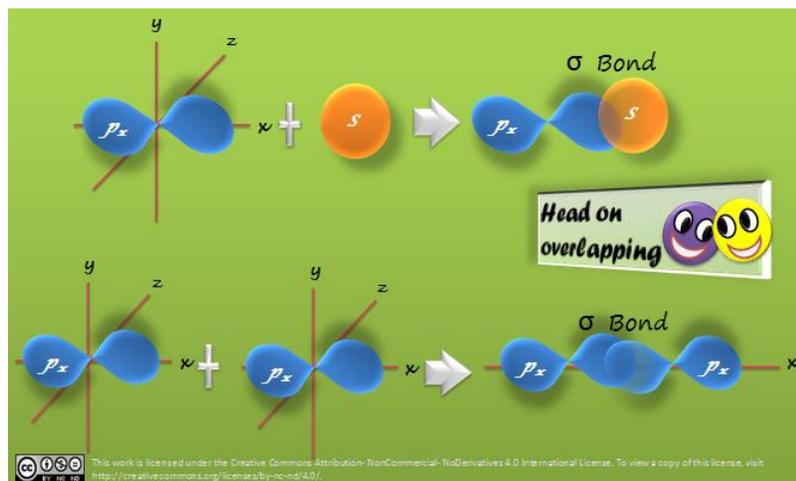


HYBRIDIZATION: IN MOLECULES CONTAINING DOUBLE AND TRIPLE BOND.

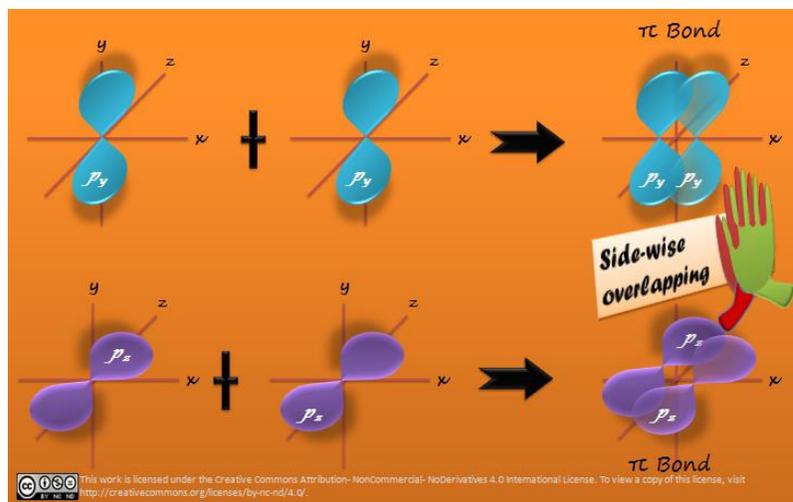
We have discussed hybridization in the molecules which have single bonds, in this post we will see how double and triple bonds are formed and how do they affect the hybridization. Hybridization is a phenomenon which is extensively used in the study of Carbon compounds. When I start my posts on organic chemistry, we will discuss different Carbon compounds and to understand their behaviour you will need to know which type of hybridization they undergo. That's why I have created this post to give you just an idea about the role of hybridization in Carbon compounds and here we will learn hybridization through the example of H-CO-H molecule.

Try to draw H-CO-H molecule's Lewis dot structure and Kekule's structure. In this molecule C forms single bond with each H and double bond with the O atom. I have told you that double bond is formed by two covalent bonds and denoted as two parallel dashes. But these two bonds are not identical because they are formed by different procedures. Let's see how they are formed.

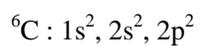
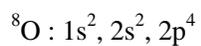


In the previous post you have learnt that a bond is formed by overlapping of orbitals. If I ask you to demonstrate this procedure with your hand how will you connect your hands? Some of you may try to connect your hands by touching the tips of your fingers and some of you may try to connect them side-wise, your palms facing each other.

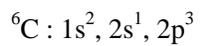
Bonding orbitals also have two ways to overlap with each other. When orbitals form a bond by head on overlapping, they form a sigma (σ) bond, it is also called the single bond. When orbitals form a bond by side-wise overlapping they form a pi (π) bond. A double bond is formed by one sigma and one pi bond.

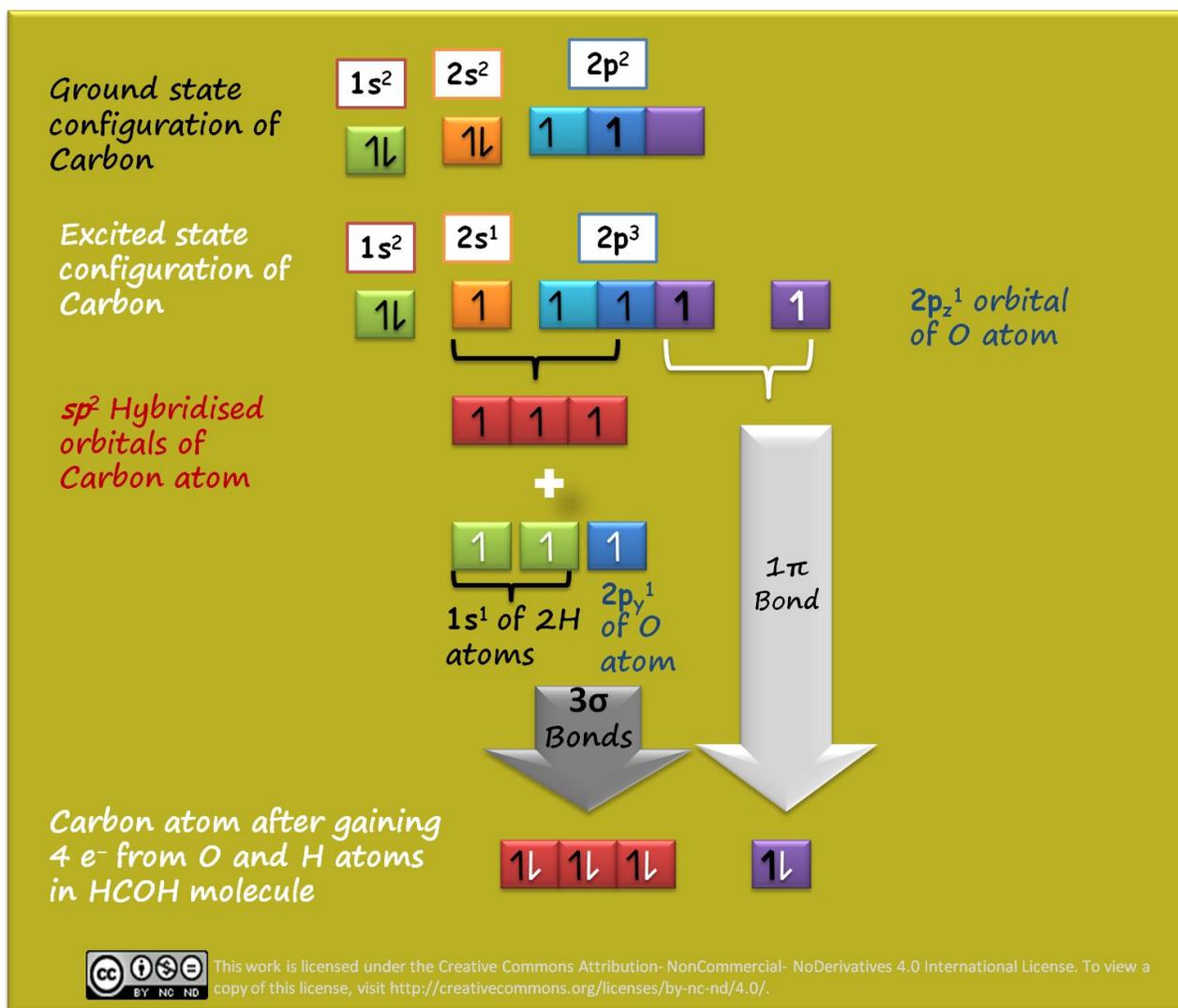


Let's see how H-CO-H molecule is formed. Write the electronic configuration of H, O and C.



C needs four unpaired electrons to make bonds with H and O. So it promotes its one of the paired electrons of s orbital to the empty p orbital. Now its excited state configuration will become:



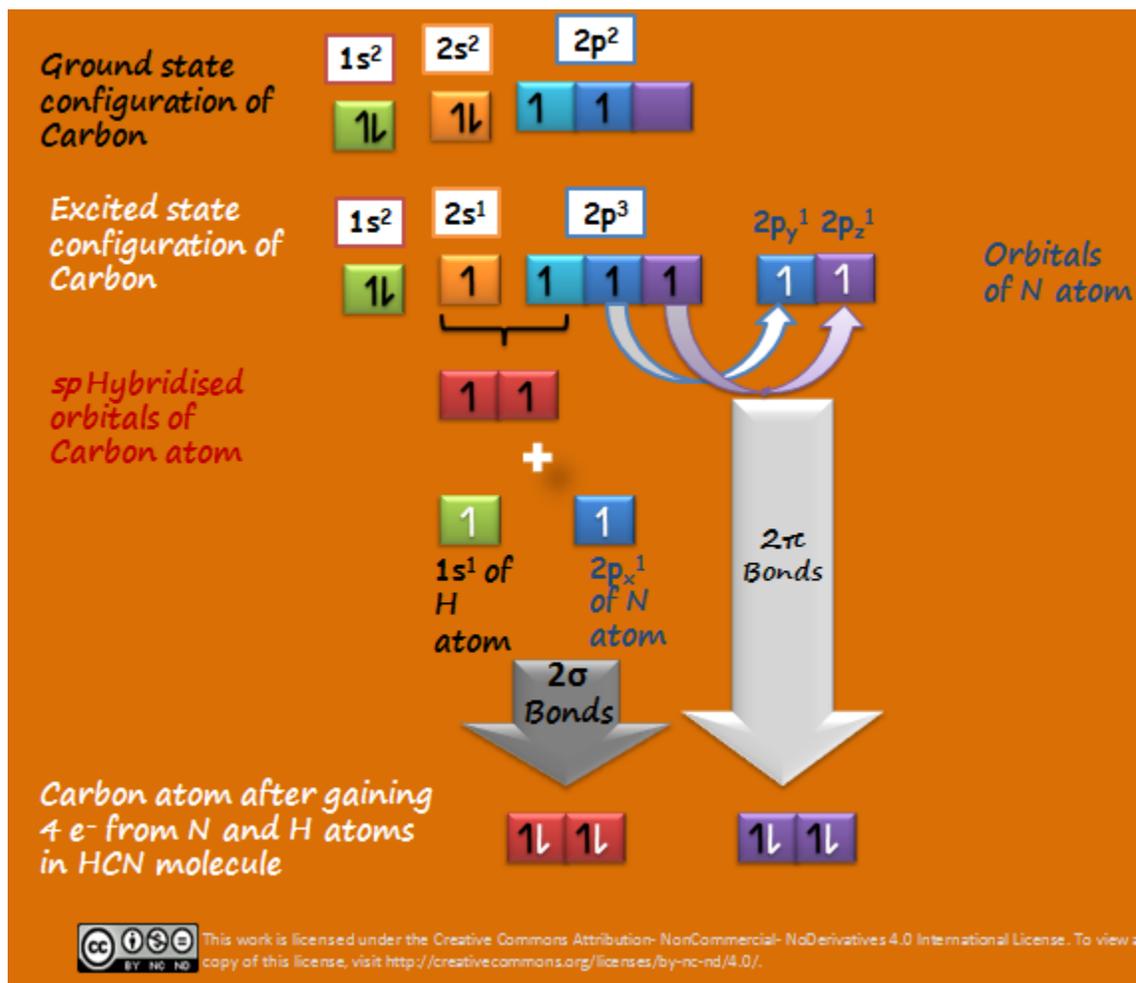


In H-CO-H molecule C forms 2 sigma bonds with H atoms and 1 sigma bond and 1 pi bond with O atom. If C chooses sp^3 hybridization then all four hybridised orbitals will be pointed towards the corners of a tetrahedron. Two of them can make head on overlapping to form sigma/single bond with two H atoms. Remaining 2 will be used for bonding with O. C has to make one sigma bond and one pi bond with O. It can manage one head on overlapping but it is impossible to do side-wise overlapping in this spatial condition.

That's why C plans a different way, it chooses one s and two p (p_x and p_y) orbitals and hybridise them to get three sp^2 hybridised orbitals. These three orbitals are arranged in a triangular shape. This way C has the remaining unhybridised p_z orbital perpendicular to the triangle and now it is available for the side-wise overlapping. That's how in H-CO-H molecule C manages to form three sigma bonds by using three sp^2 hybridised orbitals and forms one pi bond by using unhybridised p_z orbital.

Now take another example of HCN molecule. In this molecule C forms triple bond with N and single bond with H atom. Triple bond is formed by 1 sigma and 2 pi bonds. Let's see how smartly C uses hybridization to form 2 pi and 2 sigma bonds.

C has 4 unpaired electrons in excited state. It uses only two orbitals for hybridization to form 2 sigma bonds and leaves 2 orbitals free for sidewise overlapping to form 2 pi bonds.



C chooses s and p_x orbital and hybridise them to get two sp hybridised orbital. One sp hybridised orbital forms sigma bond through head on overlapping with s orbital of H and other sp hybridised orbital forms sigma bond through head on overlapping with p_x orbital of N. Now C has 2 unhybridised orbital p_y and p_z , it uses them for sidewise overlapping with p_y and p_z orbitals of N respectively to form 2 pi bonds.

In the next post we will see how lone pairs affect the hybridization.

Source : <http://chemistrynotmystery.blogspot.in/2014/08/hybridization-in-molecules-containing.html>