ABSTRACT

$Pb(Zr_{1-x}Ti_x)O_3$ (PZT) perovskite ferroelectric ceramics of a general formulae ABO_3 (A = mono, dia or trivalent; B = tetra, penta or hexavalent ions), a solid soluation of $PbTiO_3$ (ferroelectric) and $PbZrO_3$ (anti-ferroelectric), are considered to be an attractive piezoelectric materials. In past, a considerable amount of work has been done to study the effects of various dopants in varying concentrations (x) in the A- and B- sites of the PZT to modify the properties of the materials for different device applications such as non-volatile memories, transducer, phonographic pick-up etc. Majority of the dopants were isovalent, supervalent and subvalent. It is therfore, interesting to investigate the formation conditions, phase transition and some other ferroelectric and related properties of these pure/doped PLZT for better understanding of their transition mechanism and occurance of some interesting physical properties in them.

As not much work on the effect of double doping in Pb-sites (A-site) or PZT have been done so far we have carried out this work on the (i) PLZT (x/65/35); x = 7,8,9,10

(ii) $Pb_{0.93}(La_{1-x}D_x)_{0.07}(Zr_{0.65}Ti_{0.35})O_3$ system (where D = Li,Na,K, Rb and Bi, x = 0.0, 0.1, 0.3, 0.5 and 0.7)

(iii) PLZT + 1 wt% (Na,Bi) and (Li,Bi).

(iv) PLZT + x wt% Li and Bi, x = 1,3,5 and 10

The present thesis is mainly concerned with synthesis, testing and studies of structural, thermal and electrical properties of the above compounds.

All the studies under taken have revealed that (i) although the structural disorder $[Pb_{0.93}(La_{1-z}D_z)_{0.07}]$ $[Zr_{0.65}Ti_{0.35}]O_3$ in group C compounds is same, the dielectric

properties differ from compound to compound of the group. (ii) The ferroelectric curie temperature was found to decrease with increase of La^{3+} concentration and other dopants have no effect on shift of Curie temperature.

The room temperature structural study of the pure and mixed compounds have been under taken using powder diffraction technique in wide range of Bragg angles to confirm the reported rhombohedral structure with space group R_{3m}. By substituting various small concentration of the other subvalent and supervalent ions in the cation lattice sites of the host lattice, we find that there is not much distortion in the lattice and hence the final structures are invariant. Studies of the thermal properties of the proposed compounds in the wide temperature range using, DSC, TG and DTG, have provided very useful information about the formation and thermal stability of the compounds.

Systematic and exhaustive studies of electrical (dielectric constant, dielectric loss, ac electrical conductivity) properties of the above compounds have provided a important information about the ferrolectric/para electric phase transition. Most of the compounds have shown diffuse type of phase transition and relaxation behaviour. The Cruie-range (ie, range of relaxed transition) of few materials have been estimated and diffuseness parameter γ have been calculated for all samples and found to be in the $1<\gamma\leq 2$ range. Piezoelectric constants have been found to decrease with the addition of dopants. The highest values of the piezoelectric coefficients have been observed with $(La_{0.5}D_{0.5}) = 2$. Our results are in confirmation with the others.