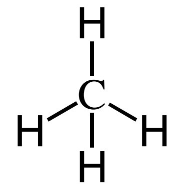
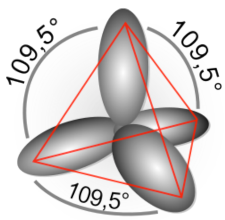
Hybridization

Hybridization is a way to explain why the geometries that are measured experimentally are possible. In dealing with a molecule like methane we have assumed that there are 4 orbitals that are all the same.

When measured in the lab all the bonds in CH_4 are the same yet, carbon doesn't have four equivalent atomic orbitals. We need a different way to look at orbitals when an atom is in a molecule that is essentially what hybridization is.

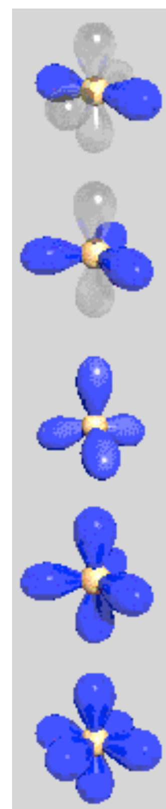




For methane we envision the 2s orbital and the three 2p orbitals as combining together to form four new sp3 orbitals.

Determining Hybridization

Determining the hybridization of an atom in a molecule is as simple as counting the number of "effective" electron pairs on the atom.



When there are two effective electron on the central atom it will have sp hybridization.

When there are three effective electron pairs on the central atom it will have sp2 hybridization.

When there are four effective electron pairs on the central atom it will have sp3 hybridization.

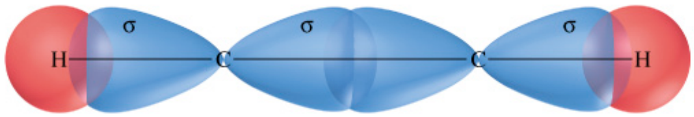
When there are five effective electron pairs on the central atom it will have dsp3 hybridization.

When there are six effective electron pairs on the central atom it will have d2sp3 hybridization.

Ex:

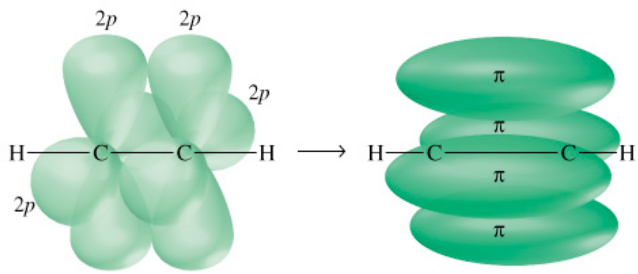
Sigma and Pi Bonding

Our counting "effective" electron pairs is important because the way the first bond between two atoms forms and the way the second and third bonds form are very different. A sigma (σ) bond is formed when orbitals overlap along the axis that connects the two nuclei.



(a) The σ-bond framework

A pi(π) bond is formed when orbitals overlap on axes that are parallel to the on connecting the nuclei.



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