

Ge

The Germanium as a mono crystal primarily used in semi-conductor is non-absorptive at $2\mu\text{m}$ to $20\mu\text{m}$ IR regions. It is used here as an optical component for IR region applications. Germanium is a high index material that is used to manufacture Attenuated Total Reflection (ATR) prisms for spectroscopy. Its refractive index is such that Germanium makes an effective natural 50% beamsplitter without the need for coatings. Germanium is also used extensively as a substrate for production of optical filters. Germanium covers the whole of the 8-14 micron thermal band and is used in lens systems for thermal imaging. Germanium can be AR coated with Diamond producing an extremely tough front optic.



Germanium is grown using the Czochralski technique by a small number of manufacturers in Belgium, USA, China and Russia. The refractive index of Germanium changes rapidly with temperature and the material becomes opaque at all wavelengths a little above 350K as the band gap floods with thermal electrons.

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Application:

- Ideal for near-IR applications
- Broadband 3 to 12 μm anti-reflection coating
- Ideal for applications requiring low dispersion
- Great for low power CO2 laser applications

Feature:

- These germanium windows do not transmit at 1.5 μm region or below, therefore its main application is in the IR regions.
- Germanium windows can be used in various infrared experiments.

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

Transmission Range :	1.8 to 23 μm (1)
Refractive Index :	4.0026 at 11 μm (1)(2)
Reflection Loss :	53% at 11 μm (Two surfaces)
Absorption Coefficient :	<0.027 cm^{-1} @ 10.6 μm
Reststrahlen Peak :	n/a
dn/dT :	396 x 10 ⁻⁶ /°C (2)(6)
dn/d μ = 0 :	Almost constant
Density :	5.33 g/cc
Melting Point :	936 °C (3)
Thermal Conductivity :	58.61 W m ⁻¹ K ⁻¹ at 293K (6)
Thermal Expansion :	6.1 x 10 ⁻⁶ /°C at 298K (3)(4)(6)
Hardness :	Knoop 780
Specific Heat Capacity :	310 J Kg ⁻¹ K ⁻¹ (3)
Dielectric Constant :	16.6 at 9.37 GHz at 300K
Youngs Modulus (E) :	102.7 GPa (4) (5)
Shear Modulus (G) :	67 GPa (4) (5)
Bulk Modulus (K) :	77.2 GPa (4)
Elastic Coefficients :	C ₁₁ =129; C ₁₂ =48.3; C ₄₄ =67.1 (5)
Apparent Elastic Limit :	89.6 MPa (13000 psi)
Poisson Ratio :	0.28 (4) (5)
Solubility :	Insoluble in water
Molecular Weight :	72.59
Class/Structure :	Cubic Diamond, Fd3m