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

<table>
<thead>
<tr>
<th>Country</th>
<th>Type</th>
<th>Number</th>
<th>Dated</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States Of America</td>
<td>Issued Patent</td>
<td>9,551,088</td>
<td>01/24/2017</td>
<td>2005-339</td>
</tr>
</tbody>
</table>

Share This

Contact

University of California, Santa Barbara Office of Technology & Industry Alliances / dobis@tia.ucsb.edu / tel: View Phone Number. Please reference Tech ID #21909.

Inventors
- Fujito, Kenji
- Hashimoto, Tadao
- Nakamura, Shuji

Other Information

Keywords
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
- Improved Manufacturing of Semiconductor Lasers
- Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
- Enhancing Growth of Semipolar (AlInGa)N Films via MOCVD
- GaN-Based Thermoelectric Device for Micro-Power Generation
- Growth of High-Quality, Thick, Non-Polar M-Plane GaN Films
- Growth of Planar Semi-Polar Gallium Nitride
- 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 Group III-Nitride Crystals using Supercritical Ammonia and Nitrogen
- Growth of Polyhedron-Shaped Gallium Nitride Bulk Crystals
- Control of Photoelectrochemical (PEC) Etching by Modification of the Local Electrochemical Potential of the Semiconductor Structure
- Phosphor-Free White Light Source
- Packaging Technique for the Fabrication of Polarized Light Emitting Diodes
- LED Device Structures with Minimized Light Re-Absorption
- 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
- Semi-polar LED/LD Devices on Relaxed Template with Misfit Dislocation at Hetero-interface
- Lattice 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
- 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)InGaN Films on Nonpolar or Semipolar Substrates
- Improved Anisotropic Strain Control in Semipolar Nitride Devices
- III-Nitride Tunnel Junction with Modified Interface
- 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
- Vertical Cavity Surface-Emitting Lasers with Continuous Wave Operation
- Efficient Implementation of a Tunnel Junction Contact on a Nitride-Based Edge-Emitting Laser Diode
- Heterogeneously Integrated GaN on Si Phonic Integrated Circuits