

Si

Silicon is a mono crystal primarily used in semiconductor and is non-absorptive at 1.2 μ m to 6 μ m IR regions. It is used here as an optical component for IR region applications.

Silicon is used as an optical window primarily in the 3 to 5 micron band and as a substrate for production of optical filters. Large blocks of Silicon with polished faces are also employed as neutron targets in Physics experiments. Silicon is grown by Czochralski pulling techniques (CZ) and contains some oxygen which causes an absorption band at 9 microns



. To avoid this, Silicon can be prepared by a Float-Zone (FZ) process. Optical Silicon is generally lightly doped (5 to 40 ohm cm) for best transmission above 10 microns. Silicon has a further pass band 30 to 100 microns which is effective only in very high resistivity uncompensated material. Doping is usually Boron (p-type) and Phosphorus (n-type)

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Application:

- Ideal for 1.2 to 7 μm NIR applications
- Broadband 3 to 12 μm anti-reflection coating
- Ideal for weight sensitive applications

Feature:

- These silicon windows do not transmit at $1\mu\text{m}$ region or below, therefore its main application is in IR regions.
- Because of its high thermal conductivity, it is suitable for use as a high power laser mirror
- ▶ Silicon windows have a shiny metal surface; it reflects and absorbs but does not transmit in the visible regions.
- ▶ Silicon windows surface reflection results in transmittance loss of 53%. (measured data 1 surface reflection at 27%)



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Technical Parameters	
Transmission Range	1.2 to 15 μm (1)
Refractive Index	3.4223 @ 5 μm (1) (2)
Reflection Loss	46.2% at 5 μm (2 surfaces)
Absorption Coefficient	0.01 cm^{-1} at 3 μm
Reststrahlen Peak	n/a
dn/dT	160 x 10 ⁻⁶ /°C (3)
dn/d μ = 0	10.4 μm
Density	2.33 g/cc
Melting Point	1420 °C
Thermal Conductivity	163.3 W m ⁻¹ K ⁻¹ at 273 K
Thermal Expansion	2.6 x 10 ⁻⁶ / at 20°C
Hardness	Knoop 1150
Specific Heat Capacity	703 J Kg ⁻¹ K ⁻¹
Dielectric Constant	13 at 10 GHz
Youngs Modulus (E)	131 GPa (4)
Shear Modulus (G)	79.9 GPa (4)
Bulk Modulus (K)	102 GPa
Elastic Coefficients	C ₁₁ =167; C ₁₂ =65; C ₄₄ =80 (4)
Apparent Elastic Limit	124.1MPa (18000 psi)
Poisson Ratio	0.266 (4)
Solubility	Insoluble in Water
Molecular Weight	28.09
Class/Structure	Cubic diamond, Fd3m



Material	Si
Diameter Tolerance	+0.0/-0.1mm
Thickness Tolerance:	±0.1mm
Surface Accuracy	$\lambda/4@632.8\text{nm}$
Parallelism	<1'
Surface Quality	60-40
Clear Aperture	>90%
Bevelling	<0.2×45°
Coating	Custom Design