Answer on Question #53713 – Chemistry – Inorganic Chemistry

Question:

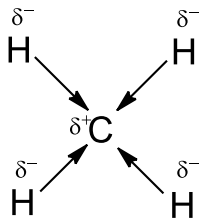
Explain dipole moment and its order by taking a example of particular group.

Answer:

Dipole moment is a characteristic of compound or functional group that defines the separation and direction of two oppositely charged atoms or group of atoms. The value of dipole moment is calculated by multiplying separated charges and distance between them: $\mu = q \times d$. Dipole moment is a vector that is directed from negative charge to positive one.

Dipole moment only exists if two bound atoms have different electronegativities. However, for entire molecule the sum of all dipole moments can equal zero, therefore it becomes non-polar with polar bonds. For instance:

CH_4, $\mu = 0$ (due to the geometry of molecule the sum of C-H dipole moments is zero)



$\mu = 0$ (total dipole moment)

For alkyl halogenides the magnitude of dipole moment depends on halogen and it increases in order of increasing electronegativity of element and bond distance C-Hal:

CH_3I, $\mu = 1.62$ D, electronegativity of I is of 2.66

CH_3Br, $\mu = 1.81$ D, electronegativity of Br is of 2.96

CH_3Cl, $\mu = 1.87$ D, electronegativity of Cl is of 3.16

CH_3F, $\mu = 1.85$ D, electronegativity of F is of 3.98 (the smaller value is explained by short C-F distance being of 138.5 pm, while C-Cl, C-Br, C-I distances are of 178.4, 192.9, 213.9 pm, respectively).

Also dipole moment for hydrides of 16th group of elements decreases down the group (in order of decreasing electronegativity of X):

X = Oxygen, $\mu = 1.85$ D

X = S, $\mu = 1.10$ D

X = Se, $\mu = 0.4$ D

X = Te, $\mu = 0.2$ D