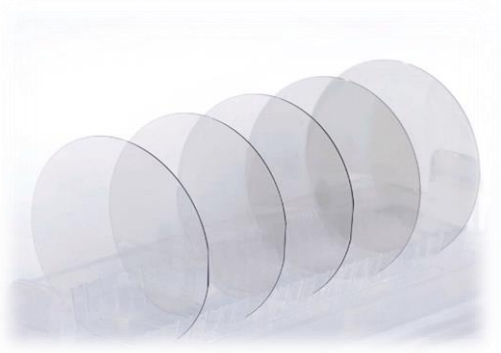


000C04EP02

4" AlGaN/GaN EPI-WAFERS on SiC-Sub

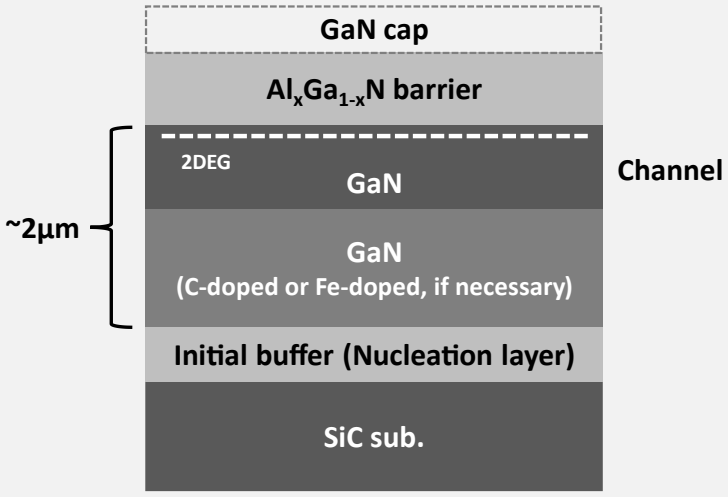
GALLIUM NITRIDE GaN on SiC EPI-WAFERS
Lowest defect density of the crystal
Sophisticated buffer layer for low leakage current
Perfect base for all kind of RF devices
Highest power density
Superior thermal conductivity due to the SiC substrate

SUBSTRATE SPECIFICATION

Item		Characteristics
Substrate		4-inch high-purity semi-insulating SiC substrate
Wafer Diameter		100.00 +0/-0.5mm
Thickness		500 ± 25µm
Orientation		(0001) just ± 0.2°
Orientation Flat	Orientation	<11-20> ± 5°
	Length	32.5 ± 2.0mm
Surface Finishing		Si-face, CMP polish, C-face optical polish

TYPICAL HEMT STRUCTURE ON SiC SUBSTRATE

Layer Structure



APPLICATIONS

Hybrid Amplifiers	Radar Systems	Receive/Transmit Modules	RF Devices	Telecom Systems	Wireless Communication
			MHz		5G/6G

EPITAXIAL LAYER STRUCTURE

Layer	Material	Al Composition	Thickness (nm)	Dopant	Doping (cm^{-3})
6	i-GaN	-	2	-	-
5	i-AlGaN	0.2 ~ 0.3	15 ~ 25	-	-
4	i-AlN	1	0 ~ 1	-	-
3	i-GaN	-	300	-	-
2	Buffer layer (Fe-doped)	-	1700	(Fe)	~ 1 x 10^{18}
1	Nucleation	-	-	-	-
Substrate	SiC				

Note:

1: **Al content and thickness of AlGaN barrier can be modified in the range of listed value according to customer Requirement.**

2: **The AlN spacer between AlGaN barrier and GaN channel is selectable according to customer requirement.**

EPITAXIAL WAFER SPECIFICATION

Item	Specification		Comments	
Barrier layer thickness (nm)	20 ± 2nm		XRD	3 points
	C.V.	< 3% (< 2% [Target])		
Barrier layer Al composition [3]	0.25 ± 0.01		XRD	3 points
	C.V.	< 3% (< 2% [Target])		
Total EPI thickness (nm) [4]	Average	Designed ± 10%	Optical interferometer	5 points
	Var	≤ ±10%		
	C.V.	< 3% (< 2% [Target])		
Sheet resistivity (Ω/sq.) [5]	Average	390 ± 20%	Non-destructive reference	
	C.V.	< 2% (< 1.5% [Target])		
Wafer bow (µm) [6]	I Bow I	≤ 50 [Target]	Flantess tester, E/E: 5mm	
Surface defect density	≤ 1 x 10^{19} cm^{-2}		AFM, center, one wafer per batch	

Note:

3: **Will be tuned according to the expected R_S value.**

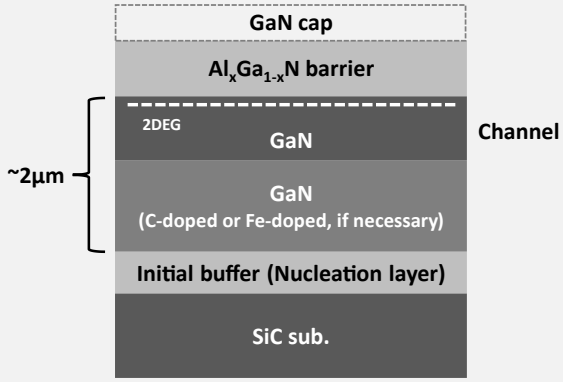
4: **The value of total EPI thickness includes that of the nucleation layer. Please be aware that there should be the difference between the designed value.**

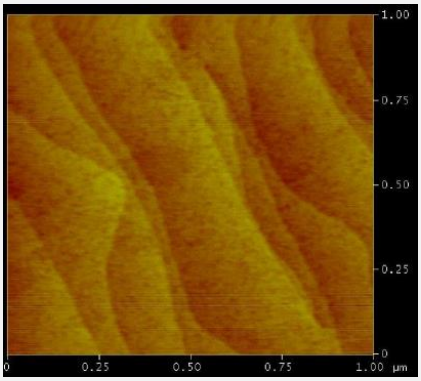
5: **The value of sheet resistance is varied according to the Al content and thickness of AlGaN barrier and/or existence of AlN.**

6: **Wafer bowing is strongly affected by the initial shape of the SiC substrate.**

TYPICAL ATOMIC FORCE MICROSCOPY (AFM) IMAGE

Layer Structure	AFM Image ▲ Defect Density





Defect density (Typical data) < 5 x 10^8 cm^{-2}

TYPICAL CHARACTERISTICS OF HEMT ON SiC

Item	Performance
Sheet Resistance [1] (Eddy Current)	Average ~ 380 ± 10 Ω/sq
Electron Mobility [2] (Eddy Current)	~ 2.1 x 10^3 cm^2/Vs
Sheet Carrier Density [3]	~ 7.8 x 10^{12} cm^{-2}
XRD-FWHM (0002)	~ 300 arcsec
XRD-FWHM (10-12)	~ 700 arcsec

Barrier specification: $Al_xGa_{1-x}N$ Barrier: x = 0.2 ~ 0.3, thickness = 15 ~ 25nm

Notes:

1: Barrier specification (Thickness and Al composition) can be tuned
2: AlN spacer can be inserted
3: Actual 2DEG characteristics will be varied depending on Al specification. Please note the 2DEG value as reference

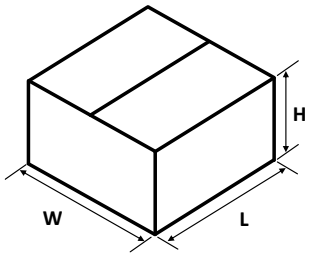
4 INCH SiC SUBSTRATE

Item	Characteristics
Material	SiC
Poly-type	4H
Orientation	(0001) just ± 0.2°
Wafer Diameter	100.0 +0/-0.5 mm
Thickness	500 ± 25 µm
Orientation Flat	<11-20> ± 5°
Length	32.5 ± 2.0 mm
Surface Finishing	Si-face, CMP polish, C-face optical polish
Resistivity	> 1 x 10^7 Ωcm

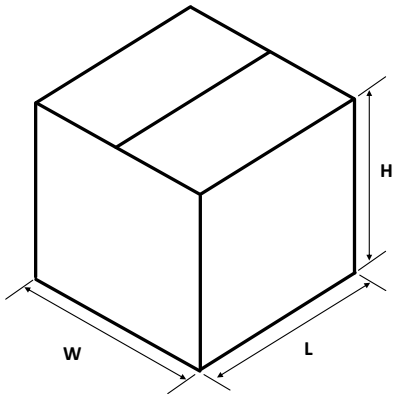
ORDERING INFORMATION AND PACKAGING

Part Number	Quantity (pcs) Wafer / Inner Box	Quantity Inner Box (pcs)	L x W x H (mm) Inner Box	Quantity (pcs) Wafer / Outer Carton	L x W x H (mm) Outer Carton
000C04EP02-12	3	4	230 x 160 x 180	12	385 x 320 x 475
000C04EP02-18	3	6	230 x 160 x 180	18	565 x 320 x 475

Inner Box



Outer Carton



Each wafer packed in cassette and vacuum bag.

CONFIRMATION TABLE

Items to be confirmed

- The structure of nucleation layer is based on GPT standard specification.
- The total thickness of epi wafer will be evaluated using optical interferometer.
- The composition and layer thickness of AlGaN barrier layer shall be tuned based on the x-ray diffraction measurement result of the evaluation wafer prior to the growth of the actual wafers. The Al composition and the layer thickness of the barrier layer will be configured based on the spectrum fitting results obtained from the x-ray diffraction measurement results.
- No visible cracks on the wafer surface.
- The wafer margin of 5mm from the edge is excluded for the guaranteed specifications listed above.
- The device characteristics using the delivered wafers are not guaranteed.
- Attached documents are
  - Delivered epi wafer list
  - Total thickness data (for each wafer)
  - Evaluated values of the barrier layer composition and thickness by X-ray diffraction curve fitting (3 points, "calibration epi"*)
  - XRD-FWHM [(0002) and (10-12)] (center, for each wafer)
  - Wafer bowing (for each wafer)

REVISION TABLE

Revision	Date	Status	Notes
001	29/03/2022	Initial release	Initial publication

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