COVALENT CARBIDES

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COVALENT CARBIDES

The only **covalent carbides** are those of **silicon and boron (SiC and B_4C).**

PREPARATION SiC and B_4C are prepared by reducing their oxides with carbon in an electric furnace.

$$SiO_2 + 3C \longrightarrow SiC + 2CO$$

$$2Be_2O_3 + 7C \longrightarrow B_4C + 6CO$$

PROPERTIES

- These are not attacked by H_2O, dil. and conc. acids.
- These are extremely hard and **decompose at high temperatures**. Because of their **hardness they are used for cutting and as abrasives.**

SILICON CARBIDE OR CARBORUNDUM - SiC

It is prepared by heating a **mixture of coke and SiO_2 in an electric furnace at 2000^0C** by passing acetylene on heating silicon.

$$SiO_2 + 3C \rightarrow SiC + 2CO$$

$$Si + 3C_2H_2 \rightarrow 2SiC + H_2$$

Manufacture: SiC is manufactured by Acheson's process.

In this process a mixture of **sand (54%), coke (34%), sawdust (10%) and salt (2%)** is heated in an **electric furnace made of fire bricks to $1550\text{-}2200^0C$.**

The **bed of the furnace** and the **end walls of it are permanent** while the side walls are built up with the charge and pulled down after the completion of the process to take out the product.

It is provided at each end with **carbon electrodes consisting of sixty rods of carbon.** A **heavy current is passed for 36 hours**. Whereby a high temperature is rapidly reached. At this high temperature, the following reaction occurs resulting in the formation of SiC.

$$SiO_2 + 3C \rightarrow SiC + 2CO$$

- For about two hours in the beginning, the **emf gradually decreases from 165 volts to 125 volts** and the **current increases from 1700 amperes to 6000 amperes** due to the gradual decrease in resistance.
- These conditions **persist for the remaining period of time**. At the end of the operation, the side walls are pulled down and **dark coloured mass of black crystals of SiC** is **crushed and washed successively with H_2SO_4 and NaOH solution to remove the impurities.**
- It is finally dried in kilns and graded into various portions according to the size of particles.
- The salt acts as a flux while saw dust increases the porosity of the charge which enables a continuous escape of CO that burns at the top of the charge.

Properties

- It is **colorless when pure**.
- The commercial sample is **yellow, green or blue**.
- It is nearly hard as diamond and **does not decompose below 2200^0C**.
- Chemically it is extremely **inert and even at high temperatures**.
- It is not attacked even by **HF, HCl, O_2 or S**.
- Even a mixture of fuming **HNO_3 and HF has no action on it**.
- It is decomposed by fused **NaOH in presence of O_2**

$$SiO + 4NaOH + 2O_2 \rightarrow Na_2CO_3 + Na_2SiO_2 + 2H_2O$$

USES

- It is used as an **abrasive for cutting and grinding glasses**.
- It has a **very high melting point** and is, therefore, **used in furnace lining.**
- On account of its refractory nature and **high heat conductivity**, it is used for **making crucibles used for melting metals.**
- It is also used as **carbon rods in resistant heaters**.
- It is also used for making **wheels, hones, whetstones by mixing SiC with moistened china clay and felspar**.
- Moulding under pressure and firing and article in a kiln.
- It is also used as a **de-oxidant in metallurgy** and as **resistor for electrical furnaces**.

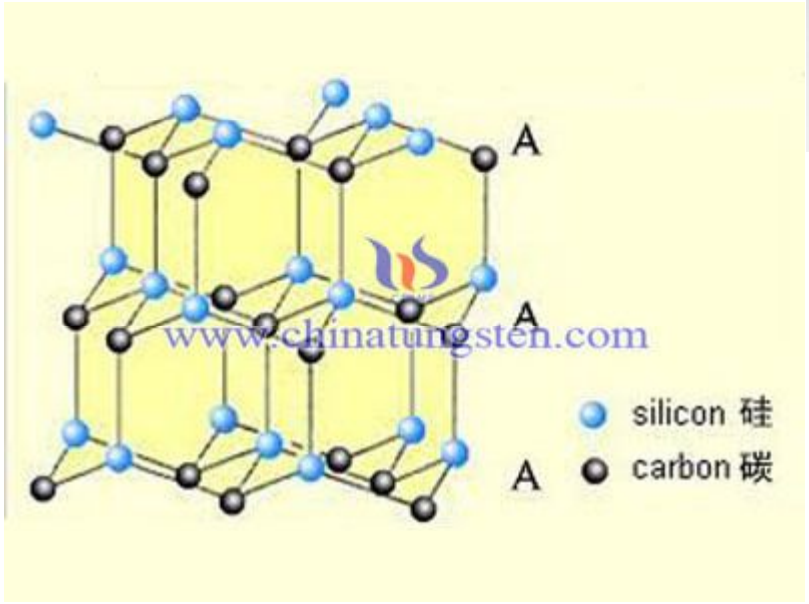
Structure

- SiC exists in **three forms** which are related to another as **diamond, zinc blende and wurtzite(ZnS).**
- These forms are **different combinations of layers** corresponding to **zinc blende and wurtzite structures**.
- These three forms are (i) carborundum I represented as aaa bb

  (ii) carborundum II represented as aa bbb

  (iii) carborundum III represented as aa bb.

  Here a zinc blende layer and b is a wurtzite layer.
- The lattice of SiC consists of C atoms at points corresponding to those occupied by atoms in a close packed **face centered cubic** or **hexogonal** structure, with Si atoms at half the points corresponding to the positions of the tetrahedral holes.
- This type of structure of SiC has been confirmed by X ray studies.



CARBIDES

- The binary compounds of carbon with the elements which are more electronegative than carbon are called carbides. Thus this definition excludes the binary compound s of carbon with N,P,O,S and halogens.

General properties :

- Generally carbides are transparent crystalline solids. In the solid state they are non conduction of electricity.
- **Colour :** Carbides of alkali metals and of Ca ,Sr and Ba are only colourless while most of the remaining carbides are coloured.
- **Softness and hardness:** alkali metal carbides are soft while others are usually hard. For example Be_2C and UC_2 are so hard that they can scratch glass and quartz.
- **Explosive nature**: Carbides of U,Cu,A,An,Hg etc. are explosive substances, e.g Hg carbide explodes on rapid heating . Uranium carbide emits sparks when struck and takes fire even when powered quickly.
- **Reducing property**: The carbides of alkali metals and of Ca ,Sr and Ba are strong reducing agents,e.g.MgO and MgCl2 are reduced to the metals on heating with CaC2.
- **Hydrolysis**: Ionic carbides can easily be hydrolyzed by water or dil acids with the formation of different types of hydrocarbons.