ABSTRACT

Current research on materials for the storage and process information is focused towards charge-based to spin-based technologies, in other words towards electronic to spintronics. Materials can be defined as Multiferroics when two or more of the primary ferroic properties are united in the same phase. BiFeO$_3$ (BFO) is one of multiferroic material on which lot of research has been carried out in recent decade. Although, Physics of multiferroics is itself in its infant days but problem in BFO is still a step ahead. For instances, structure in bulk (rhombohedral) and thin film (monoclinic) are different. Apart from this, there are many questions such as why many dielectric anomalies/transition termed as ghost, metal-insulator transition (MIT) etc. occur in these materials? Secondly, the nature of transport/spin glass behaviour, magneto-electric (ME) coupling and electrical conduction behaviour is not clear so far.

In present work, the focus is to study the effect of substituent of different ionic radii on electrical behaviour of BFO ceramics with objective to understand the nature of ghost transition, MIT and ME coupling. Thus, after optimization of processing method and conditions, various alkaline earth (AE) and rare earth (RE) substituted at Bi-site and transition metals (TM) at Fe site has been substituted with $x = 0.08$ in pre-work. Samarium ‘Sm’ with additional feature of high value of piezoelectric co-efficient ($\sim 100$ pC/N) and Ti with lesser secondary phase has been selected for further work. Therefore, three systems BiFe$_{1-x}$Ti$_x$O$_3$, Bi$_{1-x}$Sm$_x$FeO$_3$ and Bi$_{1-x}$Sm$_x$Fe$_{1-x}$Ti$_x$O$_3$ have been synthesized and studied. For analysis purpose sample synthesized in pre work i.e., AE (Sr, Ca and Ba) substituted BFO, RE (La, Ce, Nd, Sm, Eu, Gd, Dy and Ho) substituted BFO and TM (Ti, Nb, W) substituted BFO and electric studies on BZT-BFO sample has been used as primary/supplementary studies along with detail specific analysis for the these three system Sm, Ti and Sm-Ti co-substituted samples.