SYNTHESIS OF CO(II) METAL COMPLEXES WITH N_4 MACROCYCLIC LIGANDS

[1]Dr. Yogesh Pandey, [2]Akansha Shivhare, [3]Chitranjana Kashyap
[1]Associate Professor, [2]Research Scholar, [3]Research Scholar
Dept of Chemistry,
Bipin Bihari (P.G.) Science College Jhansi (U.P.) INDIA

Abstract : Family of tetra aza macrocylic Co (II) complex ($CoLX_2$) ligands where L = N_4 donor macrocylc ligands) and X = (Cl^-, NO^-_3) have been synthesized. Characterization has been done on the basis of elemental analysis, molar conductance I.R. & XPS data. These analysis shows that the ligands behave as tetra dentate through four N- atoms. The binding energies suggest the square planar geometry for Co (II).

Key WORDS; Tetra aza, macrocyclic ligands, square planar

INTRODUCTION :

Cobalt is the 7th element of 3d transition series. Cobalt shows +2 oxidation state in simple salt & +3 in complex. It is the only metal present in vitamin. Vitamin B_{12}[1-3] contains cobalt as a central metal atom. Complexes of cobalt with macrocylic ligands continue to be actively studied. Although a large no. of macrocylic complex of Cobalt (II) have been reported, only spectra have appeared. Cobalt & its compounds are widely used in analytical chemistry, metallurgical process & pigment industry. The play excellent role in catalytic property.[4]

REVIEW OF LITERATURE

A brief review on this complex forming character is presented.

The coordination chemistry of cobalt (II) ion has been less extensively investigated. Most of the working laid emphasis on the preparation & synthesis of complex of Co (II) macrocyclic ligand.

Kandar *et al*.,[5] reported a new generation of solution of melalloph thalocyanine derivatives.

Rai *et al*.,[6] reported the spectral & electro chemistry studied on some dinuclear cobalt (II) macrocylic complex.

Kang *et al*.,[7] synthesized four new metal complex with octahedral macrocylic ligands.

Chandra *et al*.,[8] reported a novel macrocylic scihff base ligands. The transition metal complex Co (II) with macrocylic ligands were synthesized and characterized by elemental, IR, mass, HNMR studied.

The Cobalt (II) metal ion forms a broad range of complexes.

AIM OF THE STUDY

The aim of the study is to deal with synthesize & characterization of Cobalt (II) complexes with macrocylic ligands (L).

EXPERIMENTAL

Material :

All the solvent used were of E. Merck (LR grade & ranbaxy) solvent were used after purification and drying by conventional methods.

The IR spectra of the complexes and ligands were recorded on perkin elmer 457 spectrometer at room temperature in KBr. X-ray photoelectron spectra were recorded in a VG scientific ESCA – 3 MK-II electron spectrometer.

The elemental analysis for C, H & N, were determined on a semi microscale.

Synthesis of ligands :-

A solution of 3,4 hexandione, 2,3 hexandione or furil (2mmol) was added drop wise with constant string in cyclohexane diamine or 2,3 phenylene diamine (2 mmol) in ethanol (20 ml) solution & refluxed for 5 hrs. A white solid product appeared which was filtered washed with C_2H_5OH & dried under vacuum. The L^- macrocyclic ligands was characterized by elemental analysis and IR spectra.

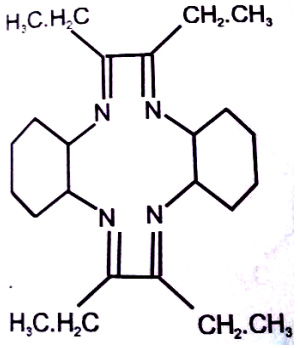

Fig.-1: Ligand = L

Synthesis of complex :-

The complex of the Co (II) with L ligands is done by using Co (II) salts such as [$CoCl_2$. $2H_2O$], Co $(NO_3)_2$ $6H_2O$.

A warm ethanolic suspension (20 ml) of ligands L (1 mmol) & hot ethanolic solution (20 ml) of corresponding Co (II) salts (1 mmol) were mixed together with constant stirring. The mixture was refluxed for 6-8 hrs at 80^0C . on cooling a colored complex was precipitated art. It was filtered, washed with cold ETOH & dried under vacuum over P_4O_{10}

RESULT AND DISCUSSION

On the basis of elemental analysis the complexes were found to have general composition [Co (L) X_2]

X = Cl^-, NO_3^-

Molar conductance :

The molar conductance indicates that the complex with L having composition $CoLX_2$ are non electrolyte in nature and may be formulated as [Co (L) X_2].

Magnetic moment :

The complexes of Co (II) in octahedral field the ground state ($^4T_1$) is orbitally degenerate. The moments would lie between the μ eff= 3.38 BM to 5.2 BM, which account for electron delocalization and a low symmetry ligands field component.

IR spectra :

IR spectra of all ligands and their complexes show that all the ligands behave as tetra dentate[9].

The IT spectra consist of three absorption bonds at 1390, 830 & 720 cm^{-1} justifies that free nitrate ions has relatively high symmetry D_3h.

Electronic spectra

Electronic spectra of present complexes having composition [Co (L) X_2] (X = Cl^-, NO_3^-). They display bonds at 9541 – 10752 cm^{-1}, 18260 – 20634 (V_3) Cm^{-1} along with 142792 – 15267 (V_2) cm^{-1}. [10]

The position of bonds indicate that these complexes have distorted octahedral geometry & posses D_4h symmetry.

Table-1: Molar conductance & Elemental analysis of Co (II) complexes: -

S. No.	Complexes	Elemental analysis for (Calc. %)			Molar conductance Ω^{-1} cm^2 mol^{-1}
		C	H	N	
1.	[Co L Cl_2]	56.4 (56.6)	7.0 (7.0)	11.2 (11.0)	10

2.	[Co L $(NO_3)_2$]	51.0 (51.1)	6.2 (6.3)	14.8 (14.9)	22

Table-2 : Magnetic moment & electronic spectra data of Co (II) complex.

S. No.	Complex	μeff B.M.	$\lambda_{max,\ cm^{-1}}$
1.	[Co L Cl_2]	**5.00**	**10030, 14792, 18260**
2.	[Co L $(NO_3)_2$]	**4.88**	**10550, 15621, 27460**

Table-3: Co 2 $p_{1/2, 3/2}$ binding energies in $CoCl_2.2H_2O$ and their metal complex.

S. No.	Salt & their metal complexes	2 $p_{1/2}$	2 $p_{3/2}$
1.	$Co.Cl_2$. 2 H_2O	795.6	780.6
2.	Co L Cl_2	794.6	779.6
3.	[Co $(NO_3)_2$. 6 H_2o	795.8	780.8
4.	[Co L $(NO_3)_2$]	794.8	779.8

CONCLUSION :

On the basis of elemental analysis, magnetic susceptibility, molar conductance measurement, IR, electron & XPS spectral studies give the below results that these complexes shows the (MLX_2) geometry, where M = Co (II)

X = Cl^-, NO_3^-

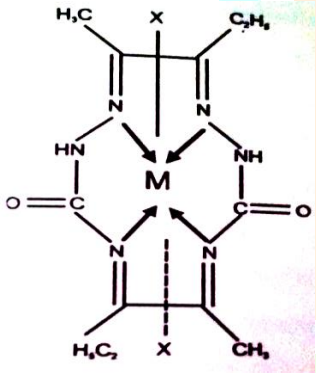

Fig-2: Structure of complex, where,

[M=Co(II)] (X=Cl, NO_3) [Co (L) X_2]

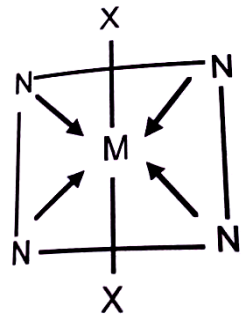

Fig-3: [Mn (L) X_2] square planar geometry

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