Germanium (Ge)
Specialist Data Sheet

Product Name	Germanium (Ge)
Transmission Range	1.8 ~ 23 μm
Refractive Index	4.0026 @ 11 μm
Reflection Loss	53% @ 11 μm (2 surfaces)
Absorption Coefficient	< 0.027 cm^{-1} @ 10.6 μm
Reststrahlen Peak	n/a
dN/dT	396 x 10^{-6}/℃
dN/du	Almost constant
Density	5.33 g/cc
Melting Point	936 ℃
Thermal Conductivity	58.61 W m^{-1} K^{-1} @ 293K
Thermal Expansion	6.1 x 10^{-6}/℃ @ 298K
Hardness	Knoop 780
Specific Heat Capacity	310 J Kg^{-1} K^{-1}
Dialectric Constant	16.6 @ 9.37 GHz @ 300K
Youngs Modulus (E)	102.7 Gpa
Shear Modulus (G)	67 Gpa
Bulk Modulus (K)	77.2 Gpa
Elastic Coefficients	C11=129; C12=48.3; C44=67.1
Apparent Elastic Limit	89.6 Mpa (13000 psi)
Poisson Ratio	0.28
Solubility	Insoluble in water
Molecular Weight	72.59
Class/Structure	Cubic Diamond, Fd3m

Notes:

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

Application:

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. It 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. It can be AR coated with diamond producing an extremely tough front optic.

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Refractive Index:

µm	No	µm	No	µm	No	µm	No
2.058	4.1020	2.577	4.0609	4.258	4.0216	9.720	4.0034
2.153	4.0919	2.714	4.0562	4.866	4.0170	11.04	4.0026
2.313	4.0786	2.998	4.0452	6.238	4.0094	12.00	4.0023
2.437	4.0708	3.303	4.0369	8.660	4.0043	13.02	4.0021