

Atomic & Physical Properties

Electronic configuration: (Noble gas) ns^2np^1

Oxidation State: +1 & +3

Metallic character: B Al Ge In Tl
NonMetal Metals

Atomic radii, ionic radii, density & stability of +1 oxidation state: Generally increase down the group.

Boiling point & stability of +3 oxidation state: Decreases down the group.

Electronegativity: $\text{B} > \text{Tl} > \text{In} > \text{Ga} > \text{Al}$

Melting point: Dec. from B to Ga then increases.
 $\text{B} > \text{Al} > \text{Ga} > \text{In} > \text{Tl}$

Ionisation Energy: $\text{B} > \text{Tl} > \text{Ga} > \text{Al} > \text{In}$

Lewis Acid: BCl_3 , AlCl_3 etc behaves as Lewis Acid due to incomplete octet.

Chemical Properties

Reactivity towards Air $\rightarrow 4\text{E} + 3\text{O}_2 \xrightarrow{\Delta} 2\text{E}_2\text{O}_3$

B_2O_3 Al_2O_3 Ga_2O_3 In_2O_3 Tl_2O_3
Acidi Amphoteri Basic

$2\text{E} + \text{N}_2 \xrightarrow{\Delta} 2\text{En}$ { Excep Ga, In, Tl }

Reactivity towards halogens:

$2\text{E} + 3\text{X}_2 \rightarrow 2\text{EX}_3$ (EXCEPT TlI_3)
(X = F, Cl, Br, I)

Reactivity towards Acids and alkalis

$2\text{Al}_{(s)} + 6\text{HCl}_{(aq.)} \rightarrow 2\text{Al}^{3+}_{(aq.)} + 6\text{Cl}^{-}_{(aq.)} + 3\text{H}_2(\text{g})$

$2\text{Al}_{(s)} + 2\text{NaOH}_{(aq.)} + 6\text{H}_2\text{O} \rightarrow 2\text{Na}^{+}[\text{Al}(\text{OH})_4]^{-}_{(aq.)} + 3\text{H}_2(\text{g})$

Silicates

- Basic Unit is SiO_4^{4-}
- They exist in different structures like chain, ring, sheet or 3-D structure.
- Zeolites are 3-D silicates in which some of the Si atoms are replaced by Al^{+3} ions. They are used in water softening.

Silicones

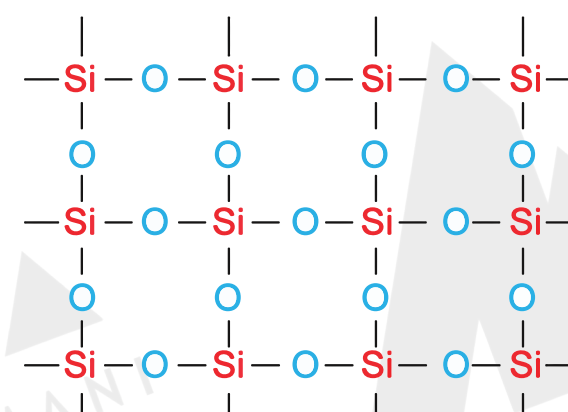
- Contains repeated $\text{R}_2\text{Si}(\text{OH})_2$ units held by Si-O-Si linkage.
- $2\text{RQ} + \text{Si} \xrightarrow{\text{Cu powder}} \text{R}_2\text{SiCl}_2$
- $\text{R}_2\text{SiCl}_2 + 2\text{H}_2\text{O} \rightarrow \text{R}_2\text{Si}(\text{OH})_2 + 2\text{HCl}$
- $n[\text{R}_2\text{Si}(\text{OH})_2] \xrightarrow{\text{Polymerise}} \text{Silicone}$
- They are water repelling due to non-polar alkyl group.

Carbon Monoxide (CO)

- Preparation:**
 $\text{C} + 2\text{H}_2\text{O} \rightarrow \text{CO} + \text{H}_2$
Watergas
- $2\text{C} + \text{O}_2 + 4\text{N}_2 \xrightarrow{1273\text{ K}} 2\text{CO} + 4\text{N}_2$
Producer gas
- Highly poisonous due to formation of a complex with haemoglobin.
- acts as reducing agent
 $\text{ZnO}(\text{s}) + \text{CO}(\text{g}) \rightarrow \text{Zn}(\text{s}) + \text{CO}_2(\text{g})$
 $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g})$

Silicon Dioxide (SiO_2)

- Covalent, three dimensional network solid.
- Almost non-reactive due to high Si-O bond enthalpy.
- Acidic in nature.
 $\text{SiO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SiO}_3 + \text{H}_2\text{O}$



Carbondioxide (CO_2)

- Preparation**
 $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
- It is consumed during photosynthesis
 $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$

Chemical Properties

- Reactivity towards air: They form oxides of the formula EO and EO_2 on heating with air.
- Acidic strength of their oxides dec. down the group.
 $\text{CO}_2, \text{SiO}_2$ GeO_2 $\text{SnO}_2, \text{PbO}_2$
Acidic Less Acidic Amphoteric
- Reactivity towards water: only Sn reacts with steam.
- Reactivity towards halogen: They form halide of formula EX_2 and EX_4 most of the EX_4 are covalent in nature.
- Except CCl_4 , other halides are easily hydrolysed by water
 $\text{SiCl}_4 + 4\text{H}_2\text{O} \rightarrow \text{Si}(\text{OH})_4 + 4\text{HCl}$
Silicic acid

THE P-BLOCK ELEMENTS

GROUP 13 BORON FAMILY

GROUP 14 CARBON FAMILY

Important Compounds of Boron

Borax

$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$

White Crystalline Solid Preparation

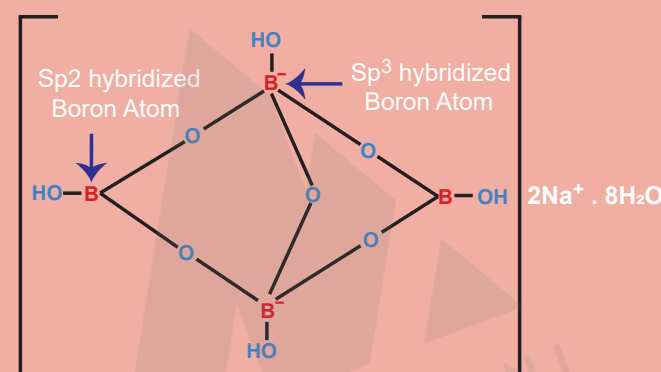
$4\text{H}_3\text{BO}_3 + \text{Na}_2\text{CO}_3 \rightarrow \text{Na}_2\text{B}_4\text{O}_7 + 6\text{H}_2\text{O} + \text{CO}_2$

Reactions

$\text{Na}_2\text{B}_4\text{O}_7 + 7\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 4\text{H}_3\text{BO}_3$

Heating

$\text{Na}_2\text{B}_4\text{O}_7 \rightarrow 2\text{NaBO}_2 + \text{B}_2\text{O}_3$



Diborane

B_2H_6

Colourless, highly toxic gas
Preparation

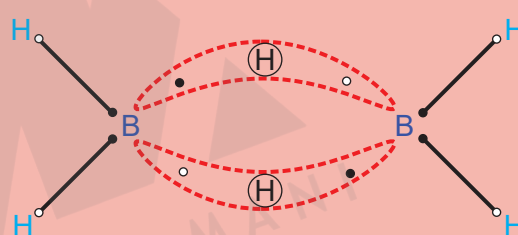
$2\text{BF}_3 + 6\text{NaH} \xrightarrow{456\text{ K}} \text{B}_2\text{H}_6 + 6\text{NaF}$

$2\text{NaBH}_4 + \text{I}_2 \rightarrow \text{B}_2\text{H}_6 + 2\text{NaI} + \text{H}_2$

reaction

$\text{B}_2\text{H}_6 + 3\text{O}_2 \rightarrow \text{B}_2\text{O}_3 + 3\text{H}_2\text{O}$

$3\text{B}_2\text{H}_6 + 6\text{NH}_3 \rightarrow 3[\text{BH}_2(\text{NH}_3)_2]^+[\text{BH}_4]^-$
 $\xrightarrow{\Delta} 2\text{B}_3\text{N}_3\text{H}_6 + 12\text{H}_2$



Orthoboric Acid

H_3BO_3

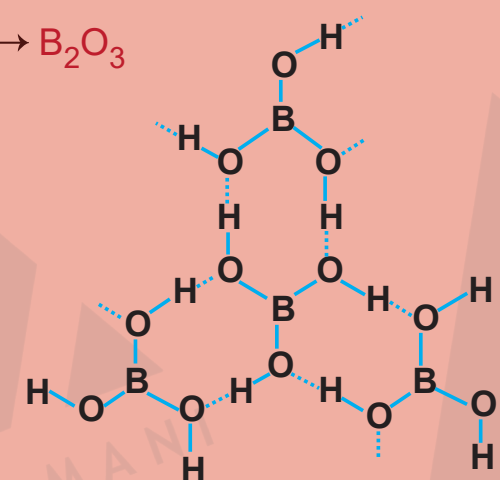
White crystalline solid, Non protic acid
Preparation

$\text{Na}_2\text{B}_4\text{O}_7 + 2\text{HCl} + 5\text{H}_2\text{O} \rightarrow 2\text{NaCl} + 4\text{H}_3\text{BO}_3$

reaction

$\text{H}_3\text{BO}_3 \xrightarrow{370\text{ K}} \text{HBO}_2 + \text{H}_2\text{O}$
Monoboric acid

$\text{HBO}_2 \rightarrow \text{B}_2\text{O}_3$



Atomic and Physical Properties

- Electronic configuration:** [Noble gas] $ns^2 np^2$
- Oxidation State:** +2 & +4
- Atomic radii, metallic character & stability of +2 Oxidation State generally increase down the group.**
 $\text{C} < \text{Si} < \text{Ge} < \text{Sn} < \text{Pb}$
- Catenation:** Decreases down the group.
Pb does not show catenation.
 $\text{C} \gg \text{Si} > \text{Ge} \approx \text{Sn}$
- Ionization enthalpy**
 $\text{C} > \text{Si} > \text{Ge} > \text{Pb} > \text{Sn}$
- Electronegativity**
 $\text{C} > \text{Pb} > \text{Si} \approx \text{Ge} \approx \text{Sn}$