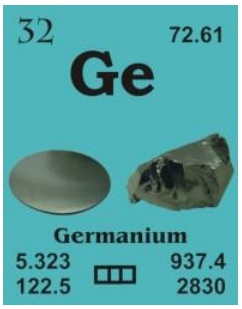
Germanium $_{32}Ge^{72.61}$

Discovered in 1886 by C.A. Winkler at Freiberg, Germany.

[Latin, Germania= Germany]
French: germanium
German: Germanium
Italian: germanio
Spanish: germanio



Atomic number	32
Density in g/cm³	5.323
Atomic radius in pm	125
Atomic weight	72.61
Melting point in °C	937.4
Boiling point in °C	2830

Description: Ultrapure germanium is a silvery-white brittle metalloid element. It is stable in air and water, is unaffected by acids, expect HNO3, and alkalis. It is used in semiconductors, alloys and special glasses for infrared devices.

GERMANIUM SINGLE CRYSTAL PROPERTIES

CRYSTALOGRAPHIC	
Syngony	Cubic
Symmetry Class	m3m
Lattice Constants	a = 5.657 Å c = a
Cleavability	(111), perfect

OPTICAL	
Refractive Index at n10.6	4.0034
Refractive Index at n8.0 **- n**12.5	0.0036
Thermal Coefficient of Refractive Index at 3.39 microns for 60 °C	35 - 40 x 10-5
Transmission Range, microns	2 - 17

THERMAL	
Thermal Linear Expansion, °C-1 **for 60 °C**	(5.1 ... 5.8) x 10-6
Thermal Conductivity, W/(m * °C) at 27 °C	59.8
Specific Heat Capacity, J/(kg * °C)	0.310
Melting Point, °C	937
Absorbance ( ), cm -1	
at 10.6 microns	0.027

MECHANICAL	
Density, g/cm3 at 25 °C	5.33
Mohs Hardness	6
Vickers Microhardness, Pa	900 x 107
Constants of Elastic Compliance, Pa-1	S11 = 9.69 x 10-12 S12 = -2.65 x 10-12 S44 = 14.89 x 10-12
Young Modulus (E), Pa	
in <100> direction	10.32x 1010
in <111> direction	15.56 x 1010
Shear Modulus (G), Pa	
in <100> direction	6.72 x 1010
in <111> direction	4.67 x 1010
Poisson Ratio	0.278

CHEMICAL	
Molecular Weight	72.61
Solubility	
in water, gram/100 cm3	insoluble

REF. INDEX VS. WAVELENGTH λ

Wavelength, Microns	Refractive Index
2.0	4.1079
3.0	4.0446
4.0	4.0242
5.0	4.0153
6.0	4.0106
7.0	4.0076
8.0	4.0053
9.0	4.0047
10.0	4.0040
11.0	4.0031
12.0	4.0029
12.5	4.0024
15.0	4.0017

INTERNAL TRANSMITTANCE

Wavelength, Microns	Internal Transmittance
3.0	0.97
5.0	0.97
6.0	0.97
7.0	0.97
8.0	0.97

9.0	0.97
10.0	0.96
12.0	0.70
15.0	0.56

Crystal structure:	(cell dimensions/pm), space group, cubic (a=565.754), Fs3m, diamond structure High pressure forms: (a=488.4, c=269.2), $I4_1/amd$; (a=593, c=698), $P4_32_12$; (a=692), b.c.c.
X-ray diffractions mass absorption coefficients:	CuK_α 75.6 (μ/r) / cm2g-1 MoK_α 64.8 (μ/r) / cm2g-1
Neutron scattering length:	0.8193 $b/10^{-12}$ cm
Thermal neutron capture cross-section:	2.2 sa / barns
Density:	5323 kg/m^{-3} [293 K]; 5490 [liquid at m.p.]
Melting point:	937.45°C / 1210.6°K
Boiling point:	2829.85°C / 3103°K
Molar volume:	13.64 cm^3
Thermal conductivity:	59.9 [300 K] W $m^{-1}K^{-1}$
Coefficient of linear thermal expansion:	5.57 x 10^{-6} K^{-1}
Electrical resistivity:	0.46 [295 K] Ωm
Mass magnetic susceptibility:	-1.328 x 10^{-9}(s) $kg^{-1}m^3$
Young's modulus:	79.9 GPa
Rigidity modulus:	29.6 GPa
Bulk modulus:	n.a.
Poisson's ratio:	0.32 GPa
Radi:	Ge^{2+} 90; Ge^{4-} 272; atomic 123; covalent 122
Electronegativity:	2.01 (Pauling); 2.02 (Allred); 4.6 eV (absolute)
Effective nuclear charge:	5.65 (Slater); 6.78 (Clementi); 7.92 (Froese-Fischer)
Number of Isotopes (incl. nuclear isomers):	24
Isotope mass range:	64-> 83