PREFACE

Semiconductors are extremely sensitive to impurity atoms (doping), defects and charge carriers. If the charge carriers are introduced by doping magnetic impurity atoms into the host lattice of semiconductors, the material would possess magneto-optical properties. The realization of materials that combine semiconducting behavior with magnetism has long been a dream of material physicists. Adopted a strategy for creating systems that are simultaneously semiconducting and magnetic is initiated in the 1980's by introducing local moments into well-understood semiconductors. The result is a new class of materials now known as Diluted Magnetic Semiconductors (DMSs). DMS are the materials in which dilute concentration of magnetic ions is incorporated in a host lattice of semiconductors. The substitution leads to magnetic behavior along with semiconducting property. In semiconductors the information is transferred by charge carrier. These dilute alloys and compounds are multifunctional materials essential to combine both charge and spin of the electrons.

The foremost characteristics of DMS materials should be its magnetic behavior and high Curie temperature, preferably above room temperature.

Magnetic semiconductors are expected to have a variety of technological applications in magneto electronic devices. Here spin of charge carriers is exploited to provide new functionality for electronic devices. The electron spin is explored in data storage media such as a hard disk of a computer; pen drives, a magnetic tape of a camcorder and Magneto-resistive Random Access Memory (MRAM).

The thesis includes history and background information, perception of the present work, the experimental work carried out, the techniques used, results obtained, outcomes and conclusions. The thesis contains the following chapters:

Chapter 1: **Introduction**

The brief introduction on semiconducting dilute alloys and compounds like II-VI, III-V and IV-VI & how transition metals doping can make these materials Dilute Magnetic Semiconductors. Along with that a detailed review of DMS system is included. At the end of the chapter, the motivation of the present work is presented.

Chapter 2: **Analytical techniques employed for characterization**

This chapter gives the outlines of fabrication and characterization techniques which are used in the present study. This chapter includes the details of experimental techniques for the synthesis and characterizations of semiconducting alloys and compounds for both bulk and thin films.

Chapter 3: **Dilute Fe doped $Ge_{1-x}Sb_x$ alloy film system**

The structural, electrical, surface morphological and magnetic properties of the Sb concentration variation in $Fe_{0.01}Ge_{1-x}Sb_x$ thin films are studied. The X-ray diffraction pattern reveals predominantly Ge phase with FeGe and $FeGe_2$ compound phases. The resistivity results show the semiconducting nature of film having a negative temperature coefficient of resistance. From surface morphological studies the effect of Sb concentration variation on the particle size and roughness of the film is observed. The Magnetic Force Microscopy (MFM) images corresponding to the Atomic Force Microscopy (AFM) images show the films exhibiting ferromagnetic interactions at room temperature.

This chapter also deals with the effects of ion beam irradiation on $Fe_{0.01}Ge_{1-x}Sb_x$ films. The films are irradiated with 100 MeV Oxygen (O^{+8}) ions with the fluence rate of 1×10^{12} ions/cm^2. The effect of irradiation on structural, electrical and morphology of films is discussed.

Chapter 4: Dilute Fe doped $Sb_{1-x}Se_x$ and SbSe bilayer film system

This chapter elaborates various characterizations of dilute Iron doped $Sb_{1-x}Se_x$ (x = 0.01, 0.05 and 0.10) alloy films grown on Silicon substrate. The X-ray diffraction pattern shows that the reflection of the different 2θ value is due to Sb. The resistivity versus temperature results shows the metal-to-semiconductor phase transition above room temperature. The particle size distribution evaluated using AFM images are the Se concentration dependent. The films exhibit ferromagnetic interactions at room temperature.

This chapter also include the study of Sb-Se bilayer films, with varying thickness of Se layer, grown on quartz substrates. Comparative study of Sb-Se as deposited, annealed and irradiated bilayer films are discussed.

Chapter 5: Studies of Iron doped InSb bulk and TM doped InSb films

This chapter elaborates the effect of Fe concentration variation in $In_{1-x}Fe_xSb$ bulk system using structural, hyperfine interactions studies using XRD and Mossbauer studies respectively.

The various studies of transitional metal (Fe, Mn, Co and Ni) doped InSb films like structural, R-T measurements, Magneto-resistive measurement at different temperatures, M-H and M-T, surface morphology, magnetic force microscopy is also discussed in this chapter. The XRD pattern of InSb films shows cubic structure. Resistivity measurements show semiconductor nature of the films. The Magneto-resistance study shows that with the increase in magnetic field magneto-resistance of the TM doped InSb film drastically increases at ~ 20 K temperature.

Chapter 6: Summary and conclusion

A summary of the present work and the future prospects are discussed.