UG1 PART-I

INORGANIC CHEMISTRY

Borazine

Preparation:

i) Heating a mixture of B_2H_6 and NH_3

This compound is formed when diborane and ammonia are reacted at high temperature in 1:2 molar ratio.

$$3B_2H_6 + 6NH_3 \xrightarrow{\text{high temp.}} 2B_3N_3H_6 + 12H_2$$

Diammoniate of diborane formed at low temperature by mixing B_2H_6 and NH_3 may also be converted to borazine by heating at high temperature.

$$B_2H_6 + 2NH_3 \xrightarrow{\text{low temp.}} B_2H_6 \cdot 2NH_3$$

$$3(B_2H_6 \cdot 2NH_3) \xrightarrow{\text{high temp.}} 2B_3N_3H_6 + 12H_2$$

ii) Reaction of $Li(BH_4)$ on NH_4Cl

This reaction is also carried at high temperature.

$$3NH_4Cl + 3Li(BH_4) \longrightarrow B_3N_3H_6 + 3LiCl + 9H_2$$

iii) Heating BCl_3 with NH_4Cl.

When BCl_3 is heated with NH_4Cl in chlorobenzene (C_6H_5Cl) in presence of a catalyst (eg. Fe, Ni, Co etc) at 133°C, trichloroborazine is obtained which on being reduced by $Li(BH_4)$ in polyether gives borazine. (yield by this method is about 50-60%)

$$3BCl_3 + 3NH_4Cl \xrightarrow[(Fe\ catalyst)]{\Delta\ C_6H_5Cl} Cl_3B_3N_3H_3 + 9HCl$$

$$2Cl_3B_3N_3H_3 + 6Li[BH_4] \xrightarrow{\text{Reduction}} 2B_3N_3H_6 + 6LiCl + 3B_2H_6$$

Properties

Borazine is a colourless and volatile liquid.

It's important chemical properties are:

A) **Hydrolysis**

(i) It is slowly hydrolysed by water to produce boric acid. H_3BO_3, ammonia and H_2 which is favoured by increasing temperature.

$$B_3N_3H_6 + 9H_2O \longrightarrow 3B(OH)_3 + 3NH_3 + 3H_2$$

(ii) It has also been reported that under certain conditions borazine reacts with three molecules of water to produce trihydroxyLborazine $(OH)_3B_3N_3H_3$, in which OH groups are attached with B atoms.

$$B_3N_3H_6 + 3H_2O \longrightarrow B_3N_3H_3(OH)_3 + 3H_2$$

B. **Addition reactions:**

i) It has been found that one molecule of borazine adds three molecules of H_2O, CH_3OH, CH_3I, HCl or HBr in the cold without a catalyst. Since B-atom is less electronegative than nitrogen atom in B-N bond, more negative groups or atoms of these molecules are generally attached with boron. HCl derivative of this compound when heated at 50–100°C, loses H_2 molecules to gives B-trichloro borazine (Cl-atoms attached to B-atoms)

$$B_3N_3H_6 + 3HCl \xrightarrow{\Delta} B_3N_3H_9Cl_3 \xrightarrow[-3H_2]{} B_3N_3H_3Cl_3$$

ii) One molecule of borazine also adds three molecules of Br_2 at 0°C giving B-tribromo-N-tribromoborazine.

$$B_3N_3H_6 \xrightarrow{+3Br_2} B_3N_3H_6Br_6 \xrightarrow{60°C} B_3N_3H_3Br_3 + 3HBr.$$

c Hydrogenation

Borazine can be converted to cyclotriborazine, $B_3N_3H_{12}$ as shown below:-

$$B_3N_3H_6 \xrightarrow{+3HCl} B_3N_3HgCl_3$$

$$B_3N_3HgCl_3 \xrightarrow{+NaBH_4} B_3N_3H_{12} + 3/2\,B_2H_6 + 3NaCl$$

cyclotriborazine.