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# Thin Film Gallium Nitride has Low Dislocation Density

Technology No. z06015

## Thin Film Gallium Nitride with Low Dislocation Density Blue LEDs Rely on Gallium Nitride

The proliferation of Blu-Ray players has increased the demand for blue LEDs and blue laser diodes that rely on gallium nitride (GaN) and other group III-nitrides. The best solution for producing high quality, long-lived devices is to use bulk GaN substrates, which are expensive. Alternatively, GaN on thin-film, non-GaN substrates can be used as a low cost alternative, but these substrates typically have high dislocation (defect) densities which greatly reduce the efficiency of the device.

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## Process Using Molecular Beam Epitaxy Reduces Dislocation Density

A manufacturing process has been developed that greatly reduces defect densities obtained in GaN or other group III-nitride semiconductor films. It involves the use of an ion beam striking the GaN growth surface during Molecular Beam Epitaxy (MBE). Growth of the GaN film under these conditions creates a nanoscale surface roughness. This can be produced entirely within a vacuum. After the surface roughness is created, the surface is smoothed and polished which effectively

filters dislocations. Repeating the alternating nanosculpted and polished regions throughout the film advantageously provides significant reduction in dislocation density in thin film structures.

## Blue LEDs and Blue Laser Diodes

The result is a thin film with reduced stress and cracking that is easily integrated into current production processes and can be scaled to produce large diameter silicon substrates. The primary applications are in high quality, long-lived blue LEDs and laser diodes.

**FEATURES AND BENEFITS THIN FILM GALLIUM NITRIDE:**

- Lower dislocation densities in GaN and other group III-nitride materials which increase efficiency
- Ten times less expensive than bulk GaN substrates
- Repeatable method for constructing GaN materials without need for time- consuming ?out-of-vacuum? processing steps (e.g. lithography, etching)
- Easily integrated into current production processes
- Production of desirable thin films with reduced stress and cracking
- Other than film materials, no extra materials are needed
- Scalable to large diameter silicon substrates used by semiconductor device companies

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