PREFACE

Thin films of transparent conducting coatings have wide spread applications due to their high transparency in the visible and near infrared region and high electrical conductivity. The easiest method to obtain good transparent conductors is to create electron degeneracy in wide band gap oxide materials by controlling the non-stoichiometry or by adding dopants. The distinctive characteristics of the transparent conductors have been applied in coating electrodes in optoelectronic devices, electroluminescent devices, photovoltaic cells, electrochromic devices, liquid crystal displays and gas sensors.

Although there are plenty of materials that are either conductive or transparent, the transparent conductors exhibit a useful compromise of both these desirable properties. In semi conducting oxide films such as tin oxide and indium oxide, good transparency and electrical conductivity can be obtained by adding dopants that enter substitutionally into the lattice or by adjusting the preparation condition, thereby obtaining a controlled non stoichiometry of the material.

In this thesis, studies on the electrical, optical and structural properties of the transparent conducting oxide thin films of indium oxide, tin oxide and indium tin oxide are presented. These films are grown by thermal evaporation technique.
The electrical and optical properties of these films mainly depend on the microstructure, stoichiometry and the nature of the impurities present. It also depends on the substrate temperature, deposition conditions and annealing.

The large conductivity of oxide conductors is due to high electron concentration resulting from the deviation from the stoichiometry and doping effects. The deviation in stoichiometry is due to the anion vacancies and excess interstitial electrons.

In chapter I, the properties of transparent conductors, earlier studies on indium oxide, tin oxide and indium tin oxide are described. List of reviews is also given.

In chapter II, the vacuum coating unit, different types of pumps used, Keithley programmable electrometer, the electrical conductivity cell, UV-visible Spectro photometer and the X-ray diffractometer used in the study are described. Preparation of films, annealing, measurement of thickness, measurement of electrical conductivity, measurement of optical transmission are also described.

In Chapter III, the electrical conductivity, activation energy, sheet resistance and their variation with different parameters for indium oxide, tin oxide and indium tin oxide are presented. In chapter IV, The transmission spectrum, optical band gap and variation of optical band gap of these material films with different processing parameters are also studied. In Chapter V, the film structure and change of structure of these films with different parameters are investigated. Chapter VI is the concluding chapter, which gives the summary of the results obtained discussion. The future scope of the work is also presented.
Most of the work presented in this thesis have either been published in journals or presented in international/national conferences or are in the process of publication. A list of such papers is given below:

1. The effect of deposition rate on electrical, optical and structural properties of ITO thin films.

2. Effect of substrate temperature on the electrical and optical properties of reactively evaporated tin oxide thin films.

3. Electrical, optical and structural characterization of reactively evaporated indium oxide thin films.
   P. S. Raghupathi, Joseph George & C. S. Menon, Asian Chemistry Letters (Accepted for publication).

4. Optical studies on indium oxide thin films.

5. Optical studies on tin oxide thin films.
6. Optical characterization of indium tin oxide thin films.

P. S. Raghupathi & C. S. Menon, International Conference on Advances in Polymer blends, Composites, IPNS and Gels: Macro to Nano scales, Mahatma Gandhi University, Kottayam, Kerala (2005).

7. Optical characterization of indium oxide thin films.


8. Electrical and optical properties of thermally evaporated ITO thin films.