

Atomic Energy Central School, Indore

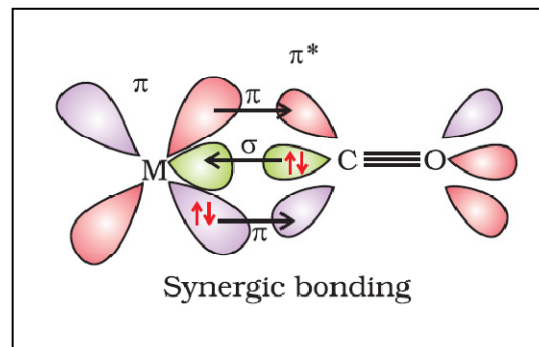
Class XII Chemistry CO-ORDINATION COMPOUNDS

Handout 6/6

Bonding in Metal Carbonyls

The homoleptic carbonyls (compounds containing carbonyl ligands only) are formed by most of the transition metals.

The metal-carbon bond in metal carbonyls possess both s and p character. The M–C σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal. The M–C π bond is formed by the donation of a pair of electrons from a filled d orbital of metal into the vacant antibonding π^* orbital of carbon monoxide. The metal to ligand bonding creates a synergic effect which strengthens the bond between CO and the metal.



Stability of Coordination Compounds

The stability of a complex in solution refers to the degree of association between the two species involved in the state of equilibrium.

A reaction of the type: $M + 4L \rightleftharpoons ML_4$, the larger the **stability constant β** , the higher the proportion of ML_4 that exists in solution. The instability constant or the dissociation constant of coordination compounds is defined as the reciprocal of the formation constant/stability constant β .

Importance and Applications of Coordination Compounds

- Coordination compounds find use in many qualitative and quantitative chemical analysis. Examples of such reagents include EDTA, DMG(dimethylglyoxime), α -nitroso- β -naphthol, cupron, etc.
- Hardness of water is estimated by simple titration with Na_2EDTA . The Ca^{2+} and Mg^{2+} ions form stable complexes with EDTA.
- Some important extraction processes of metals, like those of silver and gold, make use of complex formation. Gold, for example, combines with cyanide to form the coordination entity $[Au(CN)_2]^-$ in aqueous solution. Gold can be separated in metallic form from this solution by the addition of zinc.
- Purification of metals can be achieved through formation and subsequent decomposition of their coordination compounds. For example, impure nickel is converted to $[Ni(CO)_4]$, which is decomposed to yield pure nickel.
- Coordination compounds are of great importance in biological systems. Ex. chlorophyll, is a coordination compound of magnesium, used in photosynthesis. Haemoglobin, is a coordination compound of iron. Vitamin B_{12} , cyanocobalamine, is a coordination compound of cobalt.
- The enzymes like, carboxypeptidase A and carbonic anhydrase (catalysts of biological systems).
- Coordination compounds are used as catalysts for many industrial processes. Examples include rhodium complex, $[(Ph_3P)_3RhCl]$, a Wilkinson catalyst, is used for the hydrogenation of alkenes.
- Articles can be electroplated with silver and gold much more smoothly and evenly from solutions of the complexes, $[Ag(CN)_2]^-$ and $[Au(CN)_2]^-$ than from a solution of simple metal ions.
- In black and white photography, the developed film is fixed by washing with hypo solution which dissolves the undecomposed $AgBr$ to form a complex ion, $[Ag(S_2O_3)_2]^{3-}$.
- Excess of copper and iron are removed by the chelating ligands D-penicillamine and desferrioxime B via the formation of coordination compounds.
- EDTA is used in the treatment of lead poisoning.
- *cis*-platin $[Pt(NH_3)_2Cl_2]$ effectively inhibit the growth of cancer tumors.

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