

Ge Germanium

Summary Description

Ge is a high refractive index material (4.0 @ 10 microns) with good long wavelength transmission in the infrared. At elevated temperatures the free carrier absorption becomes important and at 200 °C it is almost opaque. The high index permits very novel lens designs and ATR sampling of samples with high refractive index or high carbon black content.

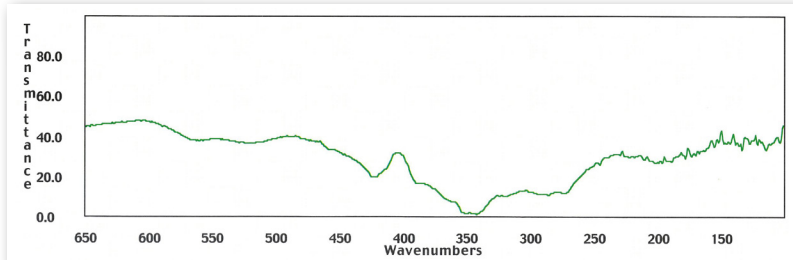
Advantages

1. Zero water solubility
2. Good chemical resistance
3. Good spectral range
4. High refractive index permits design of excellent anti-reflective (AR) coatings
5. High refractive index means very low penetration depth in ATR applications
6. High refractive index permits very innovative optical design for refractive elements
7. Low cost
8. Can be fabricated by diamond turning

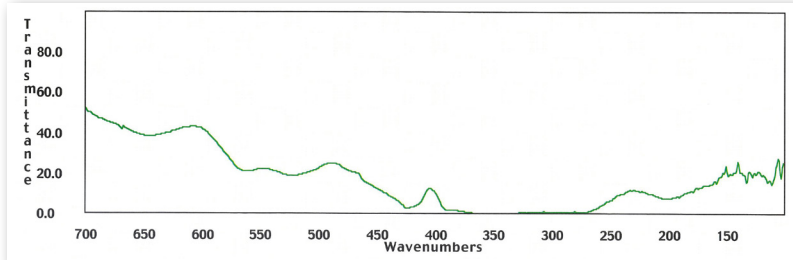
Disadvantages

1. Free carrier absorption limits use at elevated temperature
2. High refractive index will limit transmission in applications where AR coatings cannot be used

Far-IR Transmission – 1 mm thick Ge window



Far-IR Transmission – 4 mm thick Ge window



Refractive Index¹

WAVELENGTH (Microns)	INDEX	WAVELENGTH (Microns)	INDEX
2.0581	4.1016	4.258	4.0216
2.1526	4.0919	4.866	4.0170
2.3126	4.0786	6.238	4.0094
2.4374	4.0708	8.660	4.0043
2.5770	4.0609	9.720	4.0034
2.7144	4.0552	11.04	4.0026
2.9980	4.0452	12.00	4.0023
3.3033	4.0369	13.02	4.0021
3.4188	4.0334		

Specific index listed; Generic: 4.00 @ 10 microns

Physical Data

Melting Point: 936 °C

Density: 5.33 g/cm³

Solubility in H₂O: Insoluble

Hardness: 780 kg/mm²

Appearance: Metallic

TYPICAL USES

- **IR detector windows**
- **ATR elements**
- **Single bounce ATR microscopy**
- **Condensing lenses – high index permits very sharp focus for microscopic applications**
- **Imaging lenses – when combined with an AMTIR element to form an achromatic lens, excellent broad band imaging can be achieved**
- **Ge has been used as an FT-IR beamsplitter – this is done by using BBAR coating on the back side of the beamsplitter and both sides of the compensator**

Spectral Range

Short Wavelength Limit: 5,500 cm^{-1} (1 mm)

Long Wavelength Limit: 432 cm^{-1} (1 mm), 574 cm^{-1} (4 mm)

Coatings

The high refractive index of Ge permits design of BBAR coatings with greater than 98% transmission. It may also be coated to control depth of penetration in ATR applications.

Notes

Short and Long Wavelength Limits defined for which transmissivity is greater than 50% of stated crystal thickness.

- H.H. Li; Refractive Index of Germanium and Silicon and its wavelength and temperature derivatives. Journal of Physics and Chemistry, Reference data, Vol. 9m (3), p. 561-601. 1980.*