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

This technology is available for a non-exclusive license.

PATENT STATUS

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<th>Type</th>
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<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,551,088</td>
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<td>2005-339</td>
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ADDITIONAL TECHNOLOGIES BY THESE INVENTORS
▶ Method for Improved Surface of (Ga,Al,In,B)N Films on Nonpolar or Semipolar Substrates
▶ Enhanced Optical Polarization of Nitride LEDs by Increased Indium Incorporation
▶ Lateral Growth Method for Defect Reduction of Semipolar Nitride Films
Flexible Arrays of MicroLEDs using the Photoelectrochemical (PEC) Liftoff Technique
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-183)
- Internal Heating for Ammonothermal Growth of Group-III Nitride Crystals
- Highly Efficient Blue-Violet III-Nitride Semipolar Laser Diodes
- Hybrid Growth Method for Improved III-Nitride Tunnel Junction Devices
- Phosphor-Free White Light Source
- Low Temperature Deposition of Magnesium Doped Nitride Films
- Transparent Mirrorless (TML) LEDs
- Improved GaN Substrates Prepared with Ammonothermal Growth
- Laser Diode With Tunnel Junction Contact Surface Grating
- Optimization of Laser Bar Orientation for Nonpolar Laser Diodes
- High Efficiency Semipolar AlGaN-Cladding-Free Laser Diodes
- Method for Enhancing Growth of Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- 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
- Method for Manufacturing Improved III-Nitride LEDs and Laser Diodes: Monolithic Integration of Optically Pumped and Electrically Injected III-Nitride LEDs
- High-Efficiency, Mirrorless Non-Polar and Semi-Polar Light Emitting Devices
- Controlled Photoelectrochemical (PEC) Etching by Modification of Local Electrochemical Potential of Semiconductor Structure
- Incorporating Temperature-Sensitive Layers in III-N Devices
- Technique for the Nitride Growth of Semipolar Thin Films, Heterostructures, and Semiconductor Devices
- MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
- Reduced Dislocation Density of Non-Polar GaN Grown by Hydride Vapor Phase Epitaxy
- Heterogeneously Integrated GaN on Si Photonic Integrated Circuits
- 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
- Photoelectrochemical Etching Of P-Type Semiconductor Heterostructures
- Semipolar-Based Yellow, Green, Blue LEDs with Improved Performance
- Growth of Semipolar III-V Nitride Films with Lower Defect Density
- III-Nitride Tunnel Junction LED with High Wall Plug Efficiency
- Multifaceted III-Nitride Surface-Emitting Laser
- 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
- High Light Extraction Efficiency III-Nitride LED
- III-V Nitride Device Structures on Patterned Substrates
- Hexagonal Wurtzite Type Epitaxial Layer with a Low Alkali-Metal Concentration
- Method for Increasing GaN Substrate Area in Nitride Devices
- Growth of Planar, Non-Polar, A-Plane GaN by Hydride Vapor Phase Epitaxy
- GaN-Based Thermoelectric Device for Micro-Power Generation
- Limiting Strain-Relaxation in III-Nitride Heterostructures by Substrate Patterning
- Improved Manufacturing of Semiconductor Lasers
- LED Device Structures with Minimized Light Re-Absorption
- Growth of Planar Semi-Polar Gallium Nitride
- UV Optoelectronic Devices Based on Nonpolar and Semi-polar AlInN and AlInGaAlloys
- III-Nitride Based VCSEL with Curved Mirror on P-Side of the Aperture
- Low-Cost Zinc Oxide for High-Power-Output, GaN-Based LEDs (UC Case 2010-150)
- Suppression of Defect Formation and Increase in Critical Thickness by Silicon Doping
Enhancing Growth of Semipolar (Al,In,Ga,B)N Films via MOCVD

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