Covalent crystal

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Covalent crystal

- Covalent crystals are those crystals in which the valence electrons are shared equally between neighboring atoms rather than being transferred from one atom to another, as is the case in ionic crystals.

- There is no net charge associated with any atom of the crystal. This occurs between atoms having lack of one or more electrons from having a closed outer shell in the following manner.

- Two such similar or identical atom are brought together to such an inter atomic separation that the orbital of one of the unpaired electrons begin to overlap with that of one in the other atom.

- The original atomic charge distributions are then deformed in such a way that the unpaired electron charge of each atom is transferred into the space between them.

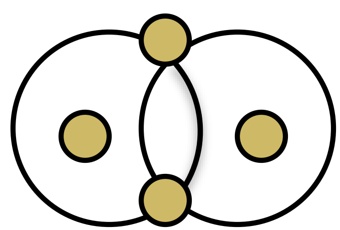
Covalent bond

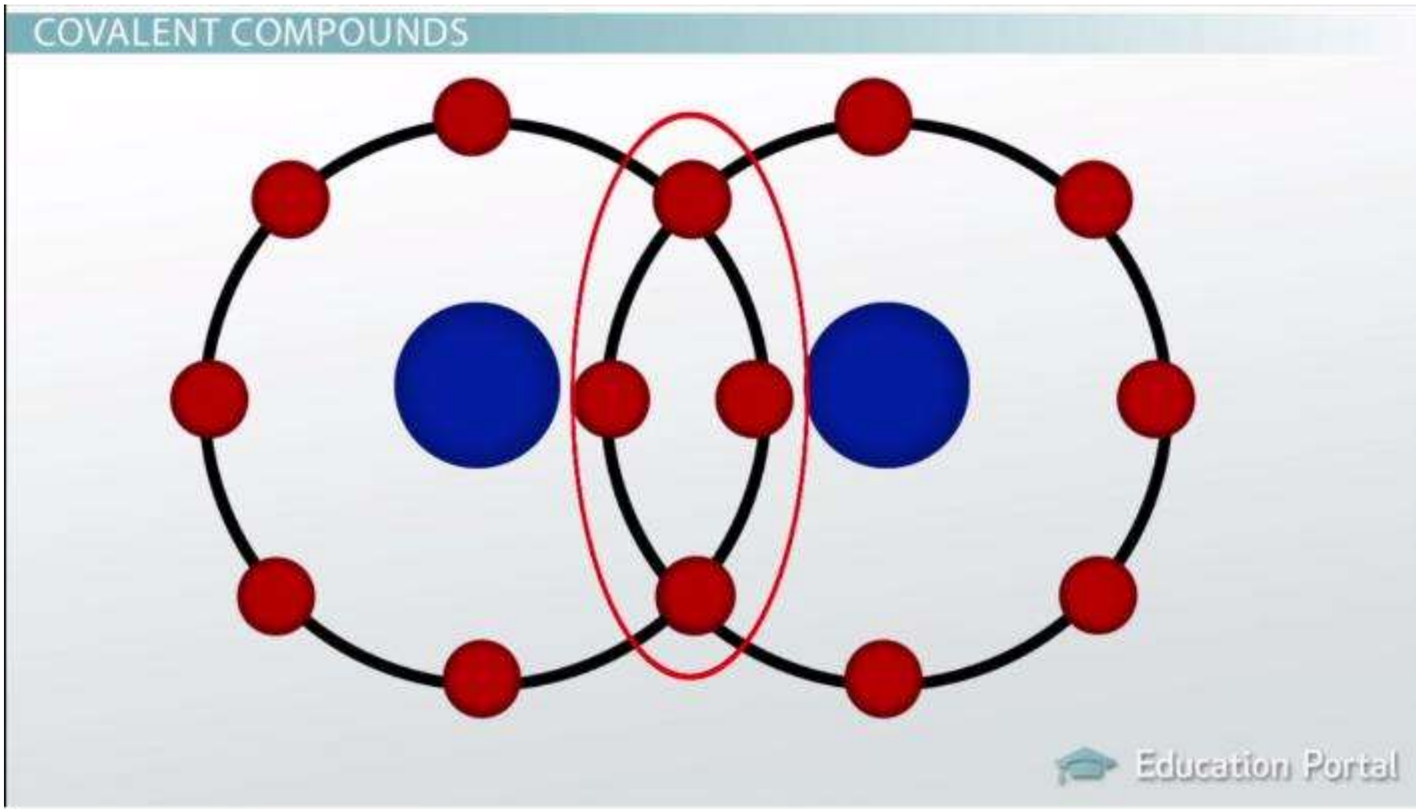
- Strong covalent bonds are formed when each atom has atleast one-half filled orbital. In one-half filled orbital, there will be a substantial lowering in the electrons energy when each of the bonding electrons occupies the orbitals of two atoms simultaneously.

- The lowering of electrons energy is proportional to the degree of overlap of the bonding orbitals.

- The more the overlap, the stronger the bond, either the electronic repulsion or the Pauli exclusion principle controls the overlap.

  Ex: Hydrogen




COVALENT COMPOUNDS
Education Portal

- Hydrogen has a single electron which occupies the 1S orbital in the ground state.

- The orbital is half-filled and the Pauli principle allows it to accommodate one more electron with the opposite spin.

- When two hydrogen atoms are brought close, their electron charge distribution by having the two electrons with opposite spins in the 1S orbital belonging to both the atoms.

- Unlike the ionic bond, the covalent bond is strongly directional since the bonding electron-pair is concentrated along the line joining the two atoms under consideration.

- Consider the number of bonds that an atom can form when present in the crystal.

- This number is determined by the number of unpaired electrons associated with the atom. The later, number is determined by 8-N rule, N – Number of column in the periodic table containing the atom.

- Example:

  Flourine – one bond

  Oxygen – two bonds

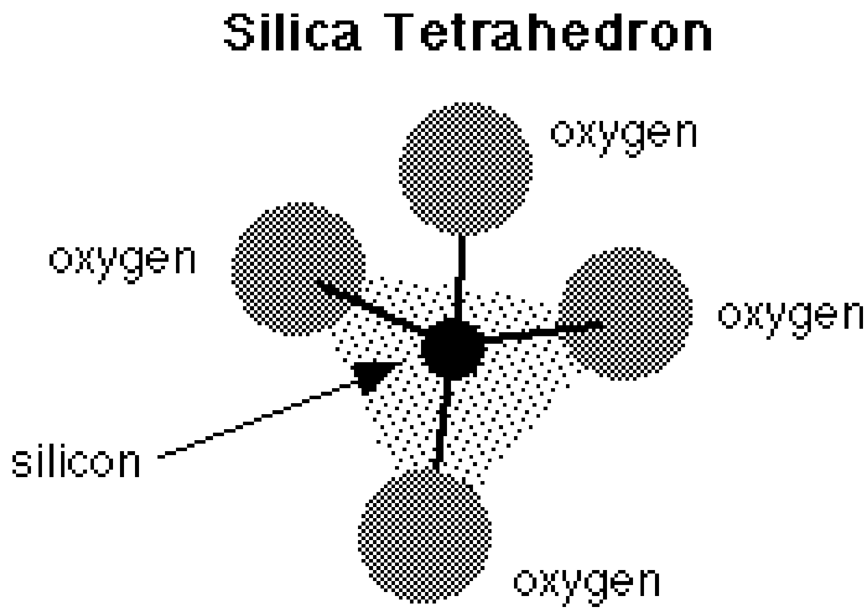
  Nitrogrn – Three bonds

- In case of carbon, according to 8-N rule, it can form four covalent bonds, even though there are only two unpaired electrons in the ground state on carbon ($1S^2$ $2S^2$ $2P^2$)

- To resolve this difficulty, the energies of the $2S^-$ and $2P^-$ states are considered. The energy difference between these states is very small, so that a carbon atom can distribute its electron as follows:

- This is one of the 2S electrons is considered excited to a 2p state.

- Now we have four unpaired electrons in the so called SP3 hybrid state.
- The four orbitals of the SP3 hybrid are elliptical and one are directed towards the four corners of a tetrahedron.


Silica Tetrahedron
oxygen
oxygen
oxygen
silicon
oxygen

Characteristics

- Covalent crystals are very strongly bound.
- The binding energy of carbon in diamond is 7.4 eV.
- It are hard, brittle materials with high melting and boiling points.
- It are insulators at ordinary temperatures.
- They are transparent to long wavelength radiation but opaque to shorter wavelength.
- Example: Si , Ge,.

Thank you