

Quadrant I - Notes

Programme: Bachelor of Science (Third Year)

Subject: Chemistry

Paper Code: CHC - 109

Paper Title: Inorganic chemistry (Section A)

Unit: Organometallic Chemistry

**Module Name: Mononuclear Metal Carbonyl- Ni(CO)₄:
Preparation, Properties, Structure and
Bonding**

Module No: 5

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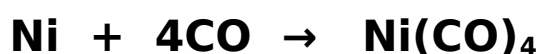
Metal carbonyl are complexes of CO ligand with transition metal in low oxidation state. Depending on the number of metal atoms they can be classified as mononuclear, binuclear or polynuclear carbonyls. The oxidation state of metal is zero, low positive or negative.

Tetracarbonylnickel - Ni(CO)₄

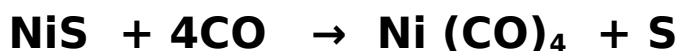
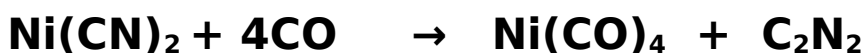
It is the first metallic carbonyls to be discovered and has found application in the metallurgy of nickel by Mond's process.

PREPARATION METHODS

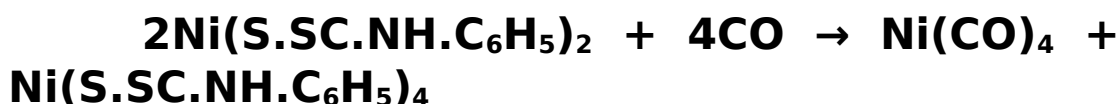
- i) Passing CO over finely divided metallic Ni below 100°C**



- ii) Passing CO through alkaline suspension of Ni(CN)₂ or NiS**



iii) By the action of CO on nickel (II) phenyl dithiocarbamate



PROPERTIES

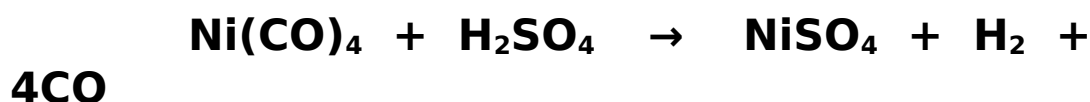
i)

a) Ni(CO)_4 is a colourless liquid boiling at 43°C and solidify at -25°C .

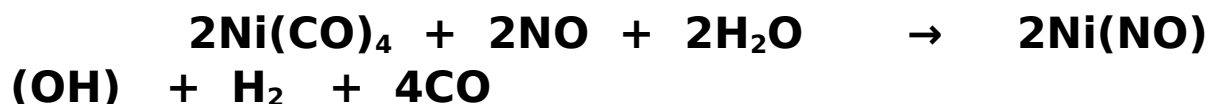
b) It is Miscible with benzene and insoluble in water.

c) No action of dilute acids or alkalies and highly poisonous

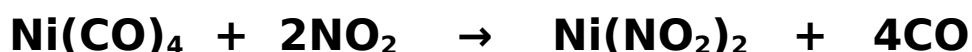
ii) Action of H_2SO_4



iii) Action of NO



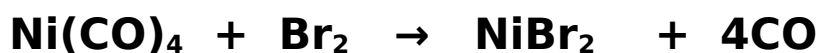
iv) Substitution reactions



v) Action of heat



vi) Oxidation reactions



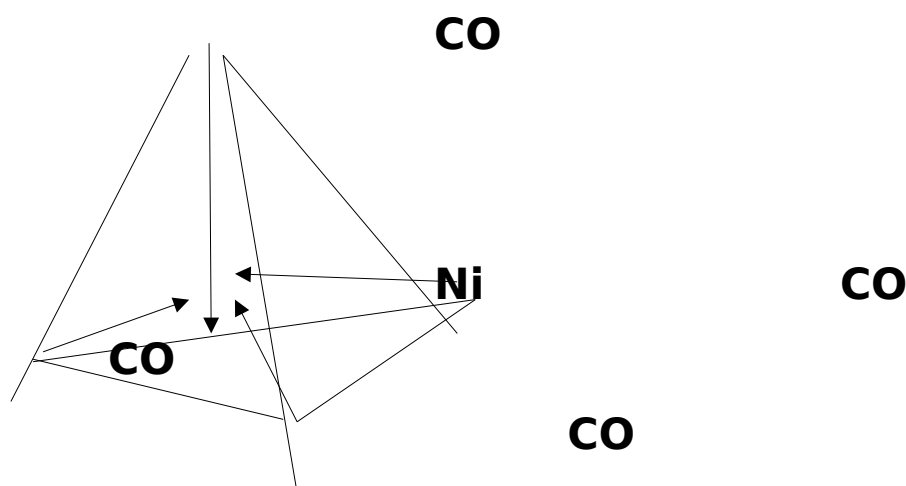
v) Reduction reaction : gets reduced by several reducing agents



Bonding in Ni(CO)₄

Free Ni atom has electronic configuration of 3d⁸ 4s². In this molecule Ni atom is sp³ hybridised. Both the electrons of 4s orbital are shifted to 3d orbitals to vacate 4s orbital. Then 4s and 4p on mixing together give four sp³ hybrid orbitals. The formation of four Ni ← CO σ bonds takes place. Due to sp³ hybridization Ni(CO)₄ has tetrahedral shape.

STRUCTURE OF Ni(CO)₄



Tetrahedral shape of Ni(CO)₄

