Borazine or Borazole $(BH_3)(NH_3)$ or $B_3N_3H_6$

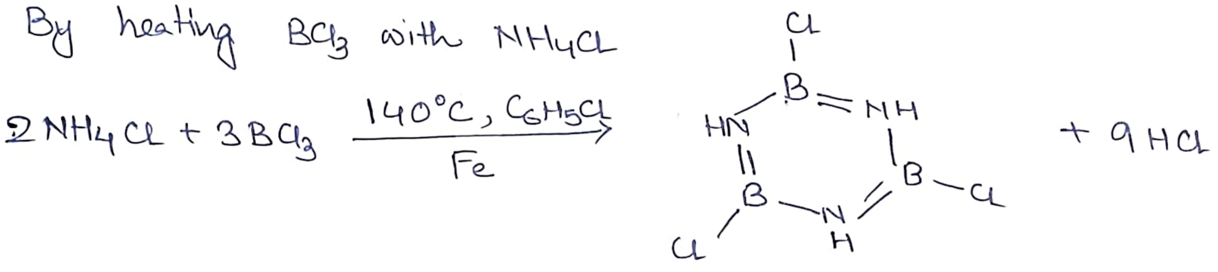
This compound is isoelectronic with benzene and has been called Inorganic benzene.

Preparation

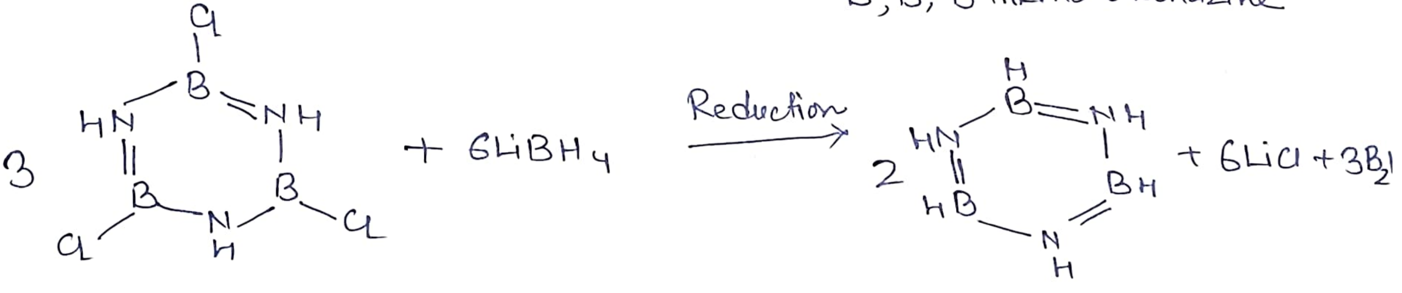
(i) By Stock and Pohland method

$$3\,B_2H_6 + 6\,NH_3 \longrightarrow \underset{\text{adducts}}{3\,[B_2H_6 \cdot 2NH_3]} \xrightarrow{200^\circ C} 2B_3N_3H_6 + 12H_2$$

(ii) By heating BCl_3 with NH_4Cl



B, B, B trichloroborazine



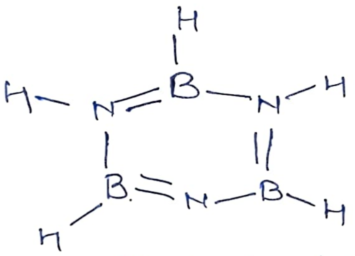
(iii) By heating a mixture of $LiBH_4$ and NH_4Cl

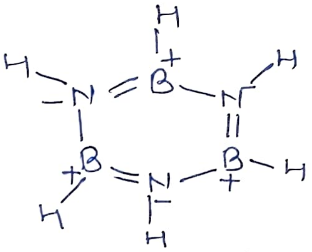
$$3NH_4Cl + 3LiBH_4 \longrightarrow B_3N_3H_6 + 3LiCl + 9H_2$$

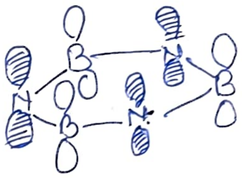
Structure

Borazine has a planar hexagonal structure, same as benzene, containing a six membered ring, in which B and N atoms are arranged alternatively.. Both B and N are sp^2 hybridized. Each N atom has one lone pair electron while each B atom has one vacant p-orbital. Therefore B–N π bond in borazine is dative, which arised due to sidewise overelap between filled p-orebital of N and empty p orebital of B.

Like benzene, boreazine also have a π electron cloud. Due to greatere difference in electronegativity values of B and N atoms, the π electron cloud in B_3N_3 reing of boreazine is paretially delocalized. In fact, complete delocalisation of cannot be expected as N-π orebitals have lowere energy than B-π orebitals.







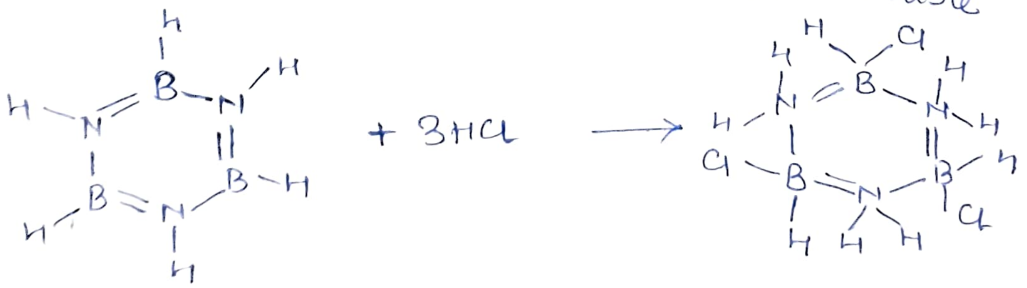
B–N bond length = 1·36 Å ; ∠B–N–B = ∠N–B–N = 120°

Properties

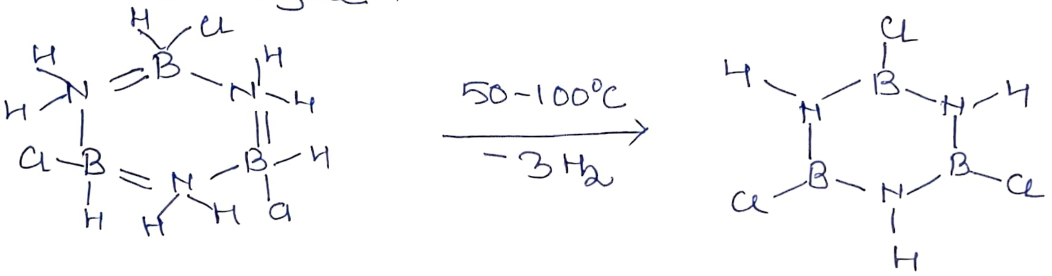
(i) Boreazine is colourless, ~~odoreless~~ volatile liquid.

M.P = −58°C B.P. = 64·5 °C

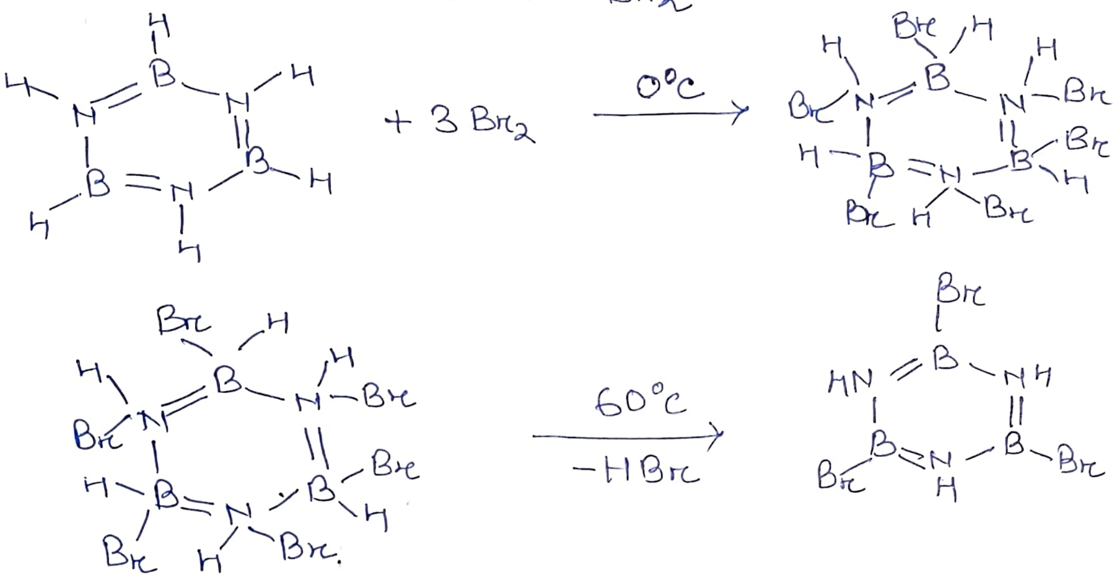
(ii) Due to paretial delocallisation of the π-electrons cloud the π-bonding in B_3N_3 reing is weakened. In addition, N atom retains its basicity and B atom retains its acidity to some extent. So it undergoes Addition reaction. Polare compounds such as HCl attacks B=N double bond.



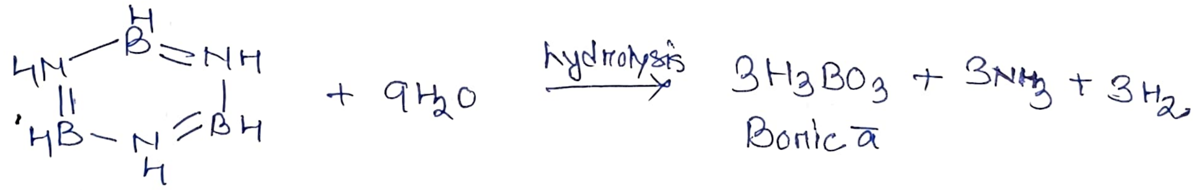
when this derivative is heated it gives B, B, B - trichloroborazine.



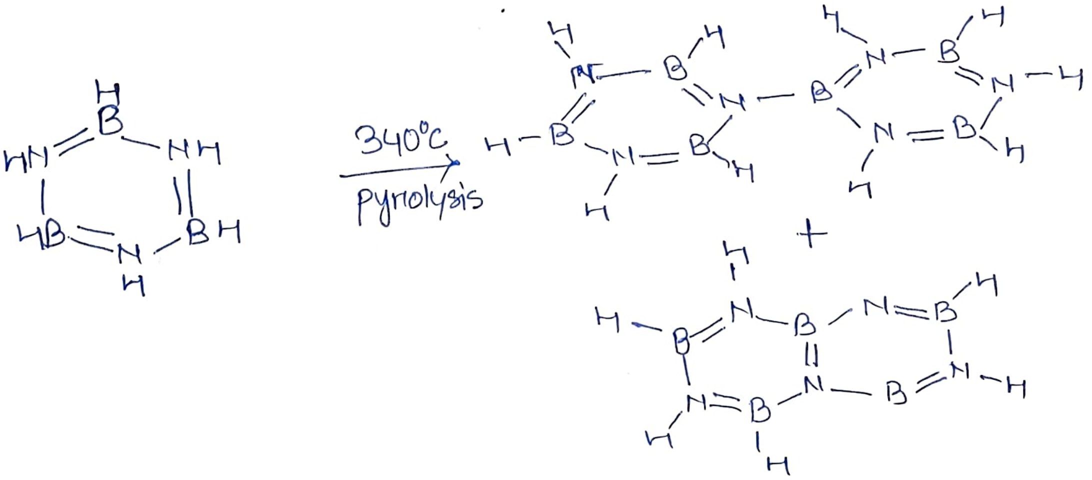
Addition reaction with Br_2



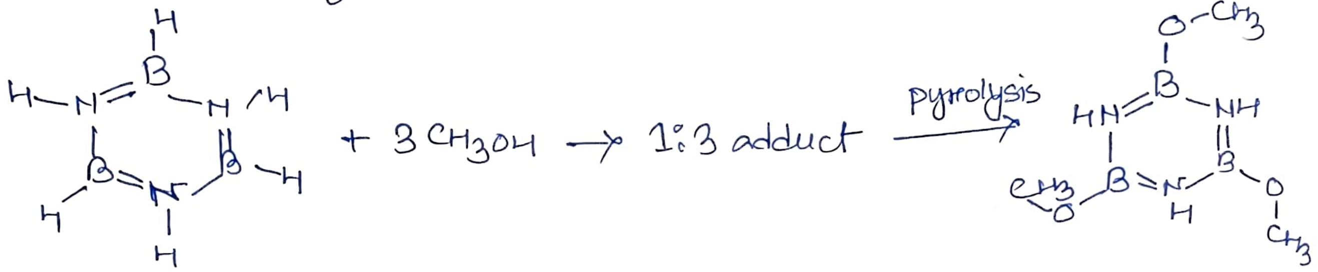
(iii) Hydrolysis



(iv)



(v) Formation of adduct



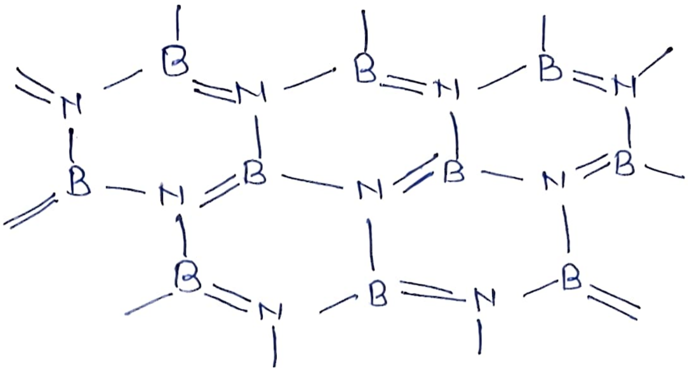
B,B,B trimethoxy-
borazine.

Boron Nitride (BN)

Structure The lattice of $(BN)_n$ consists of different layers. Each layer has a hexagonal arrangement of B and N atoms. Different layers are arranged in a manner that B atoms in one layer are immediately above the N atoms of the adjucent layer. The (B–N) distances are 1·45 Å and distance between two layers is 3·33 Å. The (B–N) bonds in $(BN)_n$ are formed by overlapping of sp^2 hybrid orbitals of B and N atoms. The remaining electrons form π-bonds.

BN molecule is isoelectronic with two adjacent C-atoms in graphite and hence the structure of $(BN)_n$ is similar to graphite. However the π-electron cloud is partially delocalised in $(BN)_n$ unlike graphite, due to difference in electronegativities of B and N.

$(BN)_n$ when heated to 3000 °c at 70,000 atm pressure goes to cubic form which has diamond-like structure. The B and N atoms attain tetrahedral co-ordination.



Preparation

(i) By heating boron to a white heat, in an atmosphere of N_2, NO or NH_3

$$2B + N_2 \xrightarrow{\Delta} 2BN$$

$$5B + 3NO \xrightarrow{\Delta} 3BN + B_2O_3$$

$$2B + 2NH_3 \xrightarrow{\Delta} 2BN + 3H_2$$

(ii) By heating B_2O_3 with $Hg(CN)_2$, KCN or NH_4Cl

$$B_2O_3 + Hg(CN)_2 \xrightarrow{\Delta} 2BN + CO + CO_2 + Hg$$

$$B_2O_3 + 2KCN \xrightarrow{\Delta} 2BN + K_2O + 2CO$$

$$B_2O_3 + 2NH_4Cl \xrightarrow{\Delta} 2BN + 3H_2O + 2HCl$$

(iii) When perfectly anhydrous borax ($Na_2B_4O_7$) is heated with dry NH_4Cl to red heat in a platinum crucible

$$Na_2B_4O_7 + 2NH_4Cl \xrightarrow{\Delta} 2BN + 2NaCl + B_2O_3 + 4H_2O$$

(iv) Pure BN is best prepared by heating boron amide $B(NH_2)_3$ or boron imide $B_2(NH)_3$ or by action of NH_3 on BCl_3

$$2B(NH_2)_3 \xrightarrow{\Delta} 2BN + 4NH_3$$

$$B_2(NH)_3 \xrightarrow{\Delta} 2BN + NH_3$$

$$2BCl_3 + 8NH_3 \longrightarrow 2BN + 6NH_4Cl$$

(v) BN can also be prepared by passing N_2 gas through a mixture of B_2O_3 and carbon heated in an electric furnace

$$B_2O_3 + 3C + N_2 \longrightarrow 2BN + 3CO$$

(vi) When diborane reacts with excess of NH_3, at high temperature, BN is obtained.

$$B_2H_6 + 2NH_3\,(\text{excess}) \longrightarrow 2BN + 6H_2$$

Properties

(i) Boron nitride is a white powder of density 2.34. It melts under pressure at 3000°c.

(ii) Decomposition →

(a) It gets decomposed when heated in steam, evolving NH_3.

$$BN + 3H_2O \longrightarrow \underset{\text{Boric }\bar{a}}{B(OH)_3} + NH_3$$

(b) It decomposes slowly upon action of HF

$$BN + 4HF \longrightarrow NH_4BF_4$$

(c) It is also decomposes when fused with KOH

$$BN + KOH \longrightarrow K_3BO_3 + NH_3$$

(iii) Reaction with K_2CO_3

$$BN + K_2CO_3 \xrightarrow{\text{fuse}} \underset{\text{Pot. cyanate}}{KCNO} + \underset{\text{Pot. metaborate}}{KBO_2}$$