ABSTRACT

Multiferroic materials combine two or more than two ferroic orders in same phase to achieve rich functionality. Bismuth ferrite ($BiFeO_3$) and lead iron niobate ($Pb(Fe_{1/2}Nb_{1/2})O_3$), commonly known as BFO and PFN respectively, are two long established multiferroic materials having perovskite (ABO_3) structure. However, their potentials are yet to be realized due to several difficulties in synthesis and characterization. In the present dissertation, Bi is partially replaced by a rare earth Nd and a non-rare earth Y separately in BFO, while Fe ion has been partially/completely replaced by Mn ion in PFN with an aim to demonstrate enhanced multiferroic behavior in these two systems. These substitutions have caused a compositional driven structural change in both the systems. BFO has shown dielectric peak near its Neel temperature. Up to 10% Y/Nd substitution, the loss tangent in BFO has been found to be controlled to a sufficient degree. 15% Y substituted BFO has shown diffused peak in the temperature dependent permittivity and loss pattern near 207 ^{o}C, indicating a possible ferroelectric transition. Ferroelectric hysteresis loops at room temperature have been observed in all the Y/Nd substituted BFO samples. The magnetization (M) versus magnetic field (H) curve for Y substituted BFO samples have exhibited a switching behavior at low field with increase in magnetization by an order in comparison to that of the BFO. Weak ferromagnetism has been evident from the M-H loops of Nd substituted BFO samples at room temperature. With both Y/Nd substitutions the spin cycloid in BFO has been found to be suppressed releasing the macroscopic magnetization locked within the cycloid. In PFN, diffuse ferroelectric phase transition at 114 ^{o}C and the antiferromagnetic transition at 158 K have been observed. More importantly, a spin glass like behavior has been observed at 9 K in this material. With 10 % Mn substitution, the ferroelectric transition has been reduced to 50 ^{o}C. However, at higher concentration of Mn the conductivity in PFN has been found to increase. The value of magnetization has been found to increase with increasing Mn concentration in PFN.

Key Words: Multiferroic, Perovskite, Magnetoelectric, Ferroelectric, Ferromagnetism, Antiferromagnetism, Spin-glass.