



SYNTHESIS OF SOME METAL COMPLEXES AND ITS STRUCTURAL INVESTIGATION

Balbir Singh, Ph. D.

Former HOD, Dept. of Chemistry, SD College Pathankot.

Abstract

Preparation and the structural investigation of some organo metallic compounds using triaryl phosphinetelluride as a ligand.



Scholarly Research Journal's is licensed Based on a work at www.srjis.com

Introduction:--

'The field of coordination chemistry is growing exponentially. Particularly in the last two decades development in bio-organic chemistry has gathered much momentum in the subject. Thus the present topic has been selected.

The complexing nature of organophosphine is due to the lone pair of electrons on the phosphorous atom. But when phosphorous attaches with elements (O, S, Se, Te etc) it becomes pentavalent and it makes double bond with the metal thus making it to act as a donor. Due to this bonding P becomes slightly positive. And will result in the contraction of its 3d-orbitals. The charge cloud is expected to be distorted in favour of metal thus making the metal an excellent donor and a good complexing agent. Survey study shows that various metal complexes of phosphine oxide, sulphide, & selenide have been reported whereas very little efforts have been made to prepare phosphine telluride complexes (1—4). Te is short of two electrons than octet, high electronegativity and small size show it has non-metallic covalent chemistry.

In the present series of investigation Cu II, Ni II, Co II, Cr III and Zn II halides have been chosen as metal ions to form complexes with tri-xylyl phosphine telluride.

Experimental:----IR spectra is recorded on Perkin-Elmer-577 IR spectrometer. (range 200--4000/cm) . Percentage composition of the complex is determined by usual gravimetric & instrumental analyser method. Magnetic moment is measured by Guoy's balance method.

Preparation of ligand:---The recrystallized triphenylphosphine has been dissolved in xylene and to this added calculated amount of tellurium metal. The mixture is refluxed on water bath for 2 to 3 hours. The contents are allowed to cool and filtered. The filtrate is concentrated to give crystals of titled complex which are recrystallized from dry alcohol.

Preparation of complexes:---A ligand is dissolved in minimum quantity of dry alcohol and the salt of metal M (M= CoCl₂, NiCl₂, CuCl₂, CrCl₂ and ZnCl₂) in minimum quantity of water. Both are mixed in equimolar quantity in a round bottomed flask fitted with water condenser. The contents were refluxed for 3 to 4 hours. Contents are then removed stirred well and allowed to stand overnight. Complex is separated out which was recrystallized from dry alcohol.. Crystals are filtered & dried gently in the folds of filter papers.

TABLE 1

Assignment	ligand				Cu(I)				Ni(I)				Co(I)				Cr(II)			Zn(II)				
C---H,stre	3047,m				3046,s				3040,s				3047,s				3048,s			3048,vv				
C=C,stre	1478,vs				1472,(vs)				1475,vs				1576,vs				1473,vs			1478,s				
C--H,inplane defor	1305,s	1190,s	1110,vs	1093,vs	1310,vs	1188,s	1097,vs	1030,s	1311,s	1191,s	1097,vs	1030,s	1310,s	1192,s	1098,vs	1031,s	1315,vs	1092,s	1090,s	1080w	1315,w	1190,w	1108,vs	1005,
C--H,outplane defor	759,s	723,vs	698,vs	630,m	751,vs	741,s	718,vs	698,vs	744,vs	710,vs	702,vs	620,s	745,vs	710,vs	702,vs	620,s	746,s	719,sh	698,s	609,s	740,s	720,m	699,m	621,w
C--P,asym	510,vs				507,sh	503,vs			508,sh	504,vs			508,sh	503,vs			503,w			512,vs	498,s			
C---p,sym	451,s				448,s	432,s			446,s	430,s			445,s	420,s			450,sh					450,w		
P--Te,stre	440,s				427,vs				435,vs				437,vs				435,vs					426,vs		
M---X,stre	----				378,m				350,w				351,w				352,s					392,m		
M--Te,stre	--				220,vs				206,m				206,m				221,s					309,s		

stre= stretching	m= medium
asym=symetric	w= wesk
sym=symetric	v w=veryeesk
defor= deformation	sh= soldier
v s=very strong	

TABLE 2

compl ex	eleme nts	metal	halogen	carb an	hyddro gen	phosphorous	telluri um
v	>	(theo)obs	(theo)obs	(theo)obs	(theo)obs	(theo)obs	(theo)obs
ligand		----- ----	--'-----	(55.49)55.59	(3.85)3.94	(795)7.97	(32.75)32.80(28.05)28.12
CuCl ₂ complex		(6.48)6.54	(7.79)7.84	(47.53)47.62	(3.32)3.33	(6.81)6.87	(28.05)28.13
NiCl ₂ complex		(6.45)6.49	7.79)7.83	47.54)47.60	(3.32)3.41	(6.81)6.87	(28.06)28.12
CoCl ₂ complex		(3.92)3.97	3.97)4.01	(48.83)48.88	(3.41)3.46	(6.99)7.00	28.82)28.89
Cr Cl ₂ complex		3.75)3.79	(3.79)4.18	(51.05)51.11	(3.57)3.63	(7.31)7.31((30.12)30.21
ZnCl ₂ complex		(7.13)7.20	(7.20)7.74	(47.20)47.30	(3.30)3.34	(6.70)6.72	(27.85)27.91

Elemental analysis
theo = theoretical
obs = observed

TABLE 3

compound	stocheometric ratio	m.pt c.grade	colour
Cu(II) compound	CuCl₂.4Ph(CH₃)₂PTE, 1 : 4	238	light blue
Ni(II) compound	NiCl₂.2Ph(CH₃)₂PTE, 1 : 2	240	blue
Co(II) compound	CoCl₂.2Ph(CH₃)₂PTE, 1 : 2	244	intence blue
Cr(III) compound	CrCl₃.3Ph(CH₃)₂PTE, 1 : 3	222	orange yellow
Zn(II) compound	ZnCl₂. Ph(CH₃)₂PTE, 1 : 1	230	white

TABLE 4

complex	mag.moment (BM)	stereo chemistry
Cu(II)complex	1.9	octahedral
Ni(II)complex	3.1	tetrahedral
Co(II)complex	4.82	tetrahedral
Cr(III)complex	3.86	tetrahedral
Zn(II)complex	diamag.	bridged

Discussion: ----

- 1) In triarylphosphinetellurideligand, Te has lone pair which it can use for coordination. The basic character of ligand is increased by two methyl groups due to its inductive effect. IR spectra of two alkyl groups (of xylene) in the ligand remains same due to p_{ii}—d_{ii} bonding between P & Te.
- 2) Vib. of the aromatic ring remain the same both in the ligand and the complex showing the ring is intact in the complex.
- 3) Metal tellurium frequencies observed in the complexes which are absent in the ligand shows that metal coordinates through Te.
- 4) Metal halide frequencies are lower in complexes than in metal halide which further supports M—Te linkage.
- 5) Lower wave number observed in case of Zn complex suggests the bridged structure through halogen. The same is further suggested by its diamagnetic character (due to d¹⁰ config.) thus sp³ hybridisation used by Zn and formation of 1:1 complex. Magnetic character of complexes show that Cu(II) complex is octahedral and Ni(II), Co(II) & Cr(II) has tetrahedral geometries.

References: ---

Sahrland, J Chatt and N R Davies, Quart Rev. Chem. Soc. 12, (1988) 265

G E Coates, J. 1951, 2003

R G Pearson, J. Am. Chem. Soc. 85 (1963), 3533.

C K Jorgenson, Inorg. Chem. 2 (1964) 1201