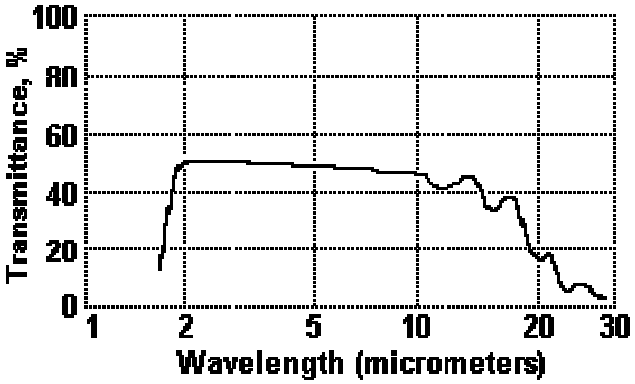
Germanium (Ge)



Germanium is a high index material that is used to manufacture lenses for thermal imaging systems and 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. It is also used extensively as a substrate for production of optical filters. Germanium transmission covers the whole of the 8-14 micron thermal band. Its transmission is very temperature sensitive, becoming opaque near 100°C. Germanium is inert, mechanically rugged, and fairly hard. Germanium is grown by Czochralski pulling techniques

OPTICAL PROPERTIES

Transmission Range	1.8 to 23 microns
Refractive Index	4.0026 at 11 microns
Reflection Loss	59.1% at 11 µm (2 surfaces)
Index of Absorption	1.3 x 10^{-3} cm-1 at 3.8 microns
dN/dT	396 x 10^{-6}/°C
dN/dµ = 0	R.I. almost constant

PHYSICAL PROPERTIES

Density	5.33 g/cm^3
Melting Point	936°C
Thermal Conductivity	58.61$Wm^{-1}K^{-1}$ at 293K
Thermal Expansion	6.1 x 10^{-6}/°C at 298K
Hardness	Knoop 780
Specific Heat Capacity	310 J $kg^{-1}K^{-1}$
Dielectric Constant	16.6 at 9.37GHz at 300K
Young's Modulus (E)	102.7 GPa
Shear Modulus (G)	67 GPa
Bulk Modulus (K)	77.2 GPa
Elastic Coefficients	C_{11} = 129 C_{12} = 48.3 C_{44} = 67.1
Apparent Elastic Limit	89.6 MPa (13000psi)
Poisson Ratio	0.28

CHEMICAL PROPERTIES

Solubility	Insoluble in water
Molecular Weight	72.59
Class/Structure	Cubic diamond, Fd3m

Wavelength, µm	2.06	2.15	2.44	2.58	3.00	3.42
Refractive Index	4.10	4.09	4.07	4.06	4.05	4.03

Wavelength, µm	4.36	6.24	8.66	9.72	11.04	13.02
Refractive Index	4.02	4.01	4.00	4.00	4.00	4.00