

Germanium

Ge

General Information

Discovery

Germanium was discovered by C.A. Winkler in 1886 in Freiberg, Germany. It was predicted by Mendeleev in 1871 who named it ekasilicon.

Appearance

Germanium is a grey-white metalloid, crystalline and brittle, retaining a lustre in air.

Source

Germanium is found in small quantities in the minerals germanite and argyrodite. It is also present in zinc ores, and commercial production of germanium is by processing zinc smelter flue dust. It can also be recovered from the by-products of combustion of certain coals, which ensures a copious future supply.

Uses

Germanium is a very important semiconductor. The pure element is doped with arsenic, gallium or other elements and used as a transistor in thousands of electronic applications.

Germanium is also finding use as an alloying agent, in fluorescent lamps and as a catalyst. Both germanium and germanium oxide are transparent to infrared radiation and so are used in infrared spectrometers. Germanium oxide has a high index of refraction and dispersion and is used in wide-angle camera lenses and microscope objectives.

Biological Role

Germanium has no known biological role. It is non-toxic. Certain germanium compounds have low mammalian toxicity but marked activity against some bacteria, which has stimulated interest in their use in pharmaceutical products.

Physical Information

Atomic Number	32
Relative Atomic Mass ($^{12}\text{C}=12.000$)	72.61
Melting Point/K	1210.6
Boiling Point/K	3103
Density/kg m ⁻³	5323 (293K)
Ground State Electron Configuration	[Ar]3d ¹⁰ 4s ² 4p ²
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	116

Key Isotopes

Nuclide	⁶⁸ Ge	⁷⁰ Ge	⁷¹ Ge	⁷² Ge	⁷³ Ge	⁷⁴ Ge
Atomic mass	67.928	69.924	70.925	71.923	72.923	73.922
Natural abundance	0%	20.5%	0%	27.4%	7.8%	36.5%
Half-life	287 days	stable	11.4 days	stable	stable	stable
Nuclide	⁷⁶ Ge	⁷⁷ Ge				
Atomic mass	75.921					
Natural abundance	7.8%	0%				
Half-life	stable	11.3 h				

Ionisation Energies/kJ mol⁻¹

M - M ⁺	762.1
M ⁺ - M ²⁺	1537
M ²⁺ - M ³⁺	3302
M ³⁺ - M ⁴⁺	4410
M ⁴⁺ - M ⁵⁺	9020
M ⁵⁺ - M ⁶⁺	11900
M ⁶⁺ - M ⁷⁺	15000
M ⁷⁺ - M ⁸⁺	18200
M ⁸⁺ - M ⁹⁺	21800
M ⁹⁺ - M ¹⁰⁺	27000

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	34.7
Enthalpy of Vaporisation/kJ mol ⁻¹	327.6

Oxidation States

Ge^{II}, Ge^{IV}

Covalent Bonds/kJ mol⁻¹

Ge - H	288
Ge - C	237
Ge - O	363
Ge - F	464
Ge - Cl	340
Ge - Ge	163