j) Catalytic properties

i) The catalytic activity of transition element is due to their ability to adopt multiple oxidation states and to form complexes.

Ex: → Iron (III) catalyses the reaction between iodide and persulphate ions.

$$2I^- + S_2O_8^{2-} \longrightarrow I_2 + 2SO_4^{2-}$$

$$2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$$

$$2Fe^{2+} + S_2O_8^{2-} \longrightarrow 2Fe^{3+} + 2SO_4^{2-}$$

→ V_2O_5 acts as a catalyst in conversion of SO_2 to SO_3.

$$SO_2 + V_2O_5 \longrightarrow SO_3 + V_2O_4$$

V (V) — Catalyst. V (IV) — Intermediate

$$2V_2O_4 + O_2 \longrightarrow 2V_2O_5$$

(Intermediate) (Catalyst)

ii) Transition element can also provide a large surface area for the reactants to be adsorbed and thus come closer to one another for the reaction to occur readily on the surface of the catalyst itself.

k) Formation of Interstitial Compounds.

Interstitial compounds are those which are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals. Ex: TiC, Mn_4N; Fe_3H etc.

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i) They are usually non-stoichiometric and are neither typically ionic nor covalent.
ii) They have high mp, higher than those of pure metals.
iii) They are very hard, some borides approach diamond in hardness.
iv) They retain metallic conductivity.
v) They are chemically inert.

6) Alloy formation.
i) Alloys are homogeneous solid solutions prepared by mixing the components.
ii) They are hard and have often high mp.
iii) The best known are ferrous alloys; Cr, V, W, Mo, Mn used in steel and stainless steel.
iv) Ex: Brass (Cu-Zn), Bronze (Cu-Sb).

1.4 Some Important Compounds of Transition Elements.

1.4.1. Oxides & Oxoanions of Metals

i) These oxides are generally formed by the reaction of metals with oxygen at high temperatures.
ii) All the metals except Scandium form MO oxides which are ionic.
iii) The highest oxidation states of the metals in these oxides are indicated by their group number. For ex: Sc_2O_3, Sc is in +3 oxidation state (group no: 3); Mn_2O_7, Mn is in +7 or (group no: 7).
iv) Besides the oxides, the oxocations stabalise V^{V} as VO_2^+, V^{IV} as VO^{2+} and Ti^{IV} as TiO^{2+}.

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v) As the oxidation number of metal increases, ionic character decreases.

vi) Mn_2O_7 is a covalent green oil. CrO_3 and V_2O_5 have low melting points. In these higher oxides, the acidic character is predominant.

vii) Thus, Mn_2O_7 gives $HMnO_4$ and CrO_3 gives H_2CrO_4 and $H_2Cr_2O_7$. V_2O_5 is, however, amphoteric though mainly acidic and it gives VO_4^{3-} as well as VO_2^+ salts.

viii) V_2O_3 – ~~less~~ basic, V_2O_4 – less basic, V_2O_5 – amphoteric.

ix) V_2O_4 dissolves in acids to give VO^{2+} salts. V_2O_5 reacts with alkalies as well as acids to give VO_4^{3-} and VO_4^+ respectively.

x) CrO → basic, Cr_2O_3 – amphoteric.