HYBRIDIZATION IN CARBON ATOM

Carbon with an electronic configuration of $1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$ has two unpaired electron. But is shows a covalency of four instead of two. To account for its tetra-valence, it is proposed that the ground state carbon first absorbs energy to become excited before bonding takes place. The energy absorbed is used to promote a 2s-electron into the vacant 2p-orbital. An excited carbon atom thus has the electronic configuration of $1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$. The 2s-orbital is spherical and of lower energy than 2p-orbitals, which are at right angles to one another. The shape of tetrahedral structure of methane, tetrachloromethane, etc., is accounted for by assuming that before the overlap of the orbitals of the orbitals of the excited carbon atom by four hydrogen or four chlorine atoms to form methane or tetrachloromethane, there is rearrangement of the unpaired orbitals. The rearrangement of the unpaired orbitals involves equalization in energy of the four unpaired orbitals and their spreading out. This is termed *hybridization*.

Hybridization is the mixing of two or more orbitals of the same principal quantum number to give new sets of orbitals, which are exactly equivalent. The new orbitals are known as hybrid orbitals. Hybridization can be sp^3, sp^2, or sp.

sp^3 hybridization. When one s-orbital hybridize with three p-orbitals of an excited carbon atom, sp^3 hybridization is formed. After spreading out, the unpaired orbitals are aligned at 109^o away from each other. They point to the corners of a regular tetrahedron with carbon atom at the centre of the tetrahedron. The overlap of each hybrid orbital with the orbitals of hydrogen atom or chlorine atom

results in a methane and tetrachloromethane, which are tetrahedral in shape.

sp^2 hybridization. When only 2 of the 3 unpaired p-orbitals in an excited carbon atom hybridize with the unpaired 2s-orbitals, sp^2 hybridization is said to have taken place. It results in three hybrid orbitals directed 120^o away from each other on the same plane. The third p-orbital which does not take part in the hybridization remains at right angle to the plane of the hybrid orbitals.

sp hybridization. A triple bond is formed when only one unpaired p-orbital and $2s^1$ orbital of an excited carbon atom hybridize. This is termed sp hybridization. The two hybrid orbitals spread out fully, so that one is 180^o away from the other. The two unhybridized p-orbitals remain at right angles with the hybrid one.