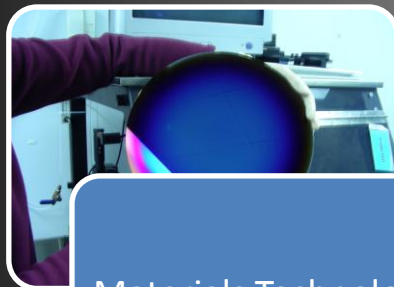
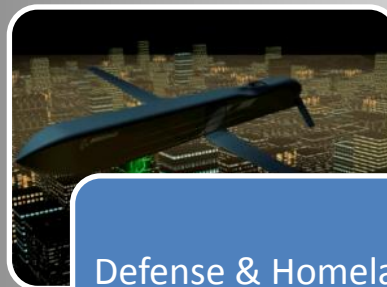




Our Mission Is To Develop Advanced Dual Use Materials Technologies to Support Defense and Homeland Security Needs and More Energy Efficient Lighting & Power



Materials Technology
Development

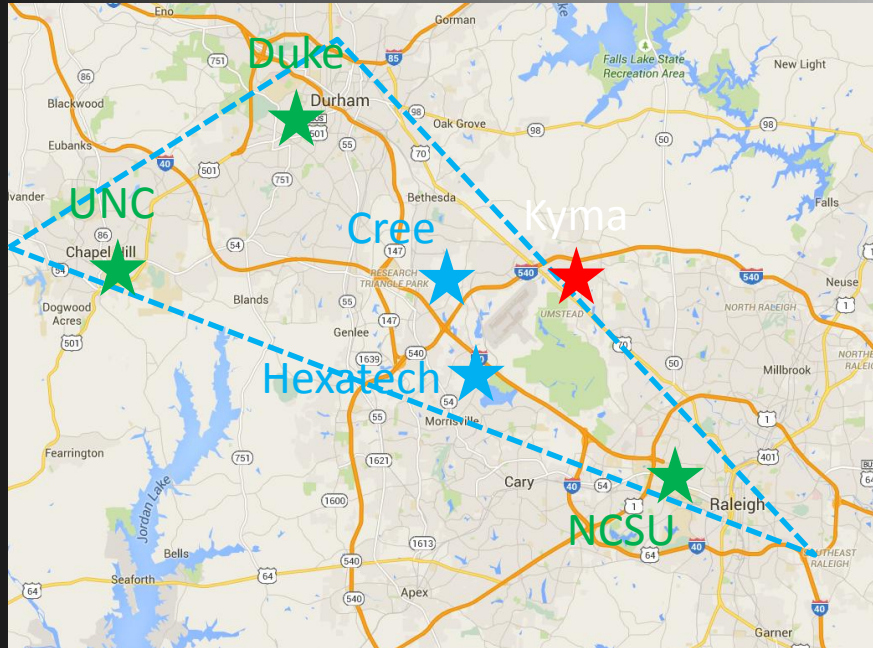


Defense & Homeland
Security Early
Adopters



Broad Scale
Commercial
Adoption in Lighting
and Electric Power
Applications

Kyma's Facilities



The Research Triangle is a region in the Piedmont of North Carolina, anchored by NC State University (Raleigh), UNC Chapel Hill (Chapel Hill), and Duke University (Durham)



Kyma Headquarters and Crystal Growth & Characterization Facility
8829 Midway West Road, Raleigh, NC 27617



Kyma Materials Fabrication & Device Test Facility
8801 Midway West Road, Raleigh, NC 27617

Kyma Single-Crystal Bulk GaN

Conduction Types Available

- Undoped (N-)
- Si-doped (N+)
- Semi-insulating

Orientations Available

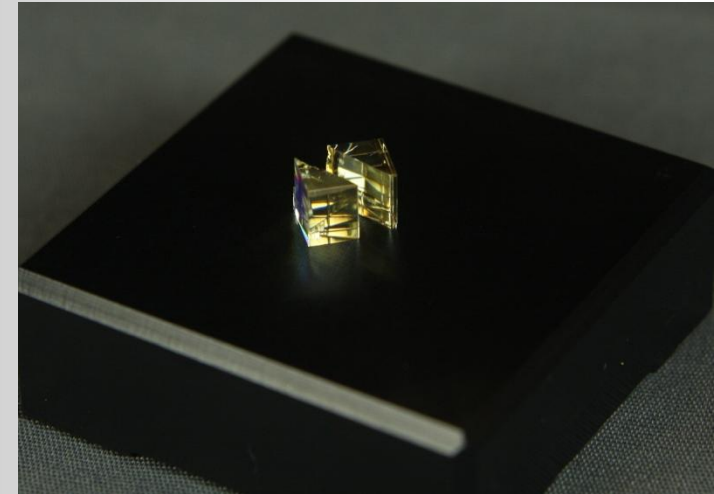
- M-plane
- A-plane
- C-plane
- (11-22)
- (10-11)
- (10-12)
- (10-13)
- (20-21)

Additional Properties

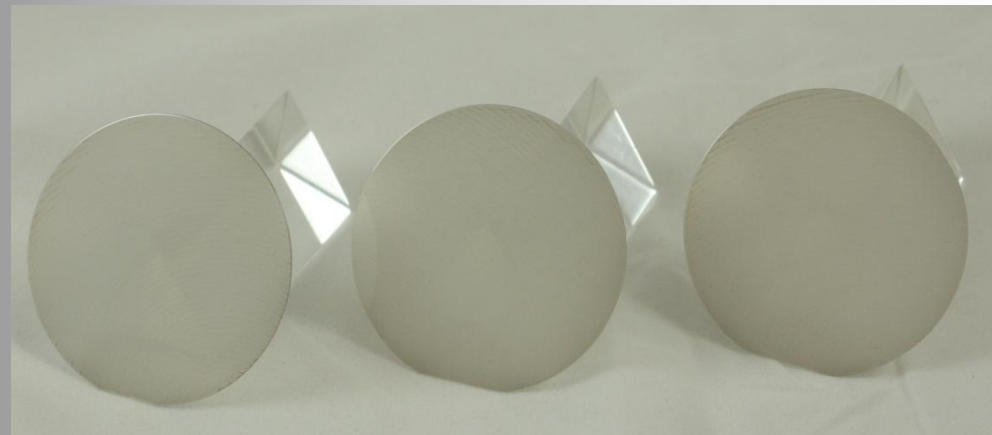
- Dislocation density: $<1 \times 10^7/\text{cm}^2$
- Thermal conductivity: 2.5 W/cm-K
- Epi-ready surface finish: RMS $<0.5\text{nm}$



Free standing GaN 10mmx10mm and 18mmx18mm substrates



Free standing GaN prisms



Free standing 2" GaN substrates

Kyma Polycrystalline Bulk GaN

Conduction Types Available

- Undoped (N-)
- Si-doped (N+)

Form Factors Available

- 25.4-100mm diam. / 500um-5mm thick
- Pellets

Options

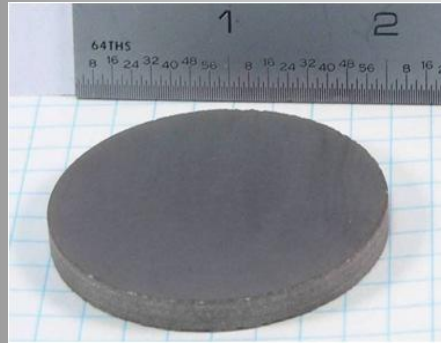
- Custom diced sizes
- Target polishing

Additional Properties

- Thermal conductivity: 1.8 W/cm-K
- High purity

Applications

- PLD targets
- Feedstock for ammonothermal growth



50mm polycrystalline GaN target



100mm polished polycrystalline GaN target



Polycrystalline GaN pellets

Kyma Templates

Products Available

- 50.8-150mm GaN on sapphire or silicon
- 50.8-300mm AlN on sapphire, silicon or SiC
- 50.8-100mm AlGaIn on sapphire or silicon

Conduction Types Available

AlN

- Semi-insulating

GaN

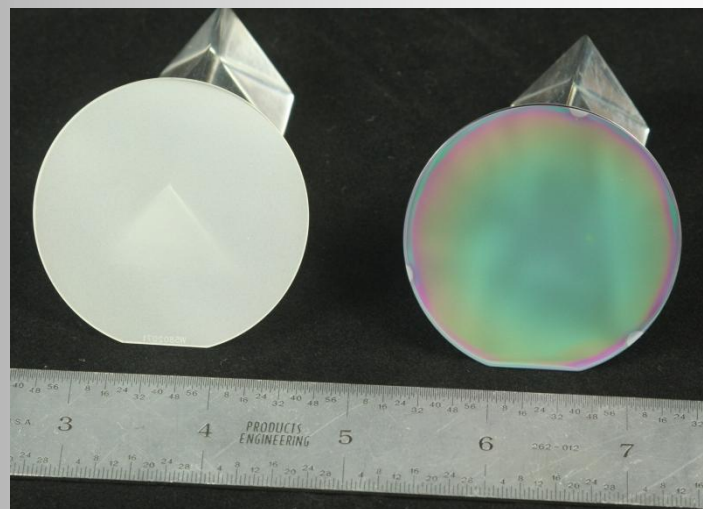
- Undoped (N-)
- Si-doped (N+)
- Semi-insulating
- P-type

Additional Properties

- Device epitaxy ready
- Uniform thickness



AlN on 50.8-150mm silicon



2" GaN on sapphire and GaN on silicon

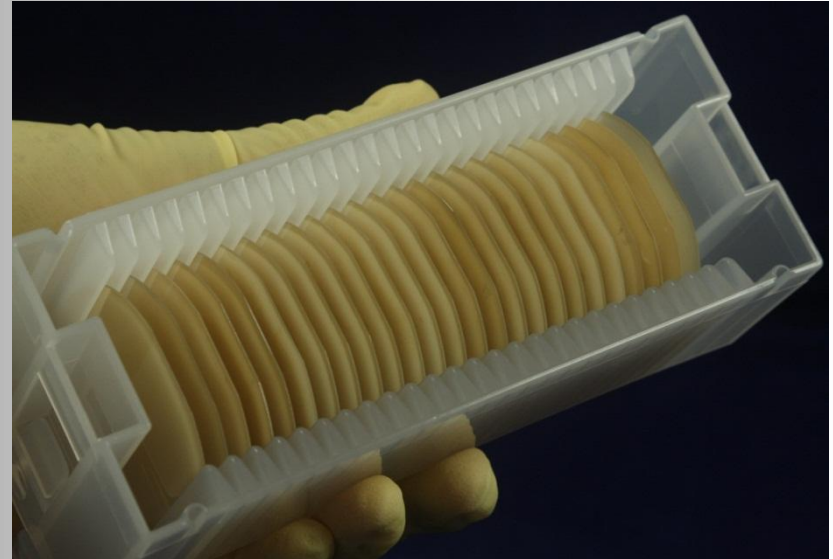
Kyma FLAAT Templates

Products Available

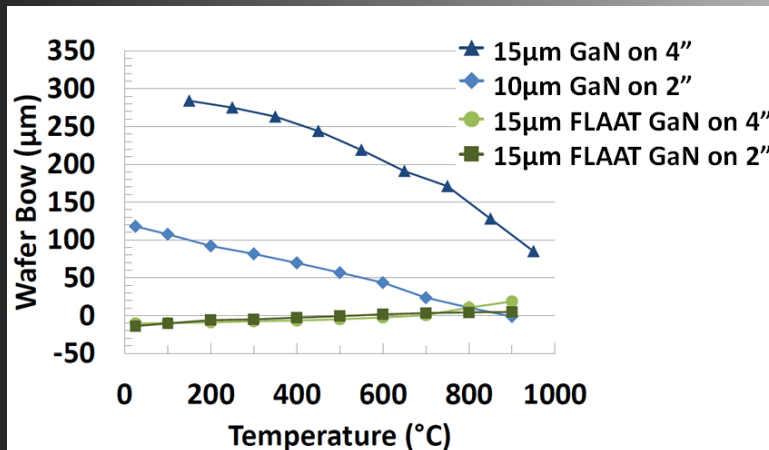
- 50.8-100mm FLAAT N+ GaN on sapphire
- 15-50um
- 50.8-100mm FLAAT layer on customer substrate

FLAAT Advantages

- GaN surface RMS <0.5nm
- Wafer bow <15um
- Use with thin film and flip chip epitaxy



2" FLAAT Templates on sapphire (15um N+ GaN epi-ready layer)



Wafer bow measured vs. temperature for standard 10-15 um thick GaN templates vs. 15 um thick FLAAT templates grown on 2" and 4" sapphire

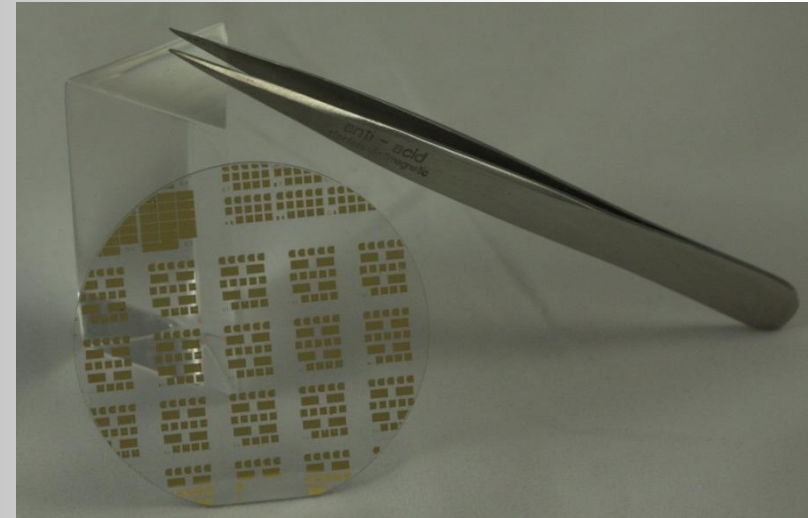
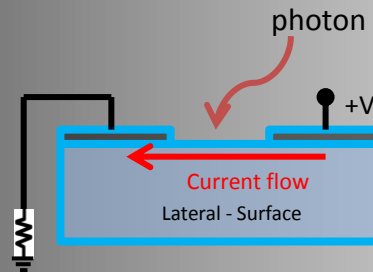


Typical FLAAT template structure

Kyma Photoconductive Switch

Lateral KO-Switch™

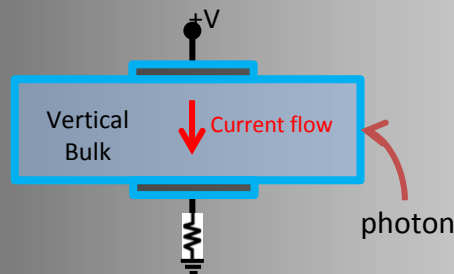
- Up to 1.5kV
- <200ps switching time
- Low on-resistance
- High current
- Pulsed power and D-class power amplifier applications



Lateral KO-Switch™ Devices

Vertical KO-Switch™

- 2-10kV
- <200ps switching time
- Low on-resistance
- Very high current
- Pulsed power, EMP, UWB, and AWG applications



Vertical KO-Switch™

Kyma200 HVPE Growth System

Features

- GaN and AlN Capable
- n-type and p-type dopants
- Suitable for thin template or thick boules growth
- 5-zone, 6-inch substrate capable furnace (up to 1150°C)
- Full LabView control and automation
- Optional gas cabinets, scrubber, chiller, and UPS for turnkey system
- Flexible design for rapid innovation cycle
- Decades of engineering improvements and process advances

Safety

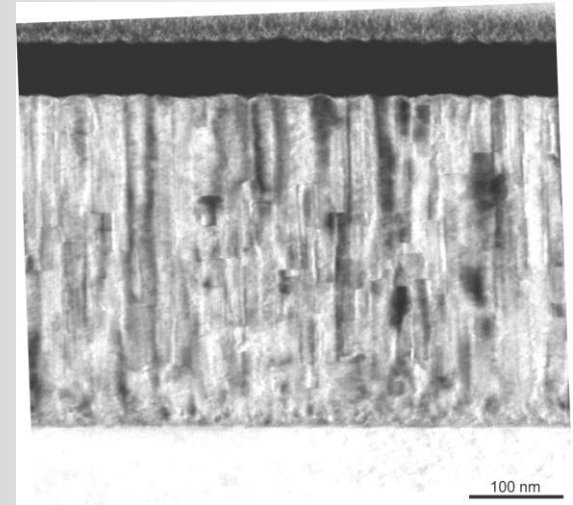
- Gas cabinet with toxic gas sensors
- Gas shutoff interlocks to gas monitors
- Overpressure interlock
- UPS



Kyma PVDNC450™ Growth System

Features

- Plasma-Vapor-Deposition of Nanocolumns (PVDNC)
- Generates AlN buffer layer for GaN-based optoelectronics
- Improved LED binning and brightness
- Low cost of ownership
- Full LabView control and automation
- Decades of engineering improvements and process advances



HR TEM of 350nm PVDNC™ AlN on sapphire



CVD 2-Dimensional TMD Growth Tool

Features

- 3-zone furnace, up to 1200°C
- Up to 100mm diameter
- 4-channel expandable gas manifold
- Process pressure control from 1torr-760torr
- Full LabView control and automation
- Programmable recipe editor
- Comprehensive process monitoring
- Optional gas cabinets, scrubber, chiller and UPS for turnkey system
- Flexible design for rapid innovation cycle

Safety

- Gas cabinet with gas (H_2 , H_2S , etc.) sensors
- Gas shutoff interlocks to gas monitors
- Overpressure interlock
- UPS



Monolayer MoS2 crystalline grains produced at Kyma



Kyma Processing Equipment

K-Orbital™ Multi-Wire Saw

- Rotating work piece
- Up to 20 slices per cut
- 50mm-100mm size capability
- Uniform material removal

K-Slice™ Diamond Wire Maker

- Perfect for R&D applications
- Long lifetime
- Low kerf loss
- Steel core + metal matrix



K-Orbital™ Multi-Wire Saw



K-Slice™ Diamond Wire Maker

Kyma Services

Materials Characterization

- AFM
- XRD
- White light interferometer (Wyko)
- Resistivity
- Filmetrics
- Wafer bow

Wafer Fabrication

- Dicing and Slicing
- Grinding
- Polishing

Other services

- Agile parts manufacturing
- Federal Contracts
- Device Fabrication



For more information, contact Ms. Tamara Stephenson at:

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sales@kymatech.com