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Synthesis and Electrical conductivity of Crystals of *p*-dimethylamino benzaldehyde and o-phenylenediamine Ligand with Co(II) and Cr(VI) Metal

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ABSTRACT

This investigation involved the synthesis and Electrical characterization of Crystals of p-dimethylaminobenzaldehyde and o-phenylenediamine Ligand with Co(II) and Cr(VI) metal. An electrical conductivity of all crystal and schiffbase was measure at different temperature. Crystals were combined and form a tabulate of 6 mm diameter. It was heated at a 1°C / min

Keyword: Electrical Conduction, Electrical Conductivity, Schiffbase, Crystals.

INTRODUCTION

Electrical conduction is the movement of electrically charged particles through a transmission medium (electrical conductor). The movement of charge constitutes an electric current. This charge transport may reflect a potential difference due to an electric field, or a concentration gradient in carrier density[1-3]. The latter reflects diffusion of the charge carriers. The physical parameters governing this transport depend upon the material. Conduction in metals and resistors follows Ohm's Law. Conduction in semiconductor devices may occur by a combination of electric field (drift) and diffusion[4]. Engineers and scientists often use energy band diagrams to graphically illustrate the energy levels of electrons in different substances[5]. When a large number of atoms (of order $\times 10^{20}$ or more) are brought together to form a solid, the number of orbitals becomes exceedingly large[6]. Consequently, the difference in energy between them becomes very small. Thus, in solids the levels form continuous bands of energy rather than the discrete energy levels of the atoms in isolation. However, some intervals of energy contain no orbitals, no matter how many atoms are aggregated, forming band gaps. Within an energy band, energy levels form a near continuum. First, the separation between energy levels in a solid is comparable with the energy that electrons constantly exchange with phonons (atomic vibrations). Second, it is comparable with the energy uncertainty due to the Heisenberg uncertainty principle, for reasonably long intervals of time. As a result, the separation between energy levels is of no consequence[6-8].

MATERIALS AND METHODS

Materials

The ligand which is a Schiff base obtained from p- dimethylaminobenzaldehyde and o-phenylenediamine were used. The stock solution of CrO3, CoCl2, were prepared.

Preparation of Schiff base

p- Dimethylaminobenzaldehyde (1.4919 gm 0.1 mol) solution in ethanol and o-phenylenediamine (1.0814 gm 0.1 mol) solution in hot water were taken in round bottomed flask, 50 ml absolute ethanol was added and the mixture was refluxed for 3 hour. The refluxed mixture was put in ice bath, and then orange colored precipitate was obtained. It was suctioned filtered and washed with distilled water. Schiff base obtained was dried and kept in vacuum dessicator. The pure Schiff base was recrystallized from absolute ethanol

Preparation of crystals

The crystals were prepared by mixing Schiff base (0.1mol) in hot ethanol solution to (0.1mol) metal chloride salt solution prepared in distilled water. The schiff base solution was added slowly with continuous stirring to metal solution. It was refluxed for 2 hours and after refluxation, the mixture was heated for 10 minutes till the contents was reduced to half. Then the crystals precipitated out after being cooled. The precipitate was filtered and washed with the distilled water. All crystals were dried and kept in vacuum dessicator.

Electrical Conductivity Measurement

To measure electrical conductivity of all crystal a crystal were combined and form a tabulate of 6 mm diameter. Tabulate form of crystal was prepared at S. K. Patel college of Pharmaceutical Education and Research, Ganpat University, Kherva, Gujarat. A rotary Tablet machine was used to prepare tabulate of crystals with hydrostatic pressure. A machine required minimum quantity of 100mg and maximum of 1000mg. An electrical conductivity of all crystals was measured at Department of Chemistry, S. P. University, V. V. Nagar, Gujarat. High resistance electrometer was used to measure electrical conductivity. The instrument works in a dynamic mode. The temperature was varied for measurement of conductivity of all crystals.

RESULTS AND DISCUSSION

An electrical conductivity of all crystal was measure at different temperature. A uniform thin layer of silver paste was applied on both the sides of the pallet of crystals, providing electrical contacts. Average diameter and thickness of each pallet were measured and found 6 mm. The pallet was firmly pressed between two circular metal disks functioning as electrodes. The other ends of electrodes were passed through the pallet holder for connections. The entire assembly was placed in a furnace. It was heated at a $1^{o}C$ / min. Examination of result presented in Table-I reveals that the electrical conductivity of all crystals from 10^{-5} to 10^{-6} Ω^{-1} cm^{-1} at 25°C. Thus the conductivity of Cr(VI) and Co(II) crystal increases with increases with temperature, slowly initially and very rapidly after some point between 400°K to 500°K depending upon the nature of material used to prepare crystal. The plots of electrical conductivity versus 1/T shown in figure I to figure III for Cr(VI) and Co(II) crystal are found to be near about linear in the higher temperature range, the temperature at which this occure designated as the break temperature. It is worth nothing that the electrical conductivity of Cr(VI) and Co(II) crystal is highly dependent on the nature of material structure, the nature of metal and the size and shape of the ligand associate with crystal. In the present cases there would be linear structure of the Cr(VI) and Co(II) crystal because the crystal formed through metal and schiffbase.

Table I: Electrical Conductivity of Crystals at Temperature

1/T $(^0K)^{-1}$	Electrical conductivity (mho per cm)of crystals (at temperature)		
	Schiffbase	Crystal of Co(II)	Crystal of Cr(VI)
3.24	$0.032x10^{-11}$	$9.220x10^{-6}$	$1.498x10^{-5}$
3.09	$0.033x10^{-11}$	$9.394x10^{-6}$	$1.555x10^{-5}$
2.19	$0.033x10^{-11}$	$9.402x10^{-6}$	$1.587x10^{-5}$
2.83	$0.032x10^{-11}$	$9.478x10^{-6}$	$1.615x10^{-5}$
2.75	$0.032x10^{-11}$	$9.512x10^{-6}$	$1.655x10^{-5}$
2.68	$0.032x10^{-11}$	$9.598x10^{-6}$	$1.695x10^{-5}$
2.61	$0.032x10^{-11}$	$9.625x10^{-6}$	$1.712x10^{-5}$
2.54	$0.032x10^{-11}$	$9.713x10^{-6}$	$1.732x10^{-5}$
2.48	$0.032x10^{-11}$	$9.731x10^{-6}$	$1.749x10^{-5}$
2.36	$0.032x10^{-11}$	$9.738x10^{-6}$	$1.752x10^{-5}$
2.25	$0.033x10^{-11}$	$9.738x10^{-6}$	$1.752x10^{-5}$
2.15	$0.033x10^{-11}$	$9.738x10^{-6}$	$1.752x10^{-5}$
2.11	$0.033x10^{-11}$	$9.738x10^{-6}$	$1.752x10^{-5}$

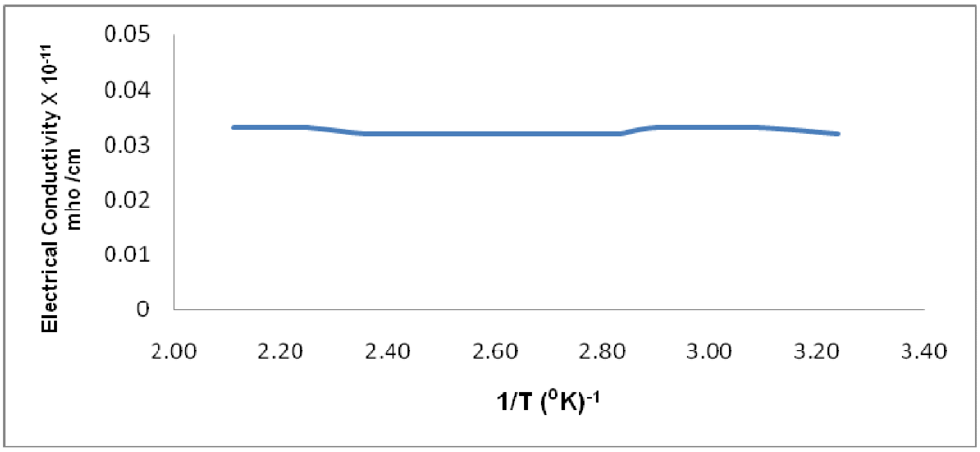

Figure I: Electrical conductivity curve of Schiff base

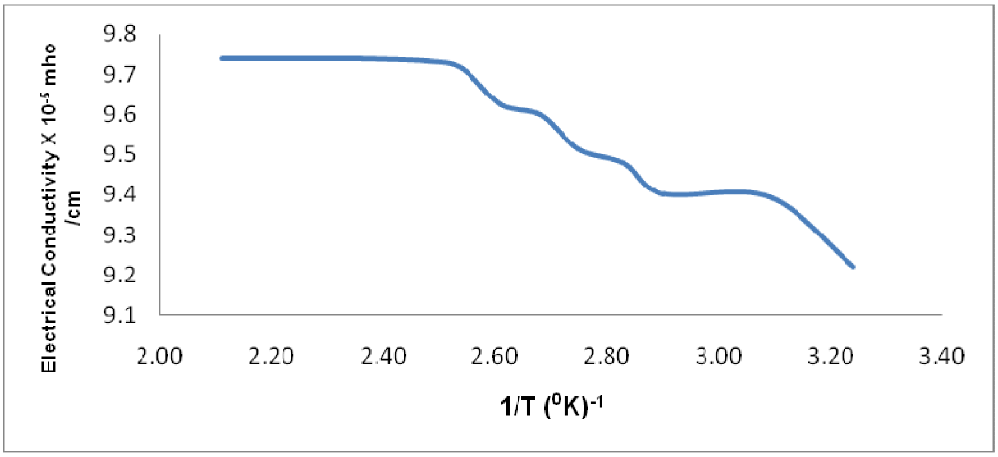

Figure II: Electrical conductivity curve of Co(II) crystal

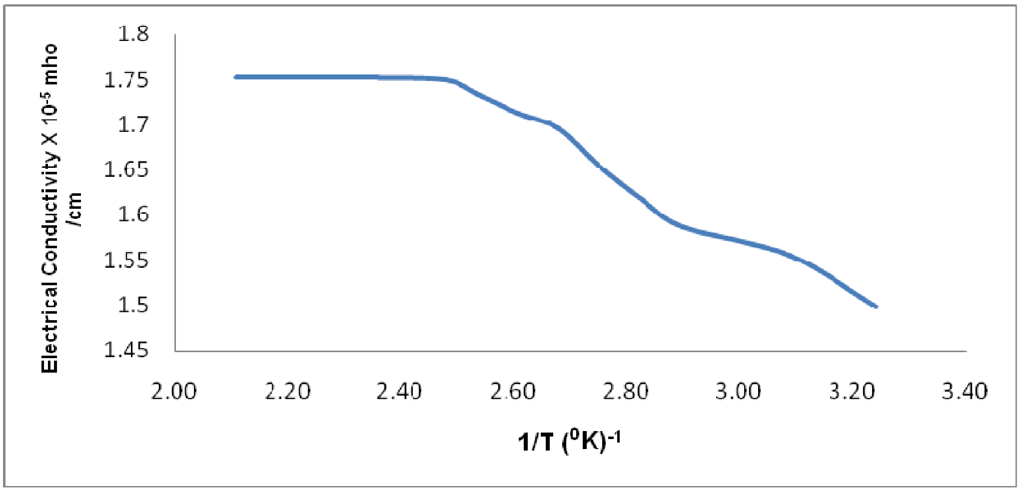

Figure III: Electrical conductivity curve of Cr(VI) crystal

CONCLUSION

However the results of our electrical conductivity measurments of Cr(VI) and Co(II) crystal reveal that they can be ranked as semiconducting materials with high resistance. The Electrical conductivity of Schiffbase observed very low near about insulator and does not change with temperature.

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