

Synthesis and D. C Electrical Conductivity Studies of Coordination Metal Complexes

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ABSTRACT

Conductivity of Schiff base metal complexes has become much importance to study the nature of synthesized transition metal complexes and attracted utmost attention of research scholars to synthesize some novel solid complexes having super functional properties viz, electrical, optical and magnetic properties. These complexes have extended their unique contribution in the field of bio-chemistry and material sciences. The present work is a sincere attempt to investigate the D.C electrical conductivity of some riluzoleschiff base transition metal complexes. The D.C electrical conductivity measurements of the prepared complexes were studied in the temperature range 364-454K.

Keywords: Coordination Complexes; Resistivity; Electrical conductivity; Schiff base ligand.

I. INTRODUCTION

In recent years, conducting metal complexes have been widely studied and have become a crucial concern for the scientific community because of their wide applications which includes high temperature coatings, electrode and display materials, lasers and homogeneous catalysts [1-5]. One of the fundamental methods to synthesize conducting organometallic complexes involves complexing transition metals with conjugated bridging Schiff base ligands. Due to their pliability and various structural aspects, a wide range of benzothiazoleschiff base metal complexes has been prepared and their complexation behaviour was examined.

II. METHODS AND MATERIAL

Synthesis of HL¹ ligand (HL¹= Riluzole, 6(trifluoro methoxy) benzothiozole – salicylaldehyde Schiff base): Riluzole, 6(trifluoromethoxy) benzothiozole (0.05M, 1.18g) was taken in a dry and cleaned round bottom flask. To this 0.6 ml (0.05M) of salicylaldehyde and 1-2ml of ethanol was added. The round bottom flask capped with water condenser was subjected to microwave irradiation at 50% intensity (450watt) for 6 minutes with an interim of 30 seconds. TLC was used to supervise the reaction. The resulting mixture was separated and dissolved in ethanol and the excess solvent was evaporated by rota-evaporater. The yellow orange crystals so obtained were separated on drying and stored in a desiccator.

Preparation of (Co, Cu, Cd, Zn and ZrO) metal complexes of HL¹ ligand

Metal (II) chlorides in ethanol (0.002mol) and Schiff base HL¹ (0.002mol) were taken in a round bottom flask and kept in microwave for 2-3mins at 50% intensity in an ethanolic medium. A pinch of sodium acetate was then added to the reaction mixture and kept in microwave for another 8-9mins. The separated metal (II) complexes were filtered and washed with distilled water containing small quantity of ethanol and dried in vacuum over fused calcium chloride. The complexes were purified using soxhlet extractor taking alcohol as a solvent. ZrO (II) complexes were prepared in methanol medium and same procedure was adopted. Electrical conductivity of the solid complexes can be measured with BPL – INDIA million mega meter R M 160 m K IIIA over wide temperature

III. RESULTS AND DISCUSSION

On the basis of spectral data, we can say that, the coordination of imines and Riluzole compounds to the central metal atom can take place through the donor sites. Different metal complexes investigated over the temperature range 364-454 K exhibit significant electrical properties. These complexes show increased behaviour of electrical conductivity with rise in temperature according to the following relation:

$$\sigma = \sigma_0 \text{Exp} (- E_a / KT)$$

Figures 1-3 shows the variation of logarithmic conductivity values with the reciprocal of absolute temperature. Most of the complexes show semiconducting behaviour in the temperature range 440-350K. Semiconducting properties of co-ordination complexes with isoterphthaldehyde 2-hydroxy-5-methylacetophenone-S-methyldithiocarbazate have also been reported by J. T. Makode [7]. Semi conductivity studies of polymeric schiff bases and their polychelates have been reported in the literature [6-8]. The synthesized complexes show low electrical conductivity which can be interpreted based on their

semiconducting properties. The delocalization of electron or hole in these complexes exhibiting semi-metallic behaviour is a characteristic of hopping mechanism. The electron or hole drifts from one localized metal site to the nearest neighbour, which results in generating atomic polarization. The electron occupied at new localized metal site is thermally energized so that it can migrate to the adjacent site [9-10].

Table 1. Summary of Activation Energy, E_a

Samples	E _a (eV)	E _a (cal/mol)	E _a (kcal/mol)
Co [(C ₁₅ H ₈ F ₃ N ₂ O ₂ S)(H ₂ O) ₃ Cl]]	0.36 6	8440.4	8.440
Cu [(C ₁₅ H ₈ F ₃ N ₂ O ₂ S)(H ₂ O) ₃ Cl]]	0.18 7	4329.6	4.329
Cd [(C ₁₅ H ₈ F ₃ N ₂ O ₂ S)(H ₂ O) ₃ Cl]]	0.08 5	1970.0	1.970
Zn [(C ₁₅ H ₈ F ₃ N ₂ O ₂ S)(H ₂ O)Cl]]	0.14 4	3336.1	3.336
ZrO [(C ₁₅ H ₈ F ₃ N ₂ O ₂ S)(H ₂ O)Cl]]	0.07 1	1655.3	1.655

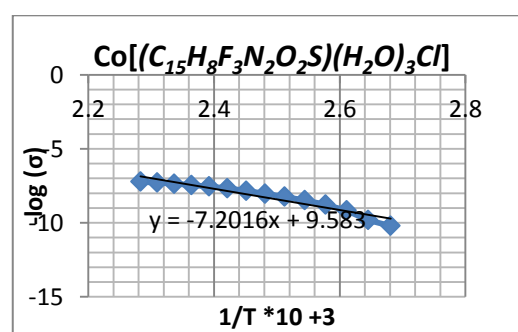


Figure 1a

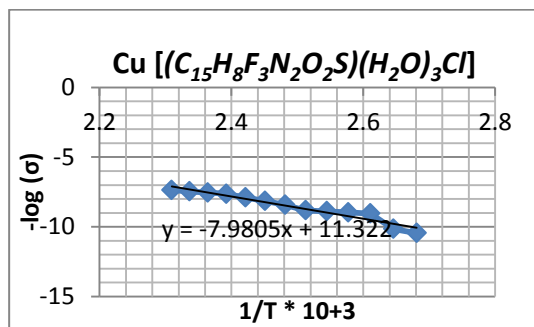


Figure 1b

Figure 1(a-b): DC-Conductivity of Co (II) and Cu (II) complex of HL¹ ligand

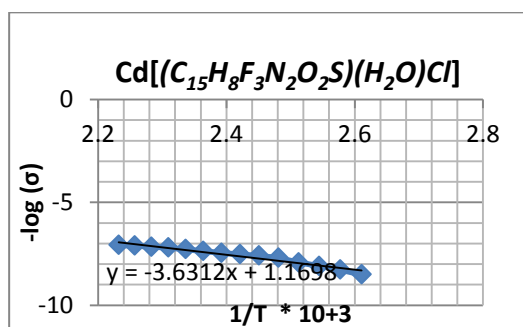


Figure 2a

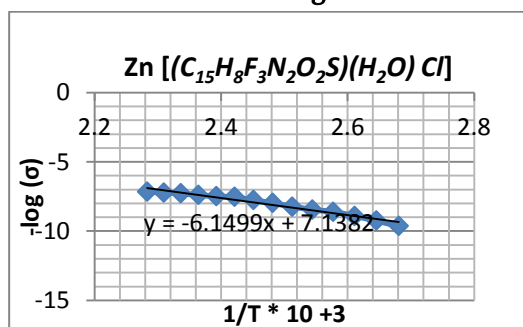


Figure 2b

Figure 2(a-b) . DC-Conductivity of Cd (II) and Zn(II) complex of HL¹ ligand

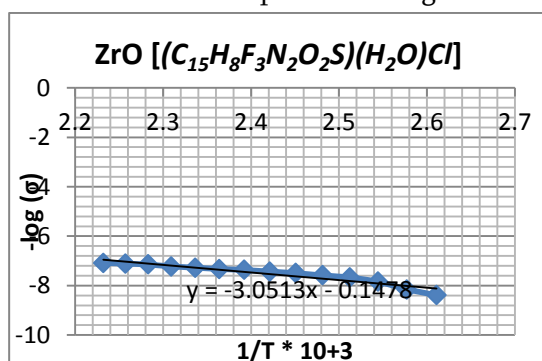


Figure 3. DC-Conductivity of ZrO (II) complex of HL¹ ligand

IV. CONCLUSION

In the present work, different transition metal complexes of riluzoleschiff base were successfully synthesized using microwave irradiation. The synthesized complexes were investigated for their D.C electrical conductivity over the temperature range 364-454 K. The observed electrical conductivity of the complexes increases with increasing temperature. At lower temperature range 300-360K they behave as non-conductor, however they exhibit semi-conducting properties in the temperature range 370-453K. The orders of the activation energy for the synthesized metal complexes are as follows.

$$\text{Co} > \text{Cu} > \text{Zn} > \text{Cd} > \text{ZrO}$$

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