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TOPIC: THE GROUP 13 ELEMENTS
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Electronic structures and oxidation states

Element	symbol	Electronic Configuration	oxidation states.
Boron	B	[He] $2s^2 2p^1$	III
Aluminium	Al	[Ne] $3s^2 3p^1$	(I) III
Gallium	Ga	[Ar] $3d^{10} 4s^2 4p^1$	I III
Indium	In	[Kr] $4d^{10} 5s^2 5p^1$	I III
Thallium	Tl	[Xe] $4f^{14} 5d^{10} 6s^2 6p^1$	I III

GENERAL PROPERTIES

Boron is a non-metal. and always forms Covalent bonds. Normally it forms Three Covalent bonds at 120° using sp^2 hybrid orbitals. There is no tendency to form univalent Compounds. All BX_3 Compounds are electron deficient, and may accept an electron pair from another atom. Thus forming a Coordinate bond BF_3 is Commercially Important as a catalyst. Boron also forms a large number of Compounds in which the boron atoms form a an open basket type of Structure. and Some which are a closed polyhedron. other atoms Such as Carbon may be Included in the polyhedron. The bonding in these Compounds is of Considerable Theoretical interest. and involves multi-centre bonds.

The four elements Al. Ga. In and Tl all form trivalent Compounds. The heavier members show the inert pair effect' and univalent Compounds become increasingly important in the order Ga ⟶ In ⟶ Tl. These four elements (Table) are more metallic. and more ionic, than B.

They are moderately reactive metals. Their Compounds are on the borderline between Ionic and Covalent. Many of Their Compounds are Covalent when anhydrous. but they form ions in Solution.

EXTRACTION

Extraction of boron

Amorphous boron of low purity (Called Moissan boron) is obtained by reducing B_2O_3 with Mg or Na at a high temperature. It is 95-98% pure (being Contaminated with metal borides) and is black in Colour.

$$\underset{\text{borax}}{Na_2[B_4O_5(OH)_4]\cdot 8H_2O} \xrightarrow{\text{acid}} \underset{\text{orthoboric acid}}{H_3BO_3} \xrightarrow{\text{heat}} B_2O_3 \xrightarrow{\text{Mg or Na}} 2B + 3MgO$$

It is difficult to obtain pure crystalline boron, as it has a very high melting point (2180°c) and the liquid is corrosive Small amounts of Crystalline boron may be obtained.

1 By reducing BCl_3 with H_2. This is done on the Kilogram Scale
2 Pyrolysis of BI_3 (Van Arkel method).
3 Thermal decomposition of diborane or other boron hydrides.

$$2BCl_3 + 3H_2 \xrightarrow{\text{red hot W or Ta filament}} 2B + 6HCl$$

$$2BI_3 \xrightarrow[\text{Van Arkel}]{\text{red hot W or Ta filament}} 2B + 3I_2$$

$$B_2H_6 \xrightarrow{\text{heat}} 2B + 3H_2$$

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