Tankeblue

Silicon Carbide Substrates

（Version:2019）

Product Specifications

4H N-Type
6H N-Type
4H Semi-insulating
6H Semi-insulating

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SILICON CARBIDE MATERIAL PROPERTIES

Property	4H-SiC, Single Crystal	6H-SiC, Single Crystal
Lattice Parameters	a=3.076 Å c=10.053 Å	a=3.073 Å c=15.117 Å
Stacking Sequence	ABCB	ABCACB
Mohs Hardness	≈9.2	≈9.2
Density	3.21 g/cm^3	3.21 g/cm^3
Therm. Expansion Coefficient	4-5 $\times 10^{-6}$/K	4-5 $\times 10^{-6}$/K
Refraction Index @750nm	n_o = 2.61 n_e = 2.66	n_o = 2.60 n_e = 2.65
Dielectric Constant	c~9.66	c~9.66
Thermal Conductivity (N-type, 0.02 ohm.cm)	a~4.2 W/cm·K@298K c~3.7 W/cm·K@298K	
Thermal Conductivity (Semi-insulating)	a~4.9 W/cm·K@298K c~3.9 W/cm·K@298K	a~4.6 W/cm·K@298K c~3.2 W/cm·K@298K
Band-gap	3.23 eV	3.02 eV
Break-Down Electrical Field	3-5 $\times 10^6$ V/cm	3-5 $\times 10^6$ V/cm
Saturation Drift Velocity	2.0 $\times 10^5$ m/s	2.0 $\times 10^5$ m/s

Applications

III-V Nitride Deposition

Optoelectronic Devices

High-Power Devices

High-Temperature Devices

High-Frequency Power Devices

General Definition

WABCDE-XXX

W – Standard
A – Diameter
  2 – 50.8 mm (2 inch)
  3 – 76.2 mm (3 inch)
  4 – 100.0 mm (4 inch)
  6 – 150.0 mm (6 inch)
B – Polytype
  4 – 4H
  6 – 6H
C – Dopant
  N – Nitrogen
  S – Semi-insulating
D – Orientation
  0 – On-axis
  4 – 4° off axis
E – Grade
  Z – Zero MPD
  P – Product
  D – Dummy
X– Silicon face polish
  P – Optical polish
  C – CMP, EPI-ready
X – Carbon face polish
  L – Lapping
  P – Optical polish
  C – CMP, EPI-ready
X – Thickness
  E – 350 ± 25 μm
  F – 330 ± 25 μm
  G – 500 ± 25 μm
  X – Other thickness

天科合达 6 英寸 SiC 晶片产品标准

6 inch diameter, Silicon Carbide (SiC) Substrate Specification

等级 Grade		精选级（Z 级 ） Zero MPD Production Grade (Z Grade)	工业级(P 级) Standard Production Grade (P Grade)	测试级（D 级） Dummy Grade (D Grade)
直径 Diameter		150.0 mm±0.2mm		
厚度 Thickness	4H-N	350 μm±25μm		
	4H-SI	500 μm±25μm		
晶片方向 Wafer Orientation		Off axis : 4.0° toward $\langle 11\bar{2}0 \rangle$±0.5° for 4H-N On axis : <0001>±0.5° for 4H-SI		
微管密度 Micropipe Density	4H-N	≤0.5 cm^{-2}	≤2 cm^{-2}	≤15 cm^{-2}
	4H-SI	≤1 cm^{-2}	≤5cm^{-2}	≤15 cm^{-2}
电阻率 Resistivity	4H-N	0.015~0.025 Ω·cm		0.015~0.028 Ω·cm
	4H-SI	≥1E5 Ω·cm		
主定位边方向 Primary Flat		{10-10}±5.0°		
主定位边长度 Primary Flat Length	4H-N	47.5 mm±2.0 mm		
	4H-SI	Notch		
边缘 Edge exclusion		3 mm		
总厚度变化/弯曲度/翘曲度 TTV/Bow /Warp		≤15 μm /≤40 μm /≤60 μm		
表面粗糙度 Roughness		Polish Ra≤1 nm		
		CMP Ra≤0.5 nm		
裂纹(强光灯观测) Cracks by high intensity light		None		Cumulative length ≤ 20mm, single length≤2mm
六方空洞（强光灯观测）* Hex Plates by high intensity light		Cumulative area ≤0.05%		Cumulative area ≤0.1%
多型(强光灯观测)* Polytype Areas by high intensity light		None		Cumulative area≤3%
目测包裹物(日光灯下观测) Visual Carbon Inclusions		Cumulative area ≤0.05%		Cumulative area ≤3%
划痕(强光灯观测)# Scratches by high intensity light		None		Cumulative length≤1×wafer diameter
崩边 Edge chip		None		5 allowed, ≤1 mm each
表面污染物（强光灯观测） Contamination by high intensity light		None		
包装 Packaging		Multi-wafer Cassette Or Single Wafer Container		

Notes:

* Defects limits apply to entire wafer surface except for the edge exclusion area.

The scratches should be checked on Si face only.

天科合达 4 英寸 SiC 晶片产品标准

4 inch diameter Silicon Carbide (SiC) Substrate Specification

等级 Grade		精选级（Z 级 ） Zero MPD Production Grade (Z Grade)	工业级(P 级) Standard Production Grade (P Grade)	测试级（D 级） Dummy Grade (D Grade)
直径 Diameter		99.5-100 mm		
厚度 Thickness	4H-N	350 μm±25μm		
	4H-SI	500 μm±25μm		
晶片方向 Wafer Orientation		Off axis : 4.0° toward $\langle 11\bar{2}0 \rangle$ ±0.5° for 4H-N On axis : <0001>±0.5° for 4H-SI		
微管密度 Micropipe Density	4H-N	≤0.5cm^{-2}	≤2 cm^{-2}	≤15 cm^{-2}
	4H-SI	≤1cm^{-2}	≤5 cm^{-2}	≤15 cm^{-2}
电阻率 Resistivity	4H-N	0.015~0.025 Ω·cm		0.015~0.028 Ω·cm
	4H-SI	≥1E7 Ω·cm		≥1E5 Ω·cm
主定位边方向 Primary Flat		{10-10}±5.0°		
主定位边长度 Primary Flat Length		32.5 mm±2.0 mm		
次定位边长度 Secondary Flat Length		18.0mm±2.0 mm		
次定位边方向 Secondary Flat Orientation		Silicon face up: 90° CW. from Prime flat ±5.0°		
边缘去除 Edge exclusion		2 mm		
局部厚度变化/弯曲度/翘曲度 LTV/TTV/Bow /Warp		≤4μm/≤10μm /≤25μm /≤35μm		≤10μm/≤15μm /≤25μm /≤40μm
表面粗糙度 Roughness		Polish Ra≤1 nm		
		CMP Ra≤0.5 nm		
裂纹(强光灯观测) Cracks by high intensity light		None		Cumulative length ≤ 10mm, single length≤2mm
六方空洞（强光灯观测）* Hex Plates by high intensity light		Cumulative area ≤0.05%		Cumulative area ≤0.1%
多型(强光灯观测)* Polytype Areas by high intensity light		None		Cumulative area ≤3%
目测包裹物（日光灯观测）Visual Carbon Inclusions		Cumulative area ≤0.05%		Cumulative area ≤3%
划痕(强光灯观测)# Scratches by high intensity light		None		Cumulative length≤1×wafer diameter
崩边 Edge chip		None		5 allowed, ≤1 mm each
表面污染物（强光灯观测）Contamination by high intensity light		None		
包装 Packaging		Multi-wafer Cassette Or Single Wafer Container		

Notes:
* Defects limits apply to entire wafer surface except for the edge exclusion area.
# The scratches should be checked on Si face only.

天科合达 3 英寸 SiC 晶片产品标准

3 inch diameter Silicon Carbide (SiC) Substrate Specification

等级 Grade	**工业级 Production Grade**	**研究级 Research Grade**	**试片级 Dummy Grade**
直径 Diameter	76.2 mm±0.38 mm		
厚度 Thickness	350 μm±25μm		
晶片方向 Wafer Orientation	On axis : <0001>±0.5° for 4H-SI Off axis : 4.0° toward $<11\bar{2}0>$ ±0.5° for 4H-N		
微管密度 Micropipe Density	≤5 cm^{-2}	≤15 cm^{-2}	≤50 cm^{-2}
电阻率 Resistivity 4H-N	0.015~0.028 Ω·cm		
电阻率 Resistivity 4H-SI	>1E5 Ω·cm		(90%) >1E5 Ω·cm
主定位边方向 Primary Flat	{10-10}±5.0°		
主定位边长度 Primary Flat Length	22.2 mm±3.2 mm		
次定位边长度 Secondary Flat Length	11.2 mm±1.5 mm		
次定位边方向 Secondary Flat Orientation	Silicon face up : 90° CW. from Prime flat ±5.0°		
边缘 Edge exclusion	2 mm		
总厚度变化/弯曲度/翘曲度 TTV/Bow /Warp	≤15μm /≤25μm /≤35μm		
表面粗糙度 Roughness	Polish Ra≤1 nm CMP Ra≤0.5 nm		
裂纹(强光灯观测) Cracks by high intensity light	None	1 allowed, ≤1 mm	1 allowed, ≤2 mm
六方空洞（强光灯观测）* Hex Plates by high intensity light	Cumulative area ≤1%	Cumulative area ≤1%	Cumulative area ≤3%
多型(强光灯观测)* Polytype Areas by high intensity light	None	Cumulative area≤2 %	Cumulative area≤5%
划痕(强光灯观测)# Scratches by high intensity light	3 scratches to 1×wafer diameter cumulative length	5 scratches to 1×wafer diameter cumulative length	8 scratches to 1×wafer diameter cumulative length
崩边 Edge chip	None	3 allowed, ≤0.5 mm each	5 allowed, ≤1 mm each
表面污染物（强光灯观测） Contamination by high intensity light	None		

Notes:

* Defects limits apply to entire wafer surface except for the edge exclusion area.

The scratches should be checked on Si face only.

天科合达 2 英寸 SiC 晶片产品标准

2 inch diameter Silicon Carbide (SiC) Substrate Specification

等级 Grade		工业级 Production Grade	研究级 Research Grade	试片级 Dummy Grade
直径 Diameter		50.8 mm±0.38 mm		
厚度 Thickness		330 μm±25μm		
晶片方向 Wafer Orientation		On axis : <0001>±0.5° for 6H-N/4H-N/4H-SI/6H-SI Off axis : 4.0° toward $\langle 11\bar{2}0 \rangle$ ±0.5° for 4H-N/4H-SI		
微管密度 Micropipe Density		≤5 cm^{-2}	≤15 cm^{-2}	≤50 cm^{-2}
电阻率 Resistivity	4H-N	0.015~0.028 Ω·cm		
	6H-N	0.02~0.1 Ω·cm		
	4/6H-SI	>1E5 Ω·cm		(90%) >1E5 Ω·cm
主定位边方向 Primary Flat		{10-10}±5.0°		
主定位边长度 Primary Flat Length		15.9 mm±1.7 mm		
次定位边长度 Secondary Flat Length		8.0 mm±1.7 mm		
次定位边方向 Secondary Flat Orientation		Silicon face up: 90° CW. from Prime flat ±5.0°		
边缘 Edge exclusion		1 mm		
总厚度变化/弯曲度/翘曲度 TTV/Bow /Warp		≤15μm /≤25μm /≤25μm		
表面粗糙度 Roughness		Polish Ra≤1 nm		
		CMP Ra≤0.5 nm		
裂纹(强光灯观测) Cracks by high intensity light		None	None	1 allowed, ≤1 mm
六方空洞（强光灯观测）* Hex Plates by high intensity light		Cumulative area≤1 %	Cumulative area≤1 %	Cumulative area≤3 %
多型(强光灯观测)* Polytype Areas by high intensity light		None	Cumulative area≤2 %	Cumulative area≤5%
划痕(强光灯观测)# Scratches by high intensity light		3 scratches to 1×wafer diameter cumulative length	5 scratches to 1×wafer diameter cumulative length	8 scratches to 1×wafer diameter cumulative length
崩边 Edge chip		None	3 allowed, ≤0.5 mm each	5 allowed, ≤1 mm each
表面污染物（强光灯观测） Contamination by high intensity light		None		

Notes:

* Defects limits apply to entire wafer surface except for the edge exclusion area.

The scratches should be checked on Si face only.