PREFACE

Thin films have a decisive influence on the internal physical properties of the materials and differ in a profound way from the corresponding properties of the bulk material. The reduction of the dimension of a material to an order of several atomic layers creates an intermediate system between macro systems and molecular systems, thus providing us with a method of investigation of the microphysical nature of various processes. It is possible to say in general that the thin film limit is determined by the thickness under which the described anomalies appear, but this differs for different physical phenomena.

Phthalocyanines are an important class of materials used in the production of inks, plastics, dyes, photocopying materials, chemical sensors, liquid crystal colour display systems and micromolecular devices. Several features of the metal-substituted phthalocyanines make them attractive candidates for the use in electronic and optoelectronic devices. Phthalocyanine thin films are particularly interesting because of their chemical and thermal stability, ease of preparation, compatibility with vacuum deposition and light absorbing properties in the visible and infrared regions. Optical studies performed on trivalent and tetravalent metal phthalocyanines have shown that these materials have reasonable energy conversion efficiencies and the ratio of dark conductivity to photoconductivity is quite small. The electrical sensitivity to adsorbed impurities favours phthalocyanines for use as chemiresistors and surface acoustic wave microgravimetric devices.
The d.c. electrical conductivity of phthalocyanine thin films shows ohmic conduction at low voltages and space charge limited conduction at high voltages. Detailed investigations on the electrical properties of the phthalocyanines depend on the accurate knowledge of their molecular and crystal structures. There exist differences among different workers regarding the structure of the polymorphic forms of phthalocyanines. The electrical conductivity of the metal sulphides, viz. CdS, ZnS and MnS films depends on the evaporation rate, substrate temperature and post evaporation annealing. The optical properties are also found to depend on the crystal structure, deposition parameters and annealing temperatures.

The thesis deals with the techniques of preparation of metallic sulphide thin films, metal substituted phthalocyanine thin films and multilayer films with copper phthalocyanines and the study of their electrical conductivity, optical properties and structural characteristics.

Chapter 1 gives the introduction and a brief review of the earlier studies on sulphide thin films and their multilayer films with copper phthalocyanines.

In Chapter 2, the apparatus and experimental set up used in the present study are discussed. Methods of film preparation including the chemical bath deposition technique and thermal evaporation technique are given here. Brief descriptions of the vacuum coating unit, different pumps and gauges used, UV-VIS-NIR spectrophotometer, Keithley electrometer and X-ray diffractometer which are used in the present study are described. Different techniques used for thickness measurement of the deposited films are also discussed.
Chapter 3 deals with the preparation of sulphide thin films by chemical bath deposition technique and their multilayer films with vacuum sublimed copper phthalocyanine.

Chapter 4 deals with the electrical conductivity studies on CdS, ZnS, MnS, CuPc and multilayer CdS-CuPc, ZnS-CuPc, MnS-CuPc and ZnS-MnS thin films. The measurement of electrical conductivity and determination of the activation energy are given in this chapter. Variation of the thermal activation energy with annealing temperature are discussed here.

In Chapter 5, the optical studies on CdS, ZnS, MnS, CuPc and multilayer CdS-CuPc, ZnS-CuPc, MnS-CuPc and ZnS-MnS thin films are made. The optical band gap and their maximum absorption coefficient are determined. The variation of the band gap and the maximum absorption coefficient with annealing temperature are also studied.

Crystal structure and lattice constant determination of the CdS, ZnS, MnS, CuPc and multilayer CdS-CuPc, ZnS-CuPc, MnS-CuPc, ZnS-MnS thin films are given in chapter 6. Also the effect of annealing on the structure is given in this chapter. Lattice parameters are also determined from the X-ray diffractograms using the International Centre for Diffraction Data-Powder Diffraction (ICDD-PDF) data.

Chapter 7 is the concluding chapter, which gives the summary of the results and discussion. The future scope of this work is also indicated.
Most of the work presented in the thesis have either been published in international journals or presented in conferences or are in the process of publication. The list of publications is given below.

**List of Publications**


5. “Photoacoustical properties of chemically deposited cadmium sulphide thin films of different molar ratios”. Shaji Varghese, Mercy Iype, E.J.


