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Studies on Thermal Analysis & Magnetic Properties of Metal Complexes of Imidazole Bearing Schiff Base

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ABSTRACT

Metal complexes of Imidazole bearing Schiff base were synthesized and characterized using various sectrosocpic techniques. Thermogravimetric analysis was performed to determine different decomposition stages for all the synthesized metal complexes. The magnetic susceptibility of all the metal complexes was determined by measuring magnetic moments by Guoy balance method to study the magnetic behaviour of these complexes.

Keywords : 4H-imidazol-4-one, Schiff base, Metal complexes, Thermogravimetric analysis, Magnetic properties.

I. INTRODUCTION

The major class of heterocyclic chemicals known as imidazole derivatives has crucial biological characteristics. A wide range of biological activities, including anti-microbial [1-6], antifungal [7-9], antiviral, anticancer, and anti-inflammatory [10–13] activities, have been documented for many medicines and medicinally active compounds that integrate the imidazole ring in their scaffold.

Compounds bearing Imidazole scaffold have been widely researched as Ligands to prepare variety of metal complexes as they coordinate to transition metal ions quite readily. It has been demonstrated that Schiff base metal complexes having an imidazole ring exhibit different actions and could lead to the development of improved drugs [14-16].

In the light of above observations, novel Schiff base, 3-((E)-benzylidene)-amino)-5-(2,5 dimethoxybenzylidene)-2-phenyl-3,5-dihydro-4H-imidazol-4-one **(1a)** carrying an imidazole ring and an arylidene linkage was synthesized [17]. Different metal complexes were formed with the Schiff base **(1a)**. The current study describes the results of

thermogravimetric analysis and magnetic moment measurements of the synthesized metal complexes.

II. MATERIALS AND METHODS

All of the metal complexes were investigated using simultaneous TGA/DTG and DSC analysis, with the heating rates properly controlled at 10 °C min1 under nitrogen environment, and the weight loss measured from room temperature to 1000 °C.

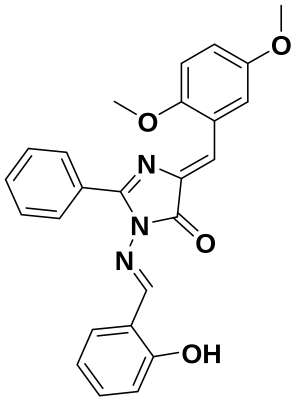
Magnetic moments were determined using Guoy balance method at room temperature.

III. EXPERIMENTAL

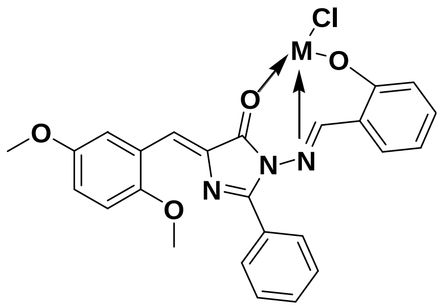
Different metal complexes **(2a-e)** of a novel Schiff base 3-((E)-benzylidene)-amino)-5-(2,5-dimethoxybenzylidene)-2-phenyl-3,5-dihydro-4H-imidazol-4-one **(1a)** were synthesized and were characterized using various spectroscopic and analytical techniques [15].

TGA graphs of metal complexes were taken at a heating rate of 10°C/min in the temperature range of ambient to 1000 °C; Thermogravimetric analysis values of complexes summarized in the Table-1.

Magnetic moments were determined using Guoy balance method at room temperature. The effective magnetic moments were calculated using the equation. $\mu_{\mathrm{eff}} = 2.84\left(X_m^{\mathrm{Corr}}T\right)^{1/2}$ BM ; where T is the absolute temperature and X_m^{Corr} is the molar susceptibility corrected for diamagnetism of all other atoms and groups present in the complex using Pascal's constants.



(1a)



M=Pd, Fe, Ru, Cr, Cu

(2a-e)

IV. RESULTS AND DISCUSSION

THERMAL ANALYSIS

Thermal analysis of all the synthesized metal complexes was performed to establish different decomposition processes and to confirm the proposed stoichiometry. All of the metal complexes were investigated using simultaneous TGA/DTG and DSC analysis, with the heating rates properly controlled at 10 °C min1 under nitrogen environment, and the weight loss was measured from room temperature to 1000 °C.
Thermograms of selected complexes have been shown in **Fig. 1**.

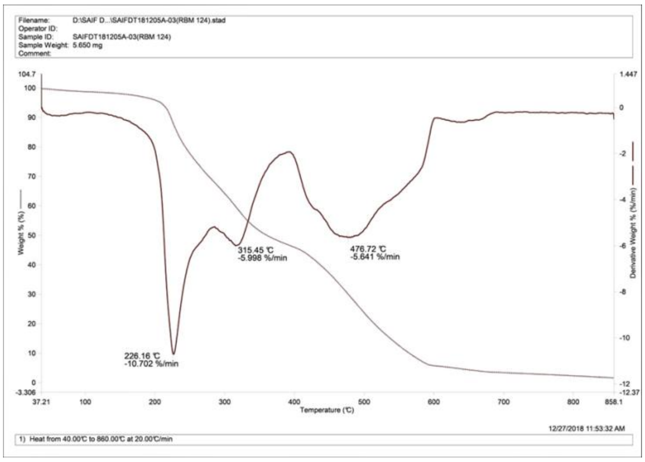
Table 1 summarises the TGA/DTG and DSC results.

Table-1

	Temp. °C	% Weight loss		Total % weight loss		Residue after weight loss
		Calcd.	Found	Calcd.	Found.	
2a	40°-250°C	-	-	-	-	-
	250°-600°C	88.93	76.14	88.93	83.62	Two ligand molecule
	600°-860°C	11.07	16.56			Formation of residue
2b	40°-250°C	-	-	-	-	-
	250°-	93.87	76.50	93.87	83.88	Two ligand

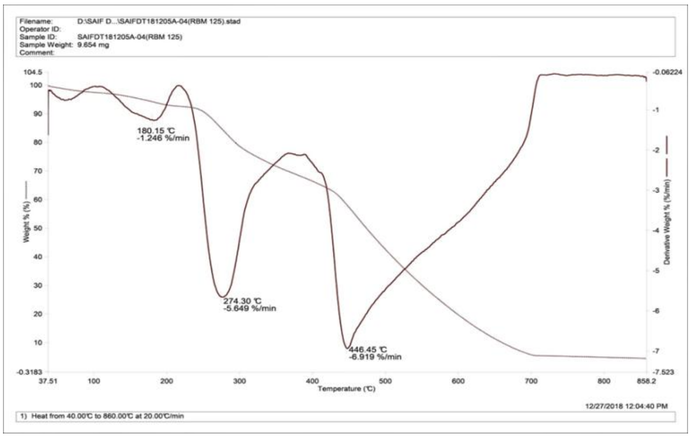
	600°C					molecule
	600° 860°C	6.13	16.3			Formation of residue
4c	40°-250°C	5.37	5.25			Two water molecule
	40°-250°C	15.87	15.60			Three chlorine atom
	250°-600°C	63.64	63.50	93.87	84.35	One ligand molecule
	600°-860°C	12.35	16.3			Formation of residue
4d	40°-250°C	3.77	3.70			One chlorine atom
	250°-600°C	90.72	90.61	94.49	94.31	Ligand molecule
	600°-860°C	5.551	22.85			Formation of residue
4e	40°-250°C	-	-			-
	250°-600°C	93.08		93.08	82.28	Ligand molecule
	600°-860°C	6.92	17.85			Formation of residue

Fig. 1 : TGA Spectrum of 1c



The complex 1c shows loss of three chlorine atom, two water molecule and ligand molecules in three different decomposition phases as shown in its TGA curve.

Fig. 2: TGA Spectrum of 1d



The complex 1d show loss of one chlorine atom and ligand molecules in two different decomposition phases as shown in TGA curve.

V. MAGNETIC BEHAVIORS

The magnetic susceptibility of complexes is usually measured by making use of Gouy's balance at room temperature. The effective magnetic moments were calculated using the equation. $\mu_{eff} = 2.84(X_m^{Corr}T)^{1/2}$ BM; where T is the absolute temperature and XmCorr is the molar susceptibility corrected for diamagnetism of all other atoms and groups present in the complex using Pascal's constants.

Cu(II) complexes have magnetic moment values in the range of 1.67-1.71 BM for copper, making them paramagnetic, and zero BM for Pd(II) complex shows its diamagnetic nature. All complexes' magnetic susceptibility statistics are closer to the values for metal ions that have been tested both theoretically and in experimentally.

VI. CONCLUSION

Metal complexes of a novel Imidazole bearing Schiff base were synthesized and their thermal analysis as well as magnetic behaviour is reported. The thermal analysis confirms the proposed stoichiometry and magnetic behaviour is also in accordance with the theoretical estimates.

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