CHAPTER 8

SCOPE FOR FUTURE WORK

8.1 Introduction

Materials with coordinate structures remain an extensively investigated subject in current Physics and Chemistry. Most of the promising technological applications deal with compounds having coordinate structure. The binary compounds form a significant group of coordinate crystal, besides d-block elements, but the attention paid to them has not been by far so great as in the case of latter ternary materials.

A crystal growth and characterization such as physical, chemical and biological were observed in the current work as discussed in synopsis. It has also been realized that properties of crystals strongly depend on growth conditions used for their synthesis. Author has investigated into the feasibility of growing such types of crystals in the form of single crystals and to study their various physical properties. He has also seen the effect of using different transporting agents on the growth of these crystals. He has made a positive contribution towards the compound which are used in all branch of science. The entire work carried out in the above manner has been described in the present thesis. Attempts have been made here to come to some important conclusions on the basis of the present work and to find out scope for future work.

8.2 Conclusions

Single crystals with powder form of d-block metals (Cu, Ni) Salicyldehyde and Ethelenediamine ligand have been successfully grown by Flux Technique in our laboratory.

The crystallization methods with their important parameter such as purification, perfection and different material growth technique with appropriate examples discussed. The building unit and MoF(Metal-Organic Frameworks) also attempted.

Crystal of 1:1 Binary mixtures (M^1 L_1or L_2 and M^2L_1or L_2) and 1:1:1 ternary mixtures ($M^1L_1L_2$ and $M^2L_1L_2$) were produced but crystals of ternary mixtures $M^1L_1L_2$ and $M^2L_1L_2$ were used for further work

Examination of the results of chapter 3 reveals that the electrical conductivities of all the crystals are in the range from 10^{-12} to 10^{-11} $ohm^{-1}.cm^{-1}$ at 25^0C. This show that the conductivity of crystals is rather low at room temperature but the conductivity increase with temperature slowly initially and very rapidly after some point between 410 and 510 ^{0}K depending upon the nature of the crystals.

The plots of log σ vs 1/T for all samples are found to be linear in the higher temperature range. The temperature at which this occurs is designated as the break temperature. The change in the value of σ beyond this break temperature and in the high temperature range is comparatively faster. Below the break temperature the change in the value of log σ vs 1/T is slow and regular except in the case of Ni(II) crystal; with these latter three the variation in the value of σ below break temperature is not regular. In these cases the value of σ increases and then decreases and further increases with increase in temperature

In fact the results of electrical conductivity of all crystals reveal that they can be ranked as semi conducting material with high resistance

Compounds containing Cu^{2+} are considered to exhibit magnetic moment close to the value (1.73 B.M.). However, the magnitude of magnetic moment (μ_{eff}) is found to be dependent on electronic spin and orbital motion and therefore many Cu^{2+} containing compounds exhibits theoretical magnetic moment 1.73 B.M. (no orbital contribution) to a value of 3.0 B.M. However, the measured μ_{eff} usually ranges from 1.7 to 2.2 B.M. These results reveal the distorted octahedral geometry for these crystals.

Magnetic moment values of Ni(II) crystal 2.83 B.M. suggest tetrahedral geometry in high spin complexes. According Tanabe –Sugano diagram six coordinated Ni(II) crystals belong to $3d^8$ system and there are three spin allowed transition mainly

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Results inspection data of magnetic moments reveals that the metal chelates of Cu^{2+} and $Ni2^{+}$ are paramagnetic in nature

Each crystals degradation in two steps. The degradation of all the crystals start in the temperature Range of 200 to 350^0C depending upon the natures of crystals. The wt. loss amount in this first stage is in between 4.5 to 7 % this may be due to water molecules associated in to the crystals. The second stage of decomposition of all crystals is rapid with the loss of mass about 50%. This is due to “in situ” formation of metal oxide during degradation. Which accelerate the rapid degradation of crystals. The last stage of digression cause a mass loss of about 80%. This is due to loss molecular fragments of polymers.

Thermal conductivity of all crystals measured between 283°K to 373°K with equal interval of 5°K. Thermal conductivity increased as temperature increased in all the crystals which indicate that all the crystals are good conductor of heat but thermal conductivity almost remain constant in schiffbase. In Ni(II) Crystal a thermal conductivity increased continuosly up to 363°K and then become constant. The rate of increased in thermal conductivity of Ni(II) Crystal is higher and it is near about metal. This is observed because crystal synthesized by metal of Ni(II). The maximum value of thermal conductivity observed in this work was 0.828 W/cmK. In Cu(II) Crystal a thermal conductivity increased continuously but the rate of change observed very lower than the Ni(II) crystal. The maximum value of thermal conductivity of Cu(II) Crystal was observed in this work is 0.8161 W/cmK. In schiffbase a thermal conductivity almost remain constant and observed very lower than the crystals. The maximum value of thermal conductivity of schiffbase was observed in this work is 3.0314W/cmK. The rate of change in thermal conductivity is higher in Ni(II) crystal and lower in Cu(II) crystal and schiffbase of in Ni(II) crystal a composition of metal is higher than the Cu(II) crystal

The conductivity of crystals was measured in DMF as solvent using conductivity meter model, Systronic 361 μ digital. All the crystals showed the molar conductance values for 10^{-3}M concentration in range 2 to 78 $ohm^{-1}cm^{2}$ mol^{-1}. It is suggesting that all crystals are nonelectrolyte in nature.

8.3 Scope for future work

The author has the relief of satisfaction that undoubtedly efforts have been made by him in contributing to all branch of science, there are still a considerable number of aspects remained untouched and deserves further investigation.

In order to confirm the existence of phase transitions in the low and high temperature range, crystals must be examined by X-ray diffraction and electron diffraction in these temperature ranges.

It will be highly desirable to extend this range of pressure to higher pressures to look for the possibility of phase transitions and to see the effect of using different transporting agents on the physical properties under extremely high pressures.

It appears from the literature that stoichiometric amount of metal in crystals has a considerable effect on its physical properties, one may therefore take up the growth of in the single crystal form using the flux method developed during the work carried out by the author for the present thesis and compare the results with polycrystalline and amorphous samples of the same materials.

We can study Persistent Photoconductivity (PPC) on these samples which has never been observed previously. This can provide vital information on the stability of impurities, the mechanisms for carrier storage and relaxation, and the transport properties in semiconductors.

Surface of these crystals are to be examined critically by SEM to improve the overall efficiency of crystal.

Nanocrystals, Nanorods and Nanowires of d-block metals (Cu, Ni) and p-dimethylaminobenzaldehyde and o-phenylenediamine ligand can be studied in detail.

Powder XRD can study of this crystals which can give complete structure, Standard value of d spacing, d spacing angle, tip width and particle size

Different ions can be implanted within these crystals at different dosing levels and further changes occurring in their properties can be investigated.

All such studies will definitely help in knowing such materials more closely and accurately.