ABSTRACT

The Cantilever Beam Magnetometer (CBM) is an apparatus by means of which *in-situ* measurement of mechanical and magnetic properties of thin films can be performed. In this thesis we present the design, fabrication and automation of a cost-effective home built CBM set-up under high vacuum. The developed CBM instrument was calibrated and used to measure the real time stress evolution during the growth of magnetic or non-magnetic thin films on substrates and thereafter magnetization and magnetostriction of the magnetic films as a function of the applied magnetic field. The reproducible performance of the instrument has been demonstrated with various magnetic (Co, Fe) and non-magnetic (Ag) polycrystalline films deposited on a semiconducting (p-Si) substrate. Studies on the electrical and magnetic transport properties of the deposited films showed strong dependence on the morphology of the films. Studies on the transport characteristics of ferromagnetic metal/semiconductor heterostructures show the rectifying property at all temperature. The studies of the spin-polarized transport across the heterojunctions reveal that the characteristics are dependent not only on the spin-polarization of the magnetic films but also on the property of the semiconductor substrates. Based on a generalised model the presence of the critical temperature and a giant positive junction magnetoresistance (JMR) has been explained for such heterojunctions. We have also synthesized Co/CoO nanoparticles having core-shell structures and investigated the non-linear electrical transport as a function of temperature. Electrical transport properties have been interpreted in terms of tunnelling mechanism where tunnelling between ferromagnetic Co nanoparticles takes place through the antiferromagnetic CoO layer. Analysis of the dynamic conductance indicates that the inelastic tunnelling via localized states of antiferromagnetic CoO layer is dominant in the transport mechanism at low temperature. These Co nanoparticles were dispersed in poly acrylic acid (PAA) and spin coated on p-Si substrate. The Co-PAA composite/p-Si heterostructure shows a huge in-plane magnetoresistance (MR) as well as junction magnetoresistance (JMR), which basically shows dual functionality like a diode and MR (GMR/TMR) element.

Keywords: Cantilever Beam Magnetometer, Magnetostriction, Thin Film, Magnetic Diode, Core/Shell Nanostructures.