Abstract

This work contains the study of the properties of two kinds of spintronics materials, namely, dilute magnetic semiconductor (DMS) and colossal magnetoresistive (CMR) half metallic ferromagnetic manganites with very high spin polarization. The DMS materials, namely, wide band gap Zn(Fe)O and Zn(Fe,Al)O epitaxial films have been chosen with different Fe concentrations (5, 7 and 10%). The structural (XRD, FESEM, TEM, AFM etc), magnetic (M(H,T), Anomalous Hall Effect), Optical (UV-VIS absorption spectroscopy down to 5 K), electrical (resistivity, Hall, Magnetoresistance etc.) properties have been investigated explicitly and the room temperature carrier induced ferromagnetic behavior have been observed in these DMS systems. The junction properties of Zn(Fe)O and Zn(Fe,Al)O with Pt have been studied and all the junction shows positive junction magnetoresistance and this behavior is strictly found to depend on the magnetic moments of the DMS materials. It can be well described using spin injection theory. Highly spin polarized, half metallic, ferromagnetic CMR manganites, $La_{0.7}Sr_{0.3}MnO_3$ thin films have been chosen as a potential spintronic electrode materials and its structural, magnetic, electronic- and magneto-transport properties have been investigated in details. Temperature dependent electrical and magneto-transport studies have been carried out on those films and possible transport models have been examined. The $La_{0.7}Sr_{0.3}MnO_3/Si/SiO_2$ MOS like junctions show positive junction magnetoresistance and it is temperature dependent where the dominating current transport mechanism through the junctions is found to be Frenkel-Poole type tunneling. The origin of positive MR has been explicitly investigated for these junctions. The junction properties of $La_{0.7}Sr_{0.3}MnO_3$ with ZnO, Zn(Fe)O and Zn(Fe,Al)O heterojunctions have also been studied in details and the junctions show high positive to negative junction magnetoresistance depending on temperature and magnetic field. The appearance of junction magnetoresistance in all these Schottky and heterojunctions are best explained using standard spin injection theory.

Keywords: Semiconductor Spintronics, Dilute magnetic semiconductors, Colossal magnetoresistive manganite, Spin injection, Magnetic heterojunction.