ABSTRACT

The discovery of new magnetic materials has made possible to develop several practical devices which work based on principles of magnetism. One of the rapid advancement of technology that uses the magnetic property of materials is the information storage/recording devices. The superparamagnetic effect has put a limit in increase of storage density of a magnetic media by reducing grain size of present conventional magnetic storage devices. The magnetic materials such as amorphous RE-TM alloy films and FePt-based alloy thin films are possible alternative candidates to counter the superparamagnetic limit due to their large magnetic anisotropy energy.

The magnetic properties of third element doped CoTbNi and FePtCo ternary alloy thin films have been studied in this thesis. The thin films are deposited by dc magnetron sputtering under high vacuum using co-sputtering of elemental targets Ni and Co with alloy targets $C_{85}Tb_{15}$ and $Fe_{40}Pt_{60}$ respectively. The films are characterized by various techniques such as energy dispersive x-ray spectroscopy (EDX), 3D optical profilometer, atomic force microscopy (AFM), x-ray diffraction (XRD), grazing incidence x-ray diffraction (GIXRD) and vibrating sample magnetometer (VSM).

The current thesis is organised as follows

- **Chapter 1:** Gives the introduction of the relevant topics related to the thesis work, review of RE-TM and FePt-based alloy films, and defines the objectives of the thesis.

- **Chapter 2:** Gives the experimental methodology and techniques used for the experimental work and characterization carried out along with details of various experimental parameters and procedures followed for sample fabrication of thin films.

- **Chapter 3:** It presents the experimental results and discussion of CoTbNi RE-TM ternary alloy thin films. The CoTbNi alloy films crystallize in amorphous phase and structural phase transition to crystalline phase does not takes place upon post-annealing. Though CoTbNi films are amorphous in nature, they exhibit perpendicular magnetic anisotropy whose strength decreases with increase in third element Ni doping. The Ni doping also results reduction in

saturation magnetization due to the antiferromagnetic interaction. Annealing of these films results enhanced remanent magnetization and squareness of M-H curves. But perpendicular magnetic anisotropy of these films is completely lost due to the post-annealing.

- **Chapter 4:** It presents the experimental results and discussion of FePtCo ternary alloy thin films. The FePtCo films form FCC structure and show (111) texture. The third element doping to FePt and in-situ annealing of these films do not influence the structural ordering and FCC phase is retained under all deposition conditions. The FePtCo alloy films exhibit in-plane magnetic anisotropy under all deposition conditions with very large effective anisotropy constant in order of 10^6-10^7 erg/cc. The strength of magnetic anisotropy decreases with Co doping under as-deposition condition resulting from antiferromagnetic interaction of Co with FePt as evidenced by saturation magnetization. An optimum Co doping in the neighbourhood of 17 at. % is observed in in-situ annealed and Cu-underlayered films below which Co addition favours antiferromagnetic interaction. Above 17 at. %, Co doping favours ferromagnetic interaction due to which enhanced magnetization as well as effective anisotropy are observed. The insertion of Cu-underlayer has proven to improve the magnetization and in-plane anisotropy of these films.
- **Chapter 5:** It summarizes all the conclusions drawn based on the present research work. The experimental work detailed in this thesis provides new information about the magnetic behaviour of amorphous CoTbNi and FCC phase of FePtCo ternary alloy systems and contributes to overall understanding of the physics of these class of materials. This also includes future scope of works that may be carried out to enhance further understanding of the magnetic behaviour in the field.