

Organometallic compounds.

These are the compounds in which a metal atom or a metalloid (*Ge, Sb*) or a non-metal atom like *B, Si, P*, etc, (less electronegative than *C*) is directly linked to a carbon atom of a hydrocarbon radical or molecule. Organometallic compounds contain at least one..

(1) Metal – Carbon bond, (2) Metalloid – Carbon bond, (3) Non metal – Carbon bond.

Example :

Compounds : C_2H_5MgBr , $(C_2H_5)_2Zn$, $C_6H_5Ti(OC_3H_7)_3$, $(CH_3)_4Si$

Organometallic bond : $Mg - C$, $Zn - C$, $Ti - C$, $Si - C$

Note: $B(OCH_3)_3$, $(C_3H_7O)_4 Ti$ cannot be regarded as organometallics as there is not metal carbon bond.

Classification of organometallic compounds : Organometallics have been classified as :

(1) **σ -bonded organometallic compounds :** Compounds such as $RMgX$, R_2Zn , R_3Pb , R_3Al , R_4Sn etc, contains $M - C \sigma$ - bond and are called σ - bonded organometallic compound.

(2) **π -bonded organometallic compounds :** The transition metals binds to unsaturated hydrocarbons and their derivatives using their d-orbitals. Here metal atom is bonded to ligands in such a way that donations of electrons and back acceptance by the ligand is feasible. These are called π - orbitals of the ligand. These are called π complexes.

Examples :

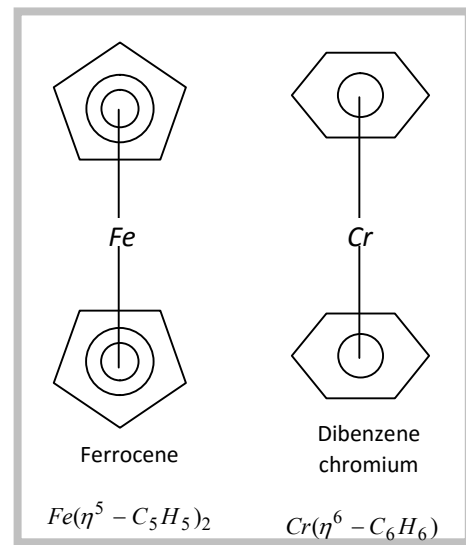
(i) **π - cyclopentadienyl - iron complex**

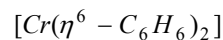
Ferrocene [$Fe(\eta^5 - CH_5)_2$], Bis (cyclopentadienyl) iron (II)

It is a π bonded sandwich compound. The number of carbon atoms bonded to the metal ion is indicated by superscript on eta (η^x) i.e. η^5 in this complex.

(ii) **Dibenzene chromium (π - complex)**

It is also a π - bonded sandwich compound. Its formula is





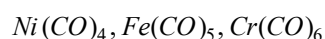
(iii) **Alkene complex (π – complex)**

Zeise's salt $K_2PtCl_6(\eta^2 - C_2H_4)$; Potassium trichloroethylene platinate (IV).

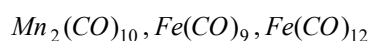
It is a π bonded complex. μ^2 indicates that two carbons of ethylene are bonded to metals.

(3) **Complexes containing both σ - and π - bonding characteristics**: Metal carbonyls, compounds formed between metal and carbon monoxide belong to this class. Metal carbonyls have been included in organometallics.

(a) **Mononuclear carbonyls**: Contain one metallic atom per molecule. e.g.



(b) **Polynuclear carbonyls**: Contain two or more metallic atoms per molecule. e.g.,



Applications of organometallics

(1) Grignard reagent ($RMgX$) has been extensively used for synthesis of various organic compounds.

(2) Wilkinson's catalyst $[(PH_3)_3 RhCl]$ i.e. tris (triphenylphosphine) chlororhodium (I) is used as a homogeneous catalyst for the hydrogenation of alkenes.

(3) Ziegler Natta catalyst (composed of a transition metal salt, generally $TiCl_4$ and trialkylaluminium) are used as heterogeneous catalysts in the polymerisation of alkenes.