**TDC Part II**

**Paper I, Group B**

**Inorganic Chemistry**



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**TOPIC:-UNIT -3,Introduction &General characteristics,**

## Formation of Coloured Ions / Compounds.

## Catalytic Activity

## Formation of Interstitial and Non-stoichiometric compounds.

## Metallic character and Alloy Formation.

**General characteristics**

## Formation of Coloured Ions / Compounds.

The elements of the second transition series also form coloured ions / compounds / complexes whether in solid or in solution state, due to usual reasons as have been given for those of first transition series as well as for general d-block elements. The cations having vacant or completely filled d-orbitals (d0 or d10) are colourless in the case of this series also. But, those with partly filled d-orbitals (d1, d2, d3 d9) are

coloured. It means the cations having all the electrons paired in d-orbitals or no electrons in this subshell are colourless but those cations / compounds having unpaired (some or all) in d-orbitals are coloured. If n is the number of unpaired electrons in d-subshell, then the ions having n = 0 are colourless while those having n

= 1, 2,….,5 are coloured. In addition to the presence of unpaired electrons in d- subshell or incomplete d-subshell, the nature of atoms (in the compounds) or ligands (in the complexes) attached to central metal ion determines the colour of the compounds as a whole.

As has been explained earlier, the colour in the substances is developed due to the movement of electrons from one d-orbital to another under the influence of visible light falling on the substance. The colour is intense if the transition is allowed but becomes dull if it is forbidden. If in place of inter orbital transition, inter atomic transitions take place, intense colours are produced because such transitions are not affected by the selection rules (*viz.* spin, Laporte and symmetry selection rules) thereby allowing free transition of electrons.

## Catalytic Activity

Like the elements of first transition series, those of second transition series also show catalytic activity, some of them being very important and useful as catalysts in a variety of reactions of industrial importance. This is because these are capable of forming inter mediate products with the reactants or have active centres on their

surface in the activated state which can activate the reactants for the desired reactions. For example,

* + - 1. Pd is used in the hydrogenation of phenol to cyclohexanol.
      2. Pd/Pt catalyses the hydrogenation of unsaturated hydrocarbons.
      3. Mo is used as a promoter in the manufacture of ammonia by Haber process.
      4. Pt/Rh is used as catalyst in the oxidation of NH3 to NO (manufacture of HNO3).

## Formation of Interstitial and Non-stoichiometric compounds.

The metals of second transition series, in general, form interstitial compounds with small non-metallic elements such as H, N, C etc. The lattice of these metals is capable of accommodating these small atoms between the metal atoms with no change in the lattice structure. Examples are: PdH0.6, ZrH1.98, ZrC, NbC, MoC, Mo2C, ZrN, NbN, Mo2N etc. These compounds have conductivity properties and are hard, thus behaving as alloys.

These elements also form non-stoichiometric compounds which often exhibit semi conductivity, fluorescence and have centres of colours. Above examples of PdH and ZrH2 also furnish the examples of non-stoichiomestry. Apparently the molecular formula of these compounds does not correspond to M: H ratio of 1:1 and 1:2.

Actually, the M: H ratio in these compounds is 1: 0.6 and 1:1.98, respectively.

## Metallic character and Alloy Formation.

All the elements of second transition series are metals which are hard, some of them malleable and ductile (e.g., Ag), fairly good conductors of heat and electricity. They crystallize in one of the following lattice structures: body centred cubic (bcc), face centredcubic (fcc) or hexa gonal close packed (hcp).

The elements of this series also form alloys though to the lesser extent than the elements of first transition series due to the obvious reasons as given earlier. These alloys are also usually harder and have higher melting points than parent metals. They are also corrosion proof/resistant.

These metals are less important than those of the first and third transition series.