

# Divalent Transition Metal Complexes with (o-Hydroxy Aceto Phenone) Imino Aceto Hydroxamic Acid: Structural Studies

Niharika Varshney<sup>1</sup>, Ashutosh Dixit<sup>2</sup>, Parvesh Saini<sup>3</sup>, Sandeep Sunori<sup>4</sup>

<sup>1</sup>Department of Electrical Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India

<sup>2</sup>Department of Electrical Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India

<sup>3</sup>Department of Electrical Engineering, Graphic Era Hill University, Dehradun, Uttarakhand India

<sup>4</sup>Department of Electronics & Communication Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India

---

## ABSTRACT

Some divalent Iron metal complexes were created using bases with donor sites for nitrogen and oxygen atoms and the Schiff base ligand (o-hydroxy aceto phenone) imino aceto hydroxamic acid. A tridentate bi-anionic molecule serves as the ligand. Using conventional physico-chemical techniques, such as elemental analysis, measurement of electrical conductance, magnetic moment, electronic and IR spectra of the ligand and the complexes, it was discovered that all the complexes were nonelectrolyte, monomeric, paramagnetic, and octahedral in geometry.

**Keywords:** Solution, condensation, ligand, complex, divalent transition metal, separation, filtration, crystallisation, cation, mono-meric, octahedral, geometry.

---

## INTRODUCTION

In the field of coordination chemistry, a lot of work has been done with Schiff bases that have nitrogen and oxygen donor atoms as ligands. The area of coordination chemistry could be significantly shortened in the absence of Schiff bases as ligands. However, research has been done on the development of divalent transition metal complexes with Schiff bases that contain a hydroxamic acid group in their moiety. As a consequence, I report the formation of some divalent Iron complexes with the Schiff base ligand, (o-hydroxy aceto phenone) imino aceto hydroxamic acid, in the presence of bases such as water, ammonia, quinoline, phenyl isocyanide, and pyridine picolines in this paper. Such complexes have wide application in the field of agriculture and medicines for the treatment of curable and incurable diseases. They are good source to increase the level of haemoglobin in the human body.

## 2. PREPARATION OF IRON(II) COMPLEXES:

**Procedure:** In methyl alcohol, around 2.10g (0.01 mole) of the ligand was fully dissolved. In about

20ml of aqueous ethyl alcohol, 2.65g (0.01 mole) of ferrous (II) sulphate heptahydrate was fully dissolved. With constant shaking, the two solutions were eventually mixed together. The resulting solution was then refluxed for around two and a half hours on a water bath. Through holding the solution in the cup-board overnight, the colour of the solution gradually improved, and slight green and in some cases dirty and brownish green colour crystals separated out in the solution. Filtration was used to isolate the substance, which was then washed with a small amount of acetone before being dried over KOH pellets in a desiccator. In the case of each base, such as water, ammonia, quinoline, phenyl isocyanide, pyridine, and different picolines, Fe(II) metal complexes with the ligand were prepared separately.

**CHEMICALS REQUIRED:** Ethyl alcohol, acetone, Fe(II) sulphate heptahydrate, DMF, ammonia, phenyl isocyanide, quinoline, pyridine, and various picolines are examples of these chemicals. All of the chemicals used were either extra pure E. Merck or BDH (AR) quality.

### ANALYTICAL METHODS:

Normal methods were used to estimate the amount of metals and non-metals present in the ligand and complexes:

I Iron: The dichromate titration approach is used to estimate iron volumetrically.

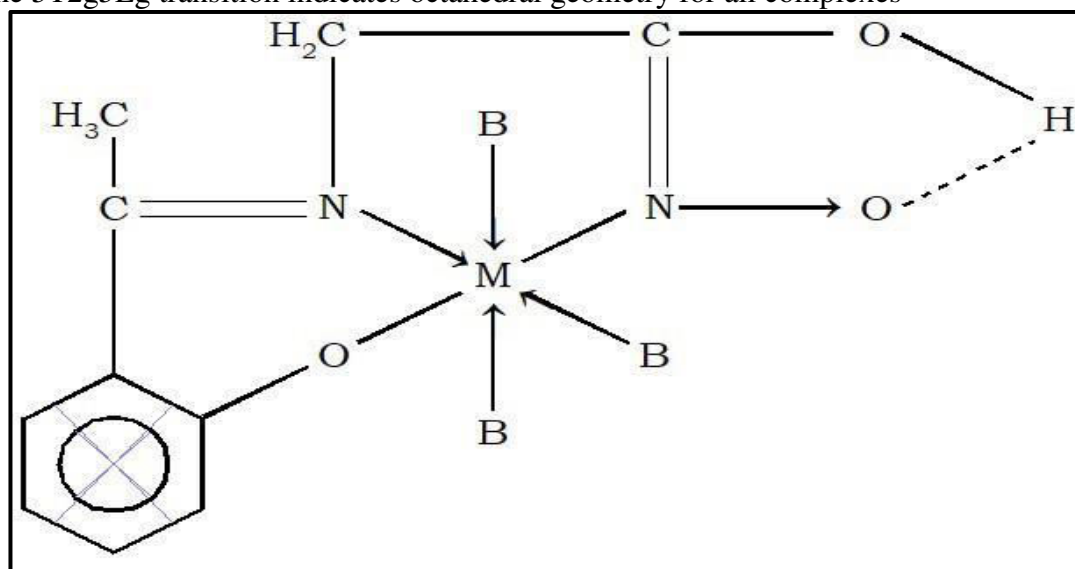
(ii) The semi-micro combustion process was used to estimate fuel, hydrogen, and **nitrogen**.

### RESULT AND DISCUSSION:

The electrical conductivity of Iron(II) complexes was measured in the range of 16-24 Am, indicating that all of the complexes are non-electrolytes.

The magnetic moment of Fe(II) complexes was found to be 4.96-5.08BM, suggesting that all of the complexes are octahedral.

A wide and unsymmetrical band obtained in the range of 10,450- 10,750cm<sup>-1</sup> for Iron(II) complexes due to the 5T<sub>2g</sub>5E<sub>g</sub> transition indicates octahedral geometry for all complexes



Where  $M = Fe(II)$  cation,  $L = ligand$  and  $B = bases$ .

### **3. INFRA RED SPECTRA OF THE LIGAND AND THE COMPLEXES:**

We have concluded that there are appreciable shifts in the ligand molecule's  $\nu(\text{OH})$ ,  $(\text{C}=\text{N})$ , and  $(\text{N}-\text{O})$  frequencies after the complex formation based on the study of infrared spectra of the ligand and complexes. After complex formation, the remaining frequencies due to the vibration of various groups present in the ligand molecule were unaffected. Due to combined  $(\text{NH}+\text{OH})$  vibrations, the highest band was obtained around  $3,480\text{cm}^{-1}$ . The deprotonation of the phenolic  $-\text{OH}$  group is indicated by the disappearance of a solid and sharp band obtained at  $3,410\text{cm}^{-1}$  in the ligand molecule due to the vibration of the phenolic  $-\text{OH}$  group in all complexes. The vibration of the phenolic  $\text{C}-\text{O}$  group in the ligand molecule has been assigned to a medium and sharp band at  $1,520\text{cm}^{-1}$ . This band has been moved to  $1,550\text{cm}^{-1}$ , indicating that the bond order of the  $(\text{C}-\text{O})$  group in the complexes has increased. This means that the phenolic  $-\text{OH}$  group's oxygen atom participates in the formation of metal cation bonds. Powerful hydrogen bonding in the ligand molecule has resulted in a sharp band about  $3,180\text{cm}^{-1}$  in the ligand molecule. Due to weaker hydrogen bonding, the frequency of this group has been increased to  $3,230\text{cm}^{-1}$ . This implies that after complex formation, the strength of hydrogen bonding weakens.

The  $\nu(\text{C}=\text{N})$  vibration produces a wide and solid band at  $1,640\text{cm}^{-1}$  in the ligand molecule and  $1,580\text{cm}^{-1}$  in the complexes. This decrease in frequency caused by the  $(\text{C}=\text{N})$  vibration indicates that aldimino as well as hydroxamino nitrogen atoms are involved in the complex formation. The  $30\text{cm}^{-1}$  rise in frequency after complex formation due to  $(\text{N}-\text{O})$  vibration also confirms the presence of one hydroxamino nitrogen atom in the complex formation. The fact that the frequency obtained by  $(\text{C}=\text{N})$  vibration increases by  $20\text{cm}^{-1}$  supports the participation of one aldimino nitrogen atom in the complex formation. The ligand's bonding sites are one aldimino nitrogen, one hydroxamino nitrogen, and one phenolic oxygen atom. The participation of the nitrogen atom of phenylisocyanide in the complex formation is indicated by a sharp and weak band about  $2,160\text{cm}^{-1}$  in the ligand and  $2,230\text{cm}^{-1}$  in the complexes. Due to  $\nu(\text{OH})$  vibration overlap, a separate band for coordinated  $\text{H}_2\text{O}$  cannot be obtained. The vibration of pyridine and picoline molecules produces two weak bands about  $960\text{cm}^{-1}$  and  $610\text{cm}^{-1}$ . The presence of quinoline in the complexes is suggested by a medium and sharp band obtained  $1430\text{cm}^{-1}$  due to the ring vibration of quinoline.

### **Conclusion**

Complexes with pyridine and different picolines display a number of bands in the far infrared and finger print fields. A deep and powerful band found in the complexes at  $440\text{cm}^{-1}$  caused by the vibration of the  $(\text{M}-\text{N})$  bond serves as additional evidence for the coordination of nitrogen atoms in the bond formation. The existence of a weak band at  $540\text{cm}^{-1}$  caused by the vibration of the  $(\text{M}-\text{O})$  bond serves as additional evidence that oxygen atoms are present in the complex formation. In light of elemental analysis, magnetic moment, electrical conductivity, electronic transition, and IR spectral behaviour, imino aceto hydroxamic acid is thus used to classify all  $\text{Fe}(\text{II})$  metal complexes with the ligand (*o*-hydroxy acetophenone)..

### **References**

1. Chen, Kaixuan, and Richard Dronskowski. "First-principles study of divalent 3d transition-metal carbodiimides." *The Journal of Physical Chemistry A* 123.43 (2019): 9328-9335.

2. Cano, A., et al. "Contribution to the coordination chemistry of transition metal nitroprussides: a cryo-XPS study." *New Journal of Chemistry* 43.12 (2019): 4835-4848.
3. Tang, Mixue, et al. "Toward efficient and air-stable carbon-based all-inorganic perovskite solar cells through substituting CsPbBr<sub>3</sub> films with transition metal ions." *Chemical Engineering Journal* 375 (2019): 121930.
4. Bozzi, Aaron T., et al. "Structures in multiple conformations reveal distinct transition metal and proton pathways in an Nramp transporter." *Elife* 8 (2019): e41124.
5. Cadar, Oana, et al. "Progress, Challenges and opportunities in divalent transition metal-doped cobalt ferrites nanoparticles applications." *Advanced Functional Materials* (2020): 1-17.
6. Naseem, Sajid, et al. "Comparison of transition metal (Fe, Co, Ni, Cu, and Zn) containing tri-metal layered double hydroxides (LDHs) prepared by urea hydrolysis." *RSC advances* 9.6 (2019): 3030-3040.
7. Chaudhary, Ratiram Gomaji, et al. "Thermal decomposition kinetics of some transition metal coordination polymers of fumaroyl bis (paramethoxyphenylcarbamide) using DTG/DTA techniques." *Arabian Journal of Chemistry* 12.7 (2019): 1070-1082.
8. Inokuchi, Yoshiya, Takayuki Ebata, and Thomas R. Rizzo. "UV and IR Spectroscopy of Transition Metal–Crown Ether Complexes in the Gas Phase: Mn<sup>2+</sup> (benzo-15-crown-5)(H<sub>2</sub>O) 0–2." *The Journal of Physical Chemistry A* 123.31 (2019): 6781-6786.
9. Abdel-Mottaleb, Mohamed SA, and Eman H. Ismail. "Transition metal complexes of mixed bioligands: synthesis, characterization, DFT modeling, and applications." *Journal of Chemistry* 2019 (2019).
10. Corkett, Alex J., and Richard Dronskowski. "A new tilt and an old twist on the nickel arsenide structure-type: synthesis and characterisation of the quaternary transition-metal cyanamides A<sub>2</sub>MnSn<sub>2</sub>(NCN)<sub>6</sub> (A= Li and Na)." *Dalton Transactions* 48.40 (2019): 15029-15035.
11. Sarac Oztuna, F. Eylul, M. Baris Yagci, and Ugur Unal. "First-Row Transition-Metal Cations (Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Fe<sup>2+</sup>) and Graphene (Oxide) Composites: From Structural Properties to Electrochemical Applications." *Chemistry–A European Journal* 25.12 (2019): 3131-3140.
12. El-ajaily, Marei M., et al. "Transition Metal Complexes of (E)-2 ((2-hydroxybenzylidene) amino-3-mercaptopropanoic acid: XRD, Anticancer, Molecular modeling and Molecular Docking Studies." *ChemistrySelect* 4.34 (2019): 9999-10005.
13. Wu, Fangling, et al. "Effect of Transition-Metal Ions on the Conformation of Enkephalin Investigated by Hydrogen/Deuterium Exchange and Theoretical Calculations." *The Journal of Physical Chemistry B* 124.1 (2019): 101-109.
14. Rogina, Anamarija, et al. "Tuning physicochemical and biological properties of chitosan through complexation with transition metal ions." *International journal of biological macromolecules* 129 (2019): 645-652.
15. Qiao, Jianwei, et al. "Divalent europium-doped near-infrared-emitting phosphor for light-emitting diodes." *Nature communications* 10.1 (2019): 1-7.