials and nutrients can be recycled)

APPLICATIONS

- Production of group III-nitride crystals

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OTHER INFORMATION

KEYWORDS

III-Nitride, ammonothermal, indssl, indbulk, indammono, cenIEE

CATEGORIZED AS

- **Engineering**
- **Energy**
  - Lighting
- **Materials & Chemicals**
  - Other
- **Optics and Photonics**
  - All Optics and Photonics
- **Semiconductors**
  - Design and Fabrication

RELATED CASES

2005-339-0

This technology is available for a non-exclusive license.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,551,088	01/24/2017	2005-339
United States Of America	Issued Patent	8,709,371	04/29/2014	2005-339

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- 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)
- 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 AlGaN template
- 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
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Growth of Group III-Nitride Crystals using Supercritical Ammonia and Nitrogen
- 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
- 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
- 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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