

Boron

B

General Information

Discovery

Boron was discovered in 1808 by L.J. Gay-Lussac and L.J. Thenard in Paris, and Sir Humphry Davy in London.

Appearance

The element is a grey powder, but is not found free in nature.

Source

Boron occurs as orthoboric acid in certain volcanic spring waters, and as borates in the minerals borax and colemanite. However, by far the most important source of boron is rasorite, which is found in the Mojave Desert in California. Extensive borax deposits are also found in Turkey.

High purity boron is prepared by the vapour phase reduction of boron trichloride or tribromide with hydrogen on electrically heated filaments. The impure, or amorphous, boron can be prepared by heating the trioxide with magnesium powder.

Uses

Amorphous boron is used in pyrotechnic flares to provide a distinctive green colour, and in rockets as an igniter. The most important compounds of boron are boric (or boracic) acid, widely used as a mild antiseptic, and borax which serves as a cleansing flux in welding and as a water softener in washing powders. Boron compounds are also extensively used in the manufacture of borosilicate glasses. Other boron compounds show promise in treating arthritis. The isotope boron 10 is used as a control for nuclear reactors, as a shield for nuclear radiation, and in instruments used for detecting neutrons. Demand is increasing for boron filaments, a high-strength, low-density material chiefly employed for advanced aerospace structures.

Biological Role

Elemental boron is not considered a poison, and indeed is essential to plants, but assimilation of its compounds has a cumulative toxic effect.

General Information

Elemental boron has an energy band gap of 1.50 to 1.56 eV, which is higher than that of either silicon or germanium. It has interesting optical characteristics, transmitting portions of the infrared only. It is a poor conductor of electricity at room temperature, but a good conductor at high temperatures.

Physical Information

Atomic Number	5
Relative Atomic Mass ($^{12}\text{C}=12.000$)	10.81
Melting Point/K	2573
Boiling Point/K	3931
Density/ kg m^{-3}	2340 (293K)
Ground State Electron Configuration	$[\text{He}]2s^22p^1$
Electron Affinity (M-M $^-$)/ kJ mol^{-1}	-15

Key Isotopes

Nuclide	^{10}B	^{11}B
Atomic mass	10.013	11.009
Natural abundance	20.0%	80.0%
Half-life	stable	stable

Ionisation Energies/ kJ mol^{-1}

M - M $^+$	800.6
M $^+$ - M $^{2+}$	2427
M $^{2+}$ - M $^{3+}$	3660
M $^{3+}$ - M $^{4+}$	25025
M $^{4+}$ - M $^{5+}$	32822

Other Information

Enthalpy of Fusion/ kJ mol^{-1}	22.2
Enthalpy of Vaporisation/ kJ mol^{-1}	504.5

Oxidation States

B $^{+3}$

Covalent Bonds/ kJ mol^{-1}

B - H	381
B - H - B	439
B - C	372
B - O	523
B - F	644
B - Cl	444
B - B	335