ABSTRACT

A detailed structural, magnetic and dielectric investigations have been carried out on selected Mn-based perovskite oxide systems to explore the various aspects such as (i) origin of magneto-dielectric coupling in R_2NiMnO_6 (R = Rare earth); (ii) charge dynamics in phase separated $R_{1-x}Ca_xMnO_3$ (R = Rare earth) systems; and (iii) inter particles interaction effect on magneto-dielectric coupling in $Pr_{0.6}Ca_{0.4}MnO_3$ nanoparticles dispersed in an insulating background. The majority of studies have been performed through frequency/temperature dependent dielectric/impedance spectroscopy along with the magneto-resistance. The structural and morphological characterizations have been carried out through high resolution x-ray diffraction and electron microscopy. The magneto-dielectric, magneto-resistance and thermo-magnetic properties have been investigated employing closed cycle helium cryostat and SQUID VSM magnetometer. A systematic change of crystal structure from disorder to ordered phase in La_2NiMnO_6 with increasing the particle size has been found from the structural analysis. Further, magnetic study using ac/dc magnetizations on La_2NiMnO_6 nanoparticles has revealed the change over in magnetic properties from spin glass to super paramagnetic with the increase of particle sizes. Extensive studies of frequency and temperature dependent impedance and magneto-dielectric measurements along with magneto-resistance has indicated an extrinsic origin of magneto-dielectric effect in ordered La_2NiMnO_6 system and the same was found to be applied irrespective of its particle size, replacement of La by other rare earth ions and replacement of Ni by Fe and Cu. The dielectric study on $R_{1-x}Ca_xMnO_3$ (R = La, Pr, Sm) phase separated manganites was found to portray various magnetic orderings. Striking a novel glassy dielectric behavior was found in $Pr_{0.6}Ca_{0.4}MnO_3$ samples below 30 K, which is associated with the rapid motion of boundaries between the competing phases. Inter particle interaction in high aspect ratio nanoparticles of $Pr_{0.6}Ca_{0.4}MnO_3$ was investigated by dispersing them in a polymer matrix; the magneto-dielectric study complements the increased particle-particle interactions obtained from the magnetic measurements.

Keywords: Magnetodielectric effect, double perovskite, nanoparticles, nanocomposites, spins glass, cluster glass and super paramagnetism.

Part of this thesis work is presented in journal articles, which are listed in the list of publications.