Silicon (Si) is grown by Czochralski pulling techniques (CZ) and contains some oxygen that causes an absorption band at 9 microns. To avoid this, material 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, and doping is usually boron (p-type) and phosphorus (n-type). After doping silicon has a further pass band: 30 to 100 microns which is effective only in very high resistivity uncompensated material.

CZ Silicon is commonly used as substrate material for infrared reflectors and windows in the 1.5 - 8 micron region. The strong absorption band at 9 microns makes it unsuitable for CO2 laser transmission applications, but it is frequently used for laser mirrors because of its high thermal conductivity and low density. Application as window, lens in the 1.5 - 8 µm region; Mirror for CO2 laser and spectrometer applications.

**Si Mirror grade**
Any dopant, any conductivity, any orientation, not warranted with respect to transmission, suitable for mirror substrates.

**Si Optical grade**
CZ, P type doped with Boron, <111> or <100>, Resistivity 5 - 40 ohmcm
FZ, N type doped with Phosphorus, <111>, Resistivity > 50, preferably > 500 ohmcm, the absorption at 9 microns is absent.

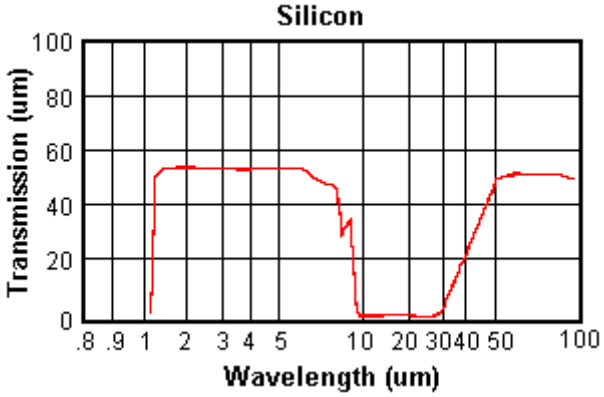
Also we produced Silicon wafers according customers specifications, these substrates can be used in the semiconductor production.

We can offer services like lapping, cutting, grinding, polishing, double-side polishing.

**Main Properties**

| **Crystal properties** | | | |
|---|---|---|---|
| Crystal Growth Method | | Czohralski (CZ) & Floatzone (FZ) | |
| Max. Size (mm)<br>CZ<br>FZ | | <350 mm<br><125 mm | |
| **Optical properties** | | | |
| Transmission Range | | 1.2~8 µm | |
| Reflection Loss, for two surfaces at 5 m | | 46.2% | |
| Refractive Index | | See below | |
| Wavelength (um) | Refractive Index (n) | Wavelength (um) | Refractive Index (n) |
| 1.357 | / | 5.500 | 3.4213 |
| 1.3951 | 3.4975 | 6.000 | 3.4202 |
| 1.6606 | 3.4929 | 6.500 | 3.4195 |
| 1.8131 | 3.4608 | 7.000 | 3.4189 |
| 2.1526 | 3.4476 | 7.500 | 3.4186 |
| 2.3254 | 3.443 | 8.000 | 3.4184 |
| 3.000 | 3.432 | 8.500 | 3.4182 |
| 3.500 | 3.4284 | 10.00 | 3.4179 |
| 4.000 | 3.4257 | 10.50 | 3.4178 |
| 4.500 | 3.4236 | 11.04 | 3.4176 |
| 5.000 | 3.4223 | | |

| Transmission Curve | See below |
|---|---|




| Crystallographic properties | |
|---|---|
| Syngony | Cubic |
| Lattice Constant, A | 5.43 |
| **Physical properties** | |
| Density | 2.33g/cm3 |
| Hardness, Mohs | 7 |
| Dielectric Constant for 9.37 x 109 Hz | 13 |
| Melting point, §à§³ | 1414 |
| Thermal Conductivity, W/m¡¤K at 313 K | 163 |
| Thermal Expansion, 1/K at 293 K | 2.6x10-6 |
| Specific Heat Capacity, J/(kg?¡ãC) | 712.8 |
| Bandgap, eV | 1.1 |
| Knoop Hardness, kg/mm2 | 1100 |
| Young's Modulus, Gpa | 130.91 |
| Shear Modulus, GPan | 79.92 |
| Bulk Modulus, GPa | 101.97 |
| Debye Temperature, K | 640 |
| Poisson's Ratio | 0.28 |
| **Chemical properties** | |
| Solubility in water | None |
| Molecular Weight | 28.09 |

**General Specifications**

| Optical grade Silicon Window Substrates | | |
|---|---|---|
| **Parameters** | **Commercial grade** | **Precision grade** |
| Substrate Material | CZ or FZ optical Silicon mono | |
| Diameter Tolerance | +0/-0.10 mm | |
| Thickness Tolerance | 0.10 mm | |
| Clear Aperture | >Central 90% of diameter | |
| Surface Quality | 60-40 S/D | 40-20 S/D |
| Parallelism | 3~5 arc min | 1 arc min |
| Surface Flatness | 1 per 25mm | L/4 |
| Chamfer | 0.15~0.35 mm 45 face width 4515 | |
| Coating | Coatings are available upon request | |

| Optical grade Silicon Lens Substrates | | | |
|---|---|---|---|
| **Parameters** | **Commercial grade** | **Precision grade** | **Ultra-precision grade** |
| Substrate Material | CZ or FZ optical Silicon mono | | |
| Diameter Tolerance | +0/-0.10mm | | |

| | | | |
|---|---|---|---|
| Thickness Tolerance | 0.10 mm | | |
| Focal Length Tolerance | <1% | | |
| Clear Aperture | >Central 90% of diameter | | |
| Surface Quality | 60-40 S/D | 40-20 S/D | 20-10 S/D |
| Centration | <3 arc min | <1 arc min | |
| Surface Flatness | Power<3 fringes(1.5¦Ë) Irregularity<0.5 fringes(¦Ë/4) | Irregularity<0.2 fringes(L/10) | |
| Chamfer | 0.15~0.35mm¡Á45¡ã face width ¡Á 45¡ã¡À15¡ã | | |
| Coating | Coatings are available upon request | | No coating |

| **Silicon Wafers** | |
|---|---|
| **Parameters** | **Value** |
| Substrate Material | CZ Silicon, N or P, R=0.003~50 ohm.cm |
| Orientation | <100> / <111> |
| Diameter Tolerance | 3"~8" 0.2 mm |
| Thickness Tolerance | According to SEMI or customer¡¯s requirements 15 um |
| Thickness Vary (TTV) | <5um |
| Surface Flatness (TIR) | <4um |
| Surface (STIR) | <0.6um |
| Warp | <30um |