



Mixed Ligand, Palladium(II) and Platinum(II) Complexes of Tertiary Diphosphines with S-1H Benzo[d] Imidazole-2-yl Benzothioate

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ABSTRACT

Palladium(II) and platinum(II) complexes containing the mixed ligands tertiary diphosphines dppm, dppp and dppf with Thioester ligand S-1H benzo[d] imidazole-2-yl benzothioate (HSBIBT) have been prepared by the reaction of PdCl₂ and PtCl₂ with one equiv of tertiary diphosphines ligands to form [Pd(k²-dppf)Cl₂], [Pd(k²-dppp)Cl₂] and [Pt(k²-dppm)Cl₂] complexes and then add the ligand HSBIBT to these complexes to form mixed ligand complexes. The prepared complexes have been characterized by single-crystal X-ray diffraction, elemental analysis, magnetic susceptibility, molar conductance, IR spectral data and UV-Visible. The results suggested that the ligand HSBIBT bonded to the metal through N atom and square planar geometries were assigned for the complexes.

Keywords: Palladium, Platinum, Tertiary diphosphine, Thioester ligand complexes.

INTRODUCTION

Benzimidazole is the heterocyclic aromatic organic compound¹. This bicyclic ring system consists of benzene ring joined with 4- and 5- situation of imidazole ring, imidazole ring having non adjacent two nitrogen atoms². 2-Mercaptobenzimidazole

derived from benzimidazole with thiol group in the 2-position. It holds extra chemical names such as, *o*-phenylthiourea, benzimidazol-2-thion with formula of C₇H₆N₂S^{3,4}. In 2-mercaptobenzimidazole have two N atoms and one S atom and they can independently contribute to its binding to metal⁵. 2-mercaptobenzimidazole derivatives, one of

the most important derivatives of benzimidazole exhibited a wide range of importance biological activities such as antimicrobial⁶, antihistamine⁷, neutropic⁸ and analgesic⁹, antiprotozoal, antiviral, and anticancer activities¹⁰. Metal derivatives of heterocyclic-2-thiones have shown a variety of biochemical application: as antidandruff, antifungal, antibacterial, antibiotic and in shampoos, hair creams, plant diseases and hepatitis¹¹.

Thioesters are important class of organosulfur compounds that play a major role in the construction of pharmaceutical, biological, industrial and natural products. In this respect, thioesters synthesis is one of the most important tasks in organosulfur chemistry. The esterification of thiols is the best and most common strategy for the synthesis of Thioesters¹². Diphosphines are a class of chelating ligands that contain two phosphine groups connected by a bridge (also referred to as a backbone). The bridge, for instance, might consist of one or more methylene groups or multiple aromatic rings with heteroatoms attached¹³. The structure of the backbone and the substituents attached to the phosphorus atoms influence the chemical reactivity of the diphosphine ligand in metal complexes through steric and electronic effects¹³. Phosphorus ligands typically bind to the metal centers via the lone pair of electrons on the phosphorus¹⁴.

EXPERIMENTAL

Materials and Instrumentation

The compounds PtCl₂, PdCl₂, dppm, dppp, dpfp and S-1H benzo[d]imidazole-2-yl benzothioate (HSBIBT) were commercially available and obtained from Yacoo chem. China. The complexes [Pd(k²-dppf)(HSBIBT)Cl]Cl, [Pd(k²-dppp)(HSBIBT)Cl]Cl, [Pt(k²-dppm)(HSBIBT)Cl]Cl were prepared according to the literature.

Elemental CHNS analysis were carried out on a EuroEA 3000 instrument. The FT-IR spectra in range (4000-200 cm⁻¹) were recorded as CsI disc on Shimadzu IRAffinity-1S FTIR Spectrophotometer, and FT-IR spectra in range (4000-400 cm⁻¹) were recorded as KBr disc on Shimadzu, FT-IR spectroscopy Mod IR Affinity-1CE spectrophotometer. UV-Visible spectra were measured using AE-UV1609 (UK) CO., LTD Shimadzu, in the range (200-800) nm. The magnetic

susceptibility values of the prepared complexes were carried out at room temperature using Bruker Magnet BM6. Conductivity measurements were made on a conductivity meter type Senz µSiemen tester 4200 (093 cell constant) (UK.). Melting points were measured on Melting Point-MPD-100 Pixel Technology CO., Limited apparatus.

Synthesis of [Pd(k²-dppf)Cl₂].CH₂Cl₂ (1)

The solution of dppf (1.6632g, 3mmol) in 15ml CH₂Cl₂ was added to a solution of PdCl₂ (0.5320g, 3mmol) that dissolved in 2 cm³ ethanol and 2 cm³ concentrate HCl. The mixture was reflux for 3 hrs. And then the solvent was evaporate at room temperature to give red precipitate. A small portion of this complex was dissolve in CH₂Cl₂ and set to slow evaporation at room temperature after a few days, the red colored needle crystals were formed suitable for single-crystal diffraction analysis¹⁵. The melting point is 253°C, yield is 2.086gm (95%), formula: [Pd(k²-dppf)Cl₂] and M.wt.is 816.58 gm/mole, as shown in Figure 1.

Synthesis of [Pd(k²-dppf)(HSBIBT)Cl]Cl(2)

A solution of ligand (0.0509 g, 0.2 mmol) in CH₂Cl₂ (15 cm³) was added to a solution of [Pd(k²-dppf)Cl₂] (0.1463 g, 0.2 mmol) in CH₂Cl₂ (15cm³), and the mixture was heated under reflux for 4 hrs and then the Solvent was evaporated at room temperature to give a red solid. Yield= 91 %, m.p= 139-141°C. as shown in Figure 1.

Synthesis of [Pd(k²-dppp)Cl₂] (3)

The solution of dppp (1.2373g, 3mmol) in 15ml CH₂Cl₂ was added to a solution of PdCl₂ (0.5320g, 3mmol) that dissolved in 2 cm³ ethanol and 2cm³ concentrate HCl. The mixture was reflux for 3 hrs. And then the solvent was evaporate at room temperature to give pale yellow precipitate. A small portion of this complex was dissolve in CH₂Cl₂ and set to slow evaporation at room temperature after a one week, the yellow colored needle crystals were formed suitable for single-crystal diffraction analysis¹⁵. The Melting point is 277°C, yield is 1.664gm (94%), formula: [Pd(k²-dppp)Cl₂] and M.wt.is 589.72 gm/mole.as shown in Figure 1.

Synthesis of [Pd(k²-dppp)(HSBIBT)Cl]Cl(4)

A solution of ligand (0.0509 g, 0.2 mmol) in CH₂Cl₂ (15 cm³) was added to a solution of [Pd(k²-

dppp)Cl₂] (0.1179 g, 0.2 mmol) in CH₂Cl₂ (15cm³), and the mixture was heated under reflux for 4 hrs and then the Solvent was evaporated at room temperature to give a yellow solid. Yield= 93 %, m.p= 142-144°C. as shown in Figure 1.

Synthesis of [Pt(k²-dppmCl)Cl₂](5)

The solution of dppm (1.1532g, 3mmol) in 15ml CH₂Cl₂ was added to a solution of PtCl₂ (0.7979g, 3mmol) that dissolved in 2 cm³ ethanol and 2cm³ concentrate HCl. The mixture was reflux for 3 hrs. And then the solvent was evaporate at room temperature to give yellow precipitate. A small portion of this complex was dissolve in CH₂Cl₂ and set to slow evaporation at room temperature after a one week, the yellow colored needle crystals were formed suitable for single-crystal diffraction analysis¹⁵. The melting point is > 300°C, yield is 1.756gm (90%), formula: [Pt(k²-dppmCl)Cl₂] and M.wt.is 667.43 gm/mole.as shown in Figure 1.

Synthesis of [Pt(k²-dppmCl)(HSBIBT)Cl]Cl(6)

A solution of ligand (0.0509 g, 0.2 mmol) in CH₂Cl₂ (15 cm³) was added to a solution of [Pt(k²-dppmCl)Cl₂] (0.1300 g, 0.2 mmol) in CH₂Cl₂ (15cm³), and the mixture was heated under reflux for 4 hrs and then the Solvent was evaporated at room temperature to give a yellow solid. Yield= 90 %, m.p= 117-119°C. as shown in Figure 1.

X-ray crystallography

Single crystal X-ray crystallography studies were performed at 200 k using a Bruker Kappa Apex II diffractometer with graphite monochromated Mo K α radiation ($\lambda = 0.71073 \text{ \AA}$). For data collection, Apex-II was used while for cell refinement and data reduction, SAINT was used¹⁶. The structures were

solved by direct methods applying SHELXL-2013¹⁷, with SHELXLE¹⁸ as a graphical interface.

Red crystals of 1, yellow crystals of 3 and yellow crystals of 5 suitable for X-ray crystallographic measurements were obtained by slow evaporation of dichloromethane solutions of the respective complex. Table 4 gives the crystallographic data and collection parameters. All Non-hydrogen atoms were refined with anisotropic displacement parameters. Hydrogen atoms were included in the models by calculating the positions (riding model) and refined with calculated isotropic displacement parameters.

RESULTS and DISCUSSIONS

The mixed ligand complexes were synthesized by two steps. The first step include the preparation of metal complexes with tertiary diphosphines ligands [MCl₂(k²-PPh₂(CH₂)_nPPh₂)] where n= 1,3 with [MCl₂(k²-dppf)], and M= Pd and Pt. The second step include the synthesis of mixed ligand complexes by addition of S-1H-benzo[d]imidazole-2-yl benzothioate (HSBIBT) ligand to tertiary diphosphines metal complexes. The physical data of complexes are given in Table (1), the suggested molecular formula are supported by IR spectra, UV-Visible sepectra, elemental analysis, magnetic moment and conductivity measurement.

IR spectral studies

The infrared spectrum of free (HSBIBT) ligand is characterized by intense absorption band at 1712 cm⁻¹. This band is assigned to $\nu(\text{C}=\text{O})$ group^{19,4}. The stretching frequency of $\nu(\text{C}=\text{N})$ band which appeared at 1618 cm⁻¹ for free (HSBIBT) ligand. This band was shifted to lower frequency during

Table 1: physical characteristics and analytical data for metal complexes

Complex	Color	Yield %	M.P °C	Elemental analysis, calc. (found) %			
				C	H	N	S
[Pd(k ² -dppf)(HSBIBT)Cl]Cl	Red	91	142-144	58.47 -58.47	3.84 -3.75	2.75 -2.84	3.15 -3.24
[Pd(k ² -dppp)(HSBIBT)Cl]Cl	Yellow	93	139-141	58.45 -58.35	4.18 -4.15	3.26 -3.32	3.46 -3.79
[Pt(k ² -dppmCl)(HSBIBT)Cl]Cl	Yellow	90	117-119	51.46 -51.78	3.6 -3.43	2.93 -3.09	3.44 -3.54

complexation due to the coordination of nitrogen atom to the metals²⁰(Table 2).

The infrared spectra of complexes showed medium intensity bands in the range 513 to 570 cm^{-1} , these bands are attributed to $\nu(\text{M-N})$ ²¹. Also showed a bands in the range 370 to 391 cm^{-1} , these bands are related to $\nu(\text{M-Cl})$ ²². Further support for the coordinated phosphines ligands has been provided by the appearance of new bands in the range 285 to 291 cm^{-1} , these bands are assigned to $\nu(\text{M-P})$ ²³.

Magnetic moments

The magnetic moments of complexes $[\text{Pd}(\text{k}^2\text{-dppf})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (2), $[\text{Pd}(\text{k}^2\text{-dppp})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (4) and $[\text{Pt}(\text{k}^2\text{-dppmCl})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (6) are 0.54, 0.6 and 0.44 B.M. respectively (Table 3), suggesting a square planer arrangement around the metal and complexes are diamagnetic^{24,25}.

Electronic spectral studies

The UV-Vis spectrum in 10^{-3} M chloroform (Table 3) shows three absorption bands of Pd(II) complex (2), at 20661 cm^{-1} , 28571 cm^{-1} , and 33783 cm^{-1} which are assigned to the $^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$, $^1\text{A}_{1g} \rightarrow ^1\text{E}_g$ and charge transfer transition respectively,

these bands are reasonable to square planer geometry²⁶. The UV-visible spectrum of Pd(II) complex(4), gave three spins allowed transitions at 24038 cm^{-1} , 29411 cm^{-1} , and 32679 cm^{-1} which are assigned to the $^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$, $^1\text{A}_{1g} \rightarrow ^1\text{E}_g$ and charge transfer transition respectively. The UV-visible spectrum of Pt(II) complex(6), shows three absorption bands at 23923 cm^{-1} , 27777 cm^{-1} , and 32573 cm^{-1} which are assigned to the $^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$, $^1\text{A}_{1g} \rightarrow ^1\text{E}_g$ and charge transfer transition respectively. These transitions value are indicated to square planer geometry²⁷.

Conductivity measurement

The molar conductivity of complexes $[\text{Pd}(\text{k}^2\text{-dppf})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (2), $[\text{Pd}(\text{k}^2\text{-dppp})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (4) and $[\text{Pt}(\text{k}^2\text{-dppmCl})(\text{HSBIBT})\text{Cl}]\text{Cl}$ (6) in dimethyl sulfoxide (DMSO) are 34.2, 41.4 and 36 ($\text{cm}^2.\text{ohm}^{-1}.\text{mol}^{-1}$)(Table 3) suggesting that they are electrolytes complexes^{28,29}.

X-ray Crystal structures

The $[\text{Pd}(\text{k}^2\text{-dppf})\text{Cl}_2].\text{CH}_2\text{Cl}_2$ complex was crystallized in a dichloromethane (CH_2Cl_2) at room temperature. After one week, the red colored needle type crystals had grown from the CH_2Cl_2 solvent

Table 2: IR frequencies (cm^{-1}) of the compounds

Complex	$\nu(\text{N-H})$	$\nu(\text{C=O})$	$\nu(\text{C=N})$	$\nu(\text{P-Ph})$	$\nu(\text{P-C})$	$\nu(\text{M-N})$	$\nu(\text{M-P})$	$\nu(\text{M-Cl})$
HSBIBT	3151	1712	1618	-	-	-	-	-
2	3165	1712	1608	1435	-	513	285	370
4	3159	1712	1612	1435	513	540	288	383
6	3153	1712	1608	1436	509	559	291	391

Table 3: Electronic spectra, magnetic moments and molar conductivity of complexes

complex	$\lambda_{\text{max}}(\text{nm})/\text{Chloroform}$	assignments	μ_{eff} (BM) ^a	$\Lambda_{\text{M}}(\Omega^{-1}\text{cm}^2\text{mol}^{-1})/\text{DMSO}$
2	484	$^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$	0.54	34.2
	350	$^1\text{A}_{1g} \rightarrow ^1\text{E}_g$		
	296	C.T		
4	416	$^1\text{A}_{1g} \rightarrow ^1\text{B}_{1g}$	0.6	41.4
	340	$^1\text{A}_{1g} \rightarrow ^1\text{E}_g$		
	306	C.T		
6	418	$^1\text{A}_{1g} \rightarrow ^1\text{A}_{2g}$	0.44	36
	360	$^1\text{A}_{1g} \rightarrow ^1\text{E}_g$		
	307	C.T		

Table 4: Crystallographic Data and structure refinement for [Pd(k²-dppf)Cl₂].CH₂Cl₂, [Pd(k²-dppp)Cl₂] and [Pt(k²-dppmCl)Cl₂] complexes.

	[Pd(k ² -dppf)Cl ₂]. CH ₂ Cl ₂	[Pd(k ² -dppp)Cl ₂]	[Pt(k ² -dppmCl)Cl ₂]
Empirical formula	C ₃₄ H ₂₆ Cl ₂ FeP ₂ Pd.CH ₂ Cl ₂	C ₂₇ H ₂₆ Cl ₂ P ₂ Pd	C _{24.27} H _{21.46} Cl ₂ P ₂ Pt(Cl) _{0.729} (H) _{0.54}
Formula weight	816.58	589.72	667.43
R	0.03	0.02	0.03
Temperature	200 K	200 K	200 k
Radiation	0.71073 A	0.71073 A	0.71073 A
Crstal system	Monoclinic	triclinic	Monoclinic
space group	P21/c	P-1	C2/c
a(°A)	9.7960(3)	8.4865(3)	16.2034(5)
b(°A)	18.1527(7)	10.5484(4)	7.8274(2)
c(°A)	19.0713(7)	14.4020(6)	19.2496(6)
γ(deg)	90	88.388(2)	90
β(deg)	102.536(1)	80.064(2)	98.918(1)
α(deg)	90	73.475(2)	90
volume	3310.5(2)A ³	1217.16(8) A ³	2411.92(12)A ³
F(000)	1640	596	4, 1.838 Mg/m ³
Z, Calculated density	4, 1.638 Mg/m ³	2, 1.609 g/m ³	6.263 mm ⁻¹
Absorption coefficient	1.426 mm ⁻¹	1.128 mm ⁻¹	1288
Crystal size	0.41 x 0.46 x 0.47 mm	0.19 x 0.31 x 0.51 mm	0.04 x 0.20 x 0.21 mm
Dataset	-13: 13 ; -20: 24 ; -25: 25	-11: 11 ; -13: 14 ; -18: 19	-13:21; -10:10; -25:25
Reflections collected / unique	60083,8203, [R(int)= 0.018]	32265, 6016, [R(int)= 0.016]	16294,3007, [R(int)= 0.030]
Observed Data [I > 2.0 sigma(I)]	7414	5668	2930
R, wR2, S	R= 0.0284, wR2= 0.0693, S= 1.04	R= 0.0177, wR2= 0.0451, S= 1.03	R= 0.0478, wR2= 0.1178, S= 1.30
Min. and Max. Resd. Dens	[-2.08, 1.73] e/Ang ³	[-0.44,0.44] e/Ang ³	[-1.71, 4.83] e/Ang ³
Max. and Av	0.00 and 0.00	0.00 and 0.00	0.00 and 0.00

Table 5: Selected bond distances (in A°) and bond angles (in degree) for [Pd(k²-dppf)Cl₂].CH₂Cl₂

Bond distance	Bond angle
Pd(1)-Cl(1) 2.3417(7)	Cl(1)-Pd(1)-P(1) 87.79(2)
Pd(1)-Cl(2) 2.3577(7)	Cl(1)-Pd(1)-P(2) 171.50(3)
Pd(1)-P(1) 2.2774(7)	Cl(2)-Pd(1)-P(1) 177.75(2)
Pd(1)-P(2) 2.2883(7)	Cl(2)-Pd(1)-P(2) 83.96(2)
Fe(1)-C1(1) 1.996(2)	P(1)-Pd(1)-P(2) 97.94(2)
Fe(1)-C1(2) 2.028(2)	C1(3)-Fe-C1(4) 40.16(10)
P(1)-C1(1) 1.802(2)	Pd(1)-P(1)-C(31) 108.46(7)

and these crystals were subjected to single-crystal X-ray diffraction study. The molecular structure of [Pd(k²-dppf)Cl₂].CH₂Cl₂ complex is shown in Figure 1. The [Pd(k²-dppf)Cl₂].CH₂Cl₂ complex crystallizes in a monoclinic space group Monoclinic, P21/c. a=9.7960(3)A, b=18.1527(7)A, c=19.0713(7)A, α=γ=90°, β=102.536(1). Structural analysis reveals that [Pd(k²-dppf)Cl₂].CH₂Cl₂ complex has a square planer geometry around the metal center, two chlorines and two phosphorus atoms are coordinated with the palladium ion. The dppf behave as bidentate chelating ligand. The crystal determination data and selected bond distances and bond angles for

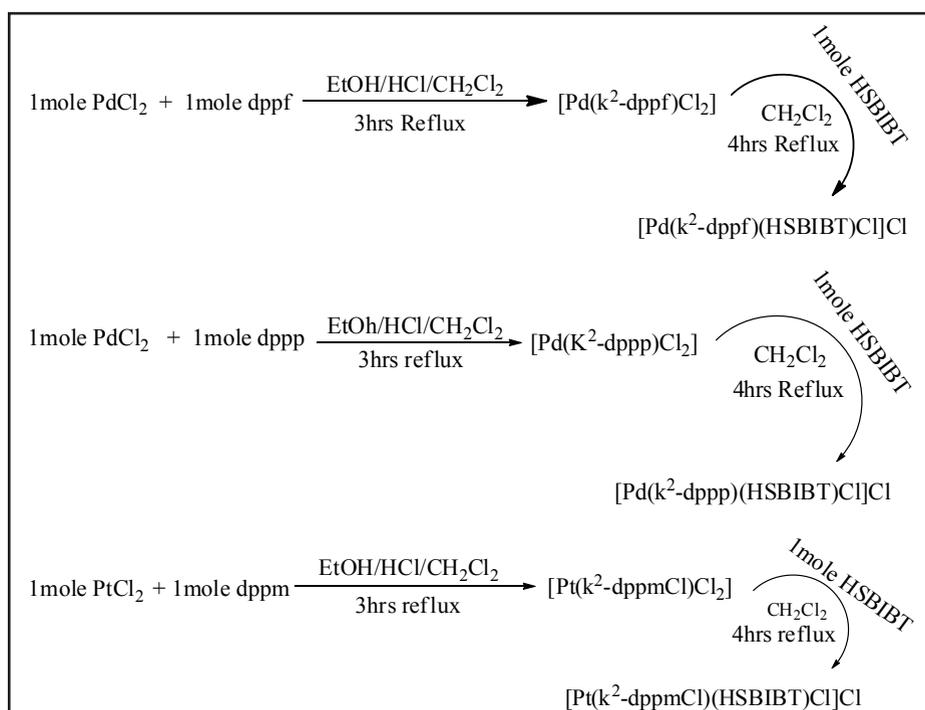


Table 6: Selected bond distances (in Å) and bond angles (in degree) for [Pd(k²-dppp)Cl₂]

Bond distance		Bond angle	
Pd(1)-Cl(1)	2.3575(4)	Cl(1)-Pd(1)-Cl(2)	90.54(1)
Pd(1)-Cl(2)	2.3557(4)	Cl(1)-Pd(1)-P(1)	87.77(1)
Pd(1)-P(1)	2.2424(4)	Cl(1)-Pd(1)-P(2)	177.80(2)
Pd(1)-P(2)	2.2456(4)	Cl(2)-Pd(1)-P(1)	172.11(2)
P(1)-C(1)	1.8243(16)	Cl(2)-Pd(1)-P(2)	91.39(1)
P(2)-C(3)	1.8355(16)	P(1)-Pd(1)-P(2)	90.47(1)
C(3)-H(3)A	0.9900	Pd(1)-P(1)-C(1)	116.42(5)

Table 7: Selected bond distances (in Å) and bond angles (in degree) for [Pt(k²-dppmCl)Cl₂]

Bond distance		Bond angle	
Pt(1)-Cl(1)	2.3661(19)	Cl(1)-Pt(1)-P(2)	98.10(7)
Pt(1)-P(2)	2.217(2)	Cl(1)-Pt(1)-P(1)	98.10(7)
Pt(1)-P(1)	2.217(2)	Cl(1)-Pt(1)-Cl(1)_a	90.02(6)
Pt(1)-Cl(1)_a	2.3661(19)	Cl(1)-Pt(1)-P(2)_a	171.58(7)
Pt(1)-P(2)_a	2.217(2)	Cl(1)_a-Pt(1)-P(2)	171.58(7)
P(1)-C(21)	1.816(7)	P(2)-Pt(1)-P(2)_a	73.87(8)
P(2)-C(11)	1.808(8)	Pt(1)-P(1)-C(21)	117.2(3)

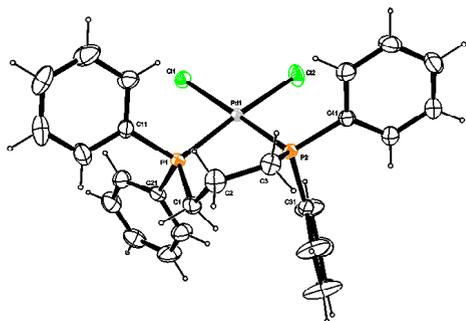


Fig. 1: synthesis route of complexes

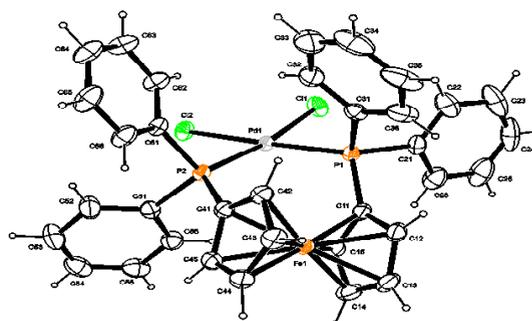


Fig. 2: Molecular Structure of $[Pd(k^2-dppf)Cl_2].CH_2Cl_2$ Complex

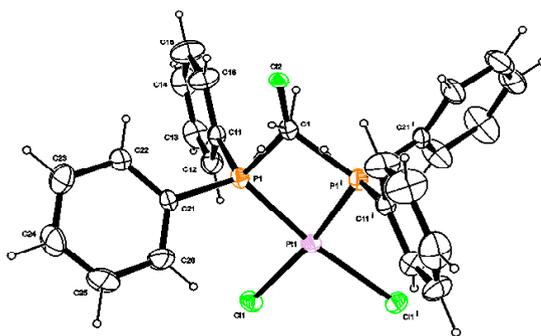


Fig. 3: Molecular Structure of $[Pd(k^2-dppp)Cl_2]$ Complex

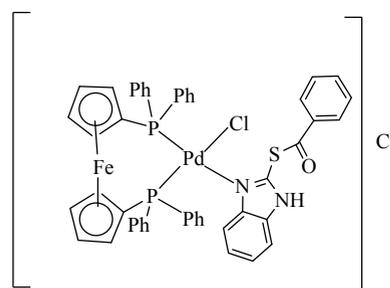


Fig. 4: The Proposed Geometrical Structure of $[Pd(k^2-dppf)(HSBIBT)Cl]Cl$ Complex

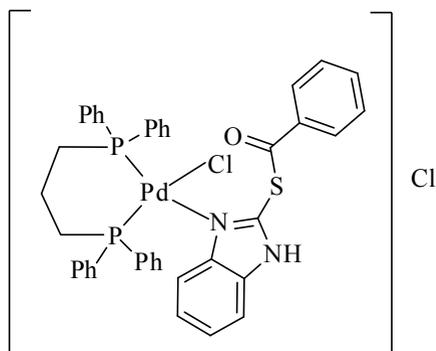


Fig. 5: The Proposed Geometrical Structure of $[Pd(k^2-dppp)(HSBIBT)Cl]Cl$ Complex

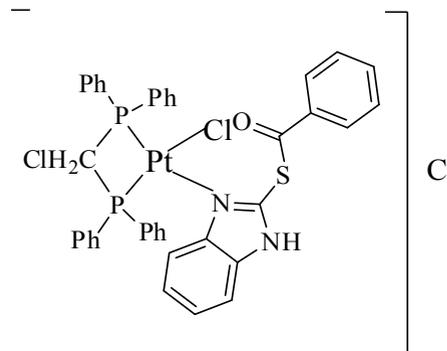


Fig. 6: The Proposed Geometrical Structure of $[Pt(k^2-dppmCl)(HSBIBT)Cl]Cl$ Complex

$[Pd(k^2-dppf)Cl_2].CH_2Cl_2$ complex are summarized in Tables 4 and 5. The palladium center was found to a distorted square planar geometry, with Cl1-Pd1-P1, Cl2-Pd1-P2, Cl1-Pd1-P2 and Cl2-Pd1-P1 angles of 87.79(2), 83.96(2), 171.50(3), and 177.75(2) respectively^{30, 31}.

The $[Pd(k^2-dppp)Cl_2]$ complex was crystallized from a CH_2Cl_2 solution of the complex at

room temperature, after a one week, as yellow colored needle type crystals are formed, these crystals were subjected to single-crystal X-ray diffractometer study. The molecular structure of $[Pd(k^2-dppp)Cl_2]$ complex is shown in Fig. 2. The structural analysis reveals that $[Pd(k^2-dppp)Cl_2]$ complex has a distorted square planar geometry around the metal center and that the two phosphorus and two chloride atoms are coordinated to the palladium ion. The dppm behave

as behave as bidentate chelating ligand. Whereas the Pd-P bond distance of 2.2424(4) and 2.2456(4) Å for P(1) and P(2) atoms of the [Pd(k²-dppp)Cl₂] complex^{30,31}. The crystal determination data and selected bond distance and bond angles for [Pd(k²-dppp)Cl₂] complex is summarized in Tables 4 and 6.

The [Pt(k²-dppmCl)Cl₂] complex was crystallized from a CH₂Cl₂ solution of the complex at room temperature, after a five days, a yellow colored needle type crystals are formed, these crystals were subjected to single-crystal X-ray diffractometer study. The molecular structure of [Pt(k²-dppmCl)Cl₂] complex is shown in Fig. 3. The structural analysis reveals that [Pt(k²-dppmCl)Cl₂] complex has a square planer geometry around the metal center and that the two phosphorus and two chlorine atoms are coordinated to the platinum ion. The dppm behave as behave as bidentate chelating ligand. Whereas the Pt-P bond length of 2.217(2) and 2.217(2) Å for P(1) and P(2) atoms of the [Pt(k²-dppmCl)Cl₂] complex^{30,31}. The crystal determination data and selected bond distances and bond angles for [Pt(k²-

dppmCl)Cl₂] complex is summarized in Tables 4 and 7.

CONCLUSIONS

In this research we have describe the synthesis and characterization of some Palladium and platinum complexes obtained from the reaction of the Thioester ligand with tertiary diphosphines metal complexes as shown in Figure 1. The manner of bonding and overall structure of complexes were determined through elemental analysis, magnetic susceptibility, molar conductance, IR spectral data and UV-Visible. All synthesized complexes are square planar and diamagnetic.

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