

TOPIC : THE GROUP 13 ELEMENTS

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Electronic structures and oxidation states

Element	symbol	Electronic Configuration	oxidation states-
Boron	B	[He] 2s <sup>2</sup> 2p <sup>1</sup>	III
Aluminium	Al	[Ne] 3s <sup>2</sup> 3p <sup>1</sup>	(I) III
Gallium	Ga	[Ar] 3d <sup>10</sup> 4s <sup>2</sup> 4p <sup>1</sup>	I III
Indium	In	[Kr] 4d <sup>10</sup> 5s <sup>2</sup> 5p <sup>1</sup>	I III
Thallium	Tl	[Xe] 4f <sup>14</sup> 5d <sup>10</sup> 6s <sup>2</sup> 6p <sup>1</sup>	I III

GENERAL PROPERTIES

Boron is a non-metal and always forms covalent bonds. Normally it forms three covalent bonds at  $120^\circ$  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 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 'snert pair effect' and univalent compounds become increasingly important in the order  $Ga \rightarrow In \rightarrow Tl$ . These four elements (Table) are more metallic. and more ionic, than B.

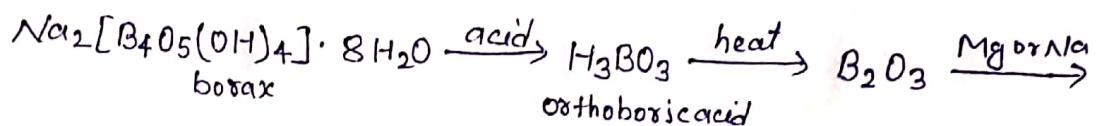
They are moderately reactive metals. Their compounds are on the borderline between ionic and covalent. Many of their compounds are covalent when anhydrous, but they form ions in solution.

### EXTRACTION

#### Extraction of boron

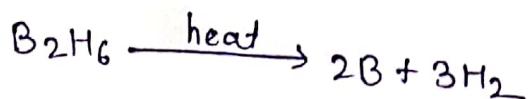
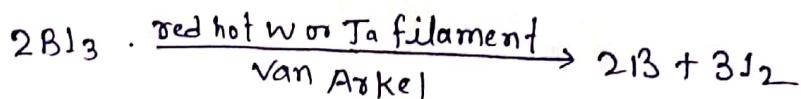
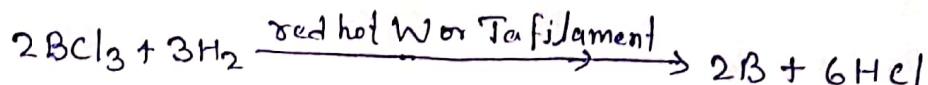
Amorphous boron of low purity (called Moissan boron) is obtained by reducing  $B_2O_3$  with Mg or Na at a high temperature.

It is 95-98% pure (being contaminated with metal borides) and is black in colour.



It is difficult to obtain pure crystalline boron, as it has a very high melting point ( $2180^\circ C$ ) and the liquid is corrosive.

- 1 By reducing  $BeCl_3$  with  $H_2$ . This is done on the kilogram scale.
- 2 Pyrolysis of  $BJ_3$  (Van Arkel method).
- 3 Thermal decomposition of diborane or other boron hydrides.



fresh