Enhancement of Semi-Polar Gallium Nitride Surface Morphology in Photo-Electrochemical Undercut Etching

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BRIEF DESCRIPTION
An etching technique that utilizes photo-generated holes to permit the electrochemical etching of a material, such as III-nitride, by achieving smooth etched n-type semipolar GaN surfaces.

BACKGROUND
Conventional polishing, thinning, and dry etching are options for removing native substrate in III-N material systems. However, advancements in the fabrication of optoelectronic devices demand new processing techniques to enable the subsequent realisation of new device designs. Obtaining smooth morphology after substrate removal of n-type semipolar GaN surfaces is challenging, and so, alternative ways to remove the substrate are needed to achieve optimal results.

DESCRIPTION
Researchers at the University of California, Santa Barbara have developed an etching technique that utilizes photo-generated holes to permit the electrochemical etching of a material, such as III-nitride, by achieving smooth etched n-type semipolar GaN surfaces. Depending on the conditions and materials used, this technique has the ability to produce a variety of etch morphologies, such as lateral undercut structures for sophisticated modern optoelectronic device applications. Further, the technique allows one to control roughness in order to achieve varying levels of rough and smooth surfaces.

ADVANTAGES
▶ Able to control roughness
▶ Thick sacrificial layer enables precise control of lateral (PEC) undercut etching
▶ Lowered etching temperature reduces the root-mean-square roughness of n-type surface

APPLICATIONS
▶ Bandgap-selective lateral etching
▶ Smoothing the rough growth layers
▶ Edge emitting lasers
▶ Vertical cavity surface emitting lasers
▶ Optoelectronic devices

PATENT STATUS
Patent Pending

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, In, Ga)N Quantum Well Design
▶ Cleaved Facet Edge-Emitting Laser Diodes Grown on Semipolar GaN
▶ Enhancing Growth of Sempoliar (AlInGa)N Films via MOCVD
▶ GaN-Based Thermoelectric Device for Micro-Power Generation
▶ Growth of High-Quality, Thin, Non-Polar M-Plane GaN Films
▶ Growth of Planar Semi-Polar Gallium Nitride
▶ Deflect Reduction of Non-Polar and Semi-Polar III-Nitrides
▶ MOCVD Growth of Planar Non-Polar M-Plane Gallium Nitride
▶ Low Temperature Deposition of Magnesium Doped Nitride Films
▶ Improved Manufacturing of Solid State Lasers via Patterning of Photonic Crystals
▶ 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, Al)N Optoelectronic Devices with Thicker Active Layers for Improved Performance
▶ Oxide Fluoride 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