Quadrant II – Transcript

Programme: Bachelor of Science (T. Y. B. Sc.)
Subject: Chemistry
Paper Code: CHC 109
Paper Title: Inorganic Chemistry - Section A
Unit: 1 – Organometallic Chemistry
Module Name: Classification of Organometallic compounds- Part B
Module No: 03
Name of the Presenter: Ms. Janesline Fernandes

Welcome students to this session in Inorganic chemistry,

The Course code is CHC109.

The topic of discussion is Organometallic chemistry and the module name is Classification of Organometallic Compounds -Part B.

I am Miss Janesline Fernandes, Associate Professor, Saint Xavier's College, Mapusa.

The outline of the study:
Describe metal carbonyls, Classification of metal carbonyls based on structure and number of metal atoms, Mononuclear carbonyls and polynuclear carbonyls, Non- bridged carbonyls. and bridged carbonyls.

At the end of this module, students will be able to;
Describe the metal carbonyls, Learn to classify Metal carbonyls,
Differentiate between different types of Metal carbonyls.

Metal carbonyls are organometallic complexes in which the transition metal atom is linked with carbon atom of the carbonyl molecules. as seen carbonyl group is linked to a metal .
The metal and carbon bond has Sigma as well as Pi character in metal carbonyls.
The transition metal is in zero, low positive or negative oxidation state.
Example; Nickel Tetracarbonyl, Octacarbonyl dicobalt, Ennea carbonyl di iron.

Classification of metal carbonyls is based on number of metal atoms present in carbonyls.
These are further classified as mononuclear carbonyls and polynuclear carbonyls.
When classification is based on structure of carbonyls, we get non bridged carbonyls and bridged carbonyls.

Non-bridged carbonyls are further classified as non-bridged carbonyls containing only terminal carbonyl group, and non bridged carbonyls containing terminal carbonyl group and metal-metal bonds.

First we shall see classification based on the number of metallic atoms present in carbonyls.

This gives following two types of carbonyls, mononuclear or monomeric carbonyls.

This carbonyl molecules contain only one metallic atom.

Example. Nickel Tetra carbonyl.

MCO_5 where M could be iron, ruthenium , osmium and MCO_6 where M could be Vanadium , chromium, molybdenum or tungsten.

Polynuclear metal carbonyls:

This carbonyls contain two or more metallic atoms. Example CO_2CO_8, $Fe_2(CO)_9$, $M_2(CO)_{10}$

where M can be Manganese, Technetium, Rhenium. And M_3CO_{12} where M can be Iron, Radon, Osmium.

Polynuclear carbonyls are further classified as homonuclear carbonyls having same metal atom Examples. $Co_2(CO)_8$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ in which the metal atom is the same.

Heteronuclear carbonyls; having different metal atoms. Example $MnCo(CO)_9$, $MnRe(CO)_{10}$

Here we see the carbonyls have different metal atoms.

Next classification based on the Structure of Carbonyls;

This classification gives the following types of carbonyls.

Non-bridged carbonyls: This carbonyls do not contain any bridging ketonic carbonyl group and further classified into following types.

First Non-bridged carbonyls which contain only terminal carbonyl group as shown in Figure 1.

Nickel tetra carbonyl, Iron hexacarbonyl, Chromium hexacarbonyl and penta carbonyl osmium

Figure One shows non- bridged structure of $Cr(CO)_6$ which has 6 terminal CO groups.

Non-bridged carbonyls which contain terminal carbonyl groups as well as metal-metal bonds as shown in Figure 2. The examples include CO_2C0_8 in solution, $Mn_2(CO)_{10}$, $Tc_2(CO)_{10}$, $Re_2(CO)_{10}$ and $Os_3(CO)_{12}$

Figure 2 shows a Non- bridged structure of CO_2CO_8 molecule in solution containing eight terminal Carbonyl groups and one Co-Co bond.

Bridge carbonyls: this carbonyls contain bridging carbonyl groups along with terminal carbonyl groups and one or more metal-metal bonds.

As shown in Figure 3.The examples include $Fe_2(CO)_9$, $Os_2(CO)_9$, $Fe_3(CO)_{12}$ and $Co_2(CO)_8$ (in solid state).

The figure 3 shows the bridge structure of Ennea carbonyl di iron molecule, containing three bridging Carbonyl groups, 6 Terminal Carbonyl groups, an one Fe- Fe bond.

Mononuclear carbonyls always have a non- bridged structure, while polynuclear carbonyls may have a Non-bridged structure.

As shown in figure, for example. $Co_2(CO)_8$ (in solution), $Mn_2(CO)_{10}$

Polynuclear carbonyls may also have abridged structure. Figure 5: Example $Co_2(CO)_8$ (in solid state), $Fe_2(CO)_9$, $Fe_3(CO)_{12}$

Figure 4 shows the non-bridged structure of polynuclear $CO_2(CO_8)$ in solution form.
And Figure 5 shows the bridged structure of polynuclear $CO_2(CO)_8$ in solid state.

Important carbonyls formed by transition metals; like Vandium, chromium, manganese, iron, cobalt and nickel are shown in the following table.

The references for the topic are listed in this slide.

Thank you.