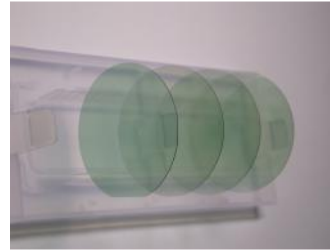
Typical Properties Single Crystal Silicon Carbide (SiC 6H / 4H)

The physical and electronic properties of SiC make it the foremost semiconductor material for short wavelength optoelectronic, high temperature, radiation resistant, and high-power/high-frequency electronic devices. A summary of the most important properties in comparison to Si and GaAs is shown below:



Chemical Formula:	SiC
Formula weight:	40.10
Unit Cell:	Hexagonal
Lattice constant:	a =3.08 A c = 15.08 A
Stacking sequence:	ABCACB (6H) ABCB (4H)
Growth Technique:	MOCVD
Orientation:	on axis or 3.5° off (0001)
Polish:	Silicon face polished
Band Gap:	2.93 eV (Indirect)
Conductivity type:	N
Resistivity:	670.0 ohm-cm
Dielectric Constant:	)11(ε 33.01 =)33(ε 66.9 =)22(ε =
Thermal Conductivity @ 300K:	5 W / cm . K
Hardness:	9 Mohs
Standard substrate size:	2” dia x 0.4 mmthick, 10 mm x 10 mm x 0.*4 mm*
Purity:	>99.999%

Physical & Electronic Properties of SiC Compared to GaAa and Si

Wide Energy Bandgap (eV)

4H-SiC	6H-SiC	GaAs	Si
4H-SiC: 3.26	**6H-SiC:** 3.03	**GaAs:** 1.43	**Si:** 1.12

Electronic devices formed in SiC can operate at extremely high temperatures without suffering from intrinsic conduction effects because of the wide energy bandgap. Also, this property allows SiC to emit and detect short wavelength light which makes the fabrication of blue light emitting diodes and nearly solar blind UV photodetectors possible.

High Breakdown Electric Field [V/cm (for 1000 V operation)]

4H-SiC: $2.2 \times 10^{6*}$ **6H-SiC:** $2.4 \times 10^{6*}$ **GaAs:** 3×10^{5} **Si:** 2.5×10^{5}

SiC can withstand a voltage gradient (or electric field) over eight times greater than than Si or GaAs without undergoing avalanche breakdown. This high breakdown electric field enables the fabrication of very high-voltage, high-power devices such as diodes, power transitors, power thyristors and surge suppressors, as well as high power microwave devices. Additionally, it allows the devices to be placed very close together, providing high device packing density for integrated circuits.

High Thermal Conductivity (W/cm · K @ RT)

4H-SiC: 3.0-3.8 **6H-SiC:** 3.0-3.8 **GaAs:** 0.5 **Si:** 1.5

SiC is an excellent thermal conductor. Heat will flow more readily through SiC than other semiconductor materials. In fact, at room temperature, SiC has a higher thermal conductivity than any metal. This property enables SiC devices to operate at extremely high power levels and still dissipate the large amounts of excess heat generated.

High Saturated Electron Drift Velocity [cm/sec (@ E ≥ 2 x 10^5 V/cm)]

4H-SiC: 2.0×10^{7} **6H-SiC:** 2.0×10^{7} **GaAs:** 1.0×10^{7} **Si:** 1.0×10^{7}

SiC devices can operate at high frequencies (RF and microwave) because of the high saturated electron drift velocity of SiC.

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