Engineering Chemistry (KAS-102)

Lecture No - 17

UNIT - II

(General methods of synthesis of organometallic compounds)

Organometallic Compounds - organometallic chemistry is the study of chemical compounds containing bonds between carbon and a metal.

- In organometallic compounds, C-atoms are linked with metal atoms, such as K, Na, Li, Ca, Mg, Al, Zn, Cd, Ag etc.

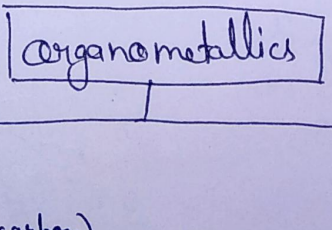
eg. CH_3-Li (methyl lithium)

$(C_2H_5)_2-Zn$ (diethylzinc)

$R-Mg-X$ (grignard reagent)

- **Classification -**

(1) On the basis of types of groups attached to the metal atom -



Alkyl / aryl (aromatic hydrocarbon) gps are attached to the metal atoms.

eg. CH_3-Li, $(C_2H_5)_2-Zn$

Groups other than alkyl/aryl are also attached directly to the metal atom

eg. $CH_3-Mg-Br$

$C_2H_5-Mg-Br$

(2). On the basis of Carbon-Metal bond :-

organometallics

Ionic organometallics

Contains negatively charged hydrocarbon part & positively charged metal ions, held together by electrostatic force of attraction

$K^+C_5H_5^-$, $Na^+C_6H_5^-$

eg. $C_{10}H_8-Na$ (Sod. naphthalene)

(σ-bonded) covalent (σ-bonded) organometallics

Formed by non-transition metals with σ-covalent bond

eg. $Al(C_2H_5)_3$

$(CH_3)_2Cd$

$(C_2H_5)_2Zn$

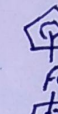
$(C_2H_5)_4Si$

Non classical bonded π-bonded organometallics

Formed by transition metals (partially filled d-subshell)

eg. $(CH_3)_4-Ti$ (sp³ 3-12)

Ferrocene



dimeric trialkyl aluminium

$Al_2(C_2H_5)_6$

General methods of synthesis :-

(i). Organomagnesium Compound / Grignard Reagent :-

These are prepared by reaction of Mg metal with alkyl halide in presence of dry ether.

$$Mg + R-X \xrightarrow{\text{dry ether}} R-Mg-X$$

$$Mg + C_2H_5-Br \xrightarrow{\text{dry ether}} C_2H_5-Mg-Br$$

(ethyl mag. bromide)
(or grignard reagent)

(ii). ~~Diethyl~~ Dialkyl Zinc :-

It is prepared by heating Zn with boiling alkyl halide in an inert atmosphere.

$$2C_2H_5Br + 2Zn \xrightarrow{\Delta} (C_2H_5)_2Zn + ZnBr_2$$

(diethyl zinc)

(iii) Tetraalkyl organometallic -

By treating metal halide with organometallic reagent.

$$C_4H_9-Br + 2Li \longrightarrow C_4H_9Li + LiBr$$

$$4\,C_4H_9-Li + SnCl_4 \longrightarrow (C_4H_9)_4Sn + 4LiCl$$

(tetrabutyl tin)

(iv). Alkyl aluminium -

Reaction of aluminium halide with grignard reagent

$$AlCl_3 + 3\,CH_3-Mg-Br \longrightarrow (CH_3)_3-Al + 3\,MgBrCl$$

(trimethyl aluminium)

(v). Hydrocarbon metal complexes -

Can be prepared by reacting the vapours of the metal with the hydrocarbon directly.

$$2C_6H_6 + Cr \longrightarrow [Cr(C_6H_6)_2]$$

(dibenzene chromium)

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(Applications of Grignard Reagent)

Grignard Reagent - It is organomagnesium compound, & can be synthesized as follows -

$$Mg + RX \xrightarrow{\text{dry ether}} R\text{-}Mg\text{-}X$$

Applications -