PREFACE

The availability of appropriate crystalline materials is a crucial factor for the development of advanced technologies as well as for breakthrough in applied and basic sciences. Crystals are the prime candidates for the fabrication of optoelectronic devices, high efficiency solar cells, fibre optic communication and other electronic industries. Growing need for technologically important crystals and crystalline heterostructures with specific properties recently renewed interest on fundamental processes and understanding phenomena.

With the advent of the Solvent Evaporation (SE) Method for Solid Crystal Growth, a large number of these compounds can easily be synthesised. An interesting feature of these compounds is that they crystallise as powder, a form very suitable for the investigation of the optical, electrical properties and the examination of crystal structure defects. This well-defined family of compounds whose physical and chemical properties have stimulated a considerable amount of interest since few years. One of the most significant features of these materials is that their weak interlayer bonding permits the process of intercalation to occur in a way similar to that in other layer type compounds e.g. graphite and silicate clay minerals. Thus metal atoms, ions, organic and inorganic molecules could be introduced successfully between the layers to form stoichiometric and non-stoichiometric compounds.

Crystallization from solution can be thought of as a two step process. The first step is the phase separation, (or birth), of a new crystals. The second is the growth of these crystals to larger size. These two processes are known as nucleation and crystal growth, respectively. Analysis of industrial crystallization processes requires knowledge of both nucleation and crystal growth. The ligand which is a Schiff base obtained from \textit{p}-dimethylaminobenzaldehyde and \textit{\textit{o}}-phenylenediamine were used. The stock solutions of FeCl$_3$, NiCl$_2$ and CuCl$_2$ were prepared.
The work proposed in the thesis is divided into Eight Chapters.

**Chapter 1** deals with the complete survey of the material used to developed crystals and the information regarding growth of this type of crystals. This chapter also describes importants of the transition metals and crystals growth from the combination of transition metal and ligands. This chapter also gives full information of crystallographic study in the different field of science and engineering. The mechanism of growth and Metal-Ligand formation fully explained in current chapter

**Chapter 2** deals with the complete survey of the literature and the existing information on growth, different properties of crystals.

**Chapter 3** describes the growth technique with three step model and required mathematical formulas. The complete crystal growth techniques are displayed in current chapter. The salient features of Solvent Evaporation (SE) Method for Solid Crystal Growth used for the growth of crystals described. A detail of experimental set-up and required peripheral units used for crystal growth is also covered in this chapter. Three methods to growth a crystals are also explained and their silent features described in current chapter. In current research work all three methods were used but crystal growth from method 3 - Rotary Evaporators are used for further research work by author. Specifications of spares required to particular techniques are covered in this chapter. This chapter also deals with preparation of material, preparation of schiffbase from ligand and preparation of crystal. Chemistry behind production of schiffbase and crystal growth with chemical formula is discussed in this chapter. Crystal of 1:1 Binary mixtures (M₁L₁or L₂ and M²L₁or L₂) and 1:1:1 ternary mixtures (M₁L₁L₂ and M²L₁L₂) were produced but crystals of ternary mixtures M₁L₁L₂ and M²L₁L₂ were used for further work (where M₁, M² are Cu²⁺, Ni²⁺, Fe³⁺ as required).

**Chapter 4** deals with the optical study such as Infrared absorption spectral study and Ultra Violet-Visible reflectance spectral study. The magnetic
moment of the crystals are also derived and discussed in this chapter. The different aspect of absorption and reflectance of optical radiation is covered briefly in ongoing chapter. The experimental setup for getting spectral characteristics (Infrared absorption and UV-Vis reflectance) is discussed in current chapter. The specification of Infrared spectrometer and UV-Vis spectrometer are displayed and discussed in current unit.

Infrared spectra of crystals exhibit bands corresponding to Schiff base and metal ions. Bands were observed in far IR region. It is known that in IR spectra of crystals, there are strong coupling and hence, quantitative interpretation of the bands is not possible without the normal coordination analysis. The important infrared absorption bands and spectra of crystals are shown in Table: 4.1 and Figures: 4.8 to 4.10 of this chapter. The spectra of crystals are obtained in the range of 4000-400 cm\(^{-1}\) using compound in the form of KBr pellets. In this chapter how the IR spectral pitch arises were explained with appropriate reasons.

This chapter deals with the important aspect which are responsible to generates picks in UV-Vis reflectance spectra such as metal to ligand charge transfer [MLCT], ligand to metal charge transfer [LMCT], Spin selection rule, Laporte selection rule, Calculation of Racah Parameter from Electronic Spectra etc. In current chapter author completely discussed the result obtained from UV-Vis reflectance spectra and responsible parameter crystal vise. On the basis of UV-Vis spectral study and allowed transition the geometry of crystals were obtained and discussed.

According to geometry and optical study (IR and UV-Vis spectra), the magnetic moment of all crystals were obtained and discussed briefly.

**Chapter 5** covered thermal analysis in the means of Thermogravimetric analysis and Thermal conductivity measurement. In current chapter different method for thermogravimetric analysis were discussed with their silent features. This chapter also explained the use of thermogravimetric analysis in
different type of materials. The apparatus to obtained thermogram of the crystals were discussed. The factors affected to thermogram of the crystals were discussed briefly in the result and discussion part of this chapter. In present investigation, thermogravimetric analysis of the crystals was carried out in air by heating at a constant rate of 10°C per minute using a Perkin-Elmer TGA-7DSC-PYRIS-1-DTA-7 thermal analysis system. According the weight loss of the crystals as a function of temperature, the water molecular associate with crystals was explained in current chapter.

The thermal conductivity of the crystals was measured in ongoing chapter as a function of temperature. The theoretical background and sample and furnace preparation are also covered in this chapter. Common thermal conductivity measurement methods are briefly discussed with material type, temperature range in °C and property range in W/(m.K). The Hot-Wire method was fully discussed in current chapter as author used this method for research work. An experimental apparatus with photograph and sample size were displayed in this chapter.

Chapter 6 deals with electrical and magnetic study of the crystals. In current chapter two different methods to measure electrical conductivity were discussed with their silent features. To measure electrical conductivity of all crystal a crystal were combined and form a tablate of 6 mm diameter. Tabulate form of crystal was prepared by Rotary Tablate Machine which was discussed with their specification. High resistance electrometer was also discussed with their specifications in experimental part as it used to measure electric conductivity of the samples.

Magnetic properties and types of magnetic behavior of crystals were discussed in ongoing chapter.

Chapter 7 deals with chemical and biological study of the crystals. In current chapter elemental analysis and molecular conductivity of the crystals
were obtained as a part of chemical analysis. An experimental setup of C-H-N-S-O elemental analyzer was discussed with their specification.

Antibacterial assay of crystals was obtained as part of biological study of crystals.

Conclusions drawn from the entire work and scope for future work finds place in Chapter 8.