CHAPTER 9

CONCLUSIONS

The present thesis, the conclusion consists of 5 parts. The conclusions of the thesis are presented as the following.

First, SFN doped with Ho_2O_3 ceramics ($Sr(Fe_{1-x}Ho_x)_{0.5}Nb_{0.5}O_3$) ceramics were synthesized via a solid state reaction technique. The undoped ceramic showed an orthorhombic phase, but it transformed to a pseudo cubic phase for higher Ho concentrations. A low solubility limit of Ho in SFN caused a formation of second phase for the x=0.15 ceramic. Dielectric behavior of undoped ceramic exhibited high dielectric constant over a wide temperature range. However, the doping shifted this region to a higher temperature. The doping also shifted the peak of dielectric loss to a higher temperature. Activation energy of dielectric relaxation increased with increasing Ho concentration. In addition, complex impedance analysis was applied to determine the behaviors of grain boundary and grain after doping.

Second, the $BiFeO_3$ was prepared by a mixed oxide, solid-state reaction method. Excess Bi_2O_3 (1-7 wt.%) was introduced prior to powder calcination to compensate for any Bi_2O_3 that may have been lost from the samples due to volatilization during heat treatments. Various heating rates (1-10°C/min) were performed at the calcination state. X-ray diffraction analysis revealed that pure phase BFO was observed for the samples calcined at a low heating rate (1°C/min) and contained lower amount of Bi_2O_3.The higher levels of excess Bi_2O_3 produced an increased in dielectric constant and dielectric loss. Further, ferroelectric behavior was improved for higher amount Bi_2O_3 contented samples.

Third, the pure and modified $BiFeO_3$ (BFO) ceramics (BFO doped with Sb) were prepared by a solid-state reaction method. Phase formation, microstructure, and dielectric properties were investigated. The samples showed a main phase of rhombohedral BFO. The additive inhibited grain growth, with average grain size decreasing from ~14 μm for pure BFO to 3μm for the modified BFO samples. The dielectric constant of the modified samples tended to improve with the additive. This improvement can be related a conduction mechanism in the studied samples

Fourth, Ga doped $BaFe_{0.5}Nb_{0.5}O_3$ ($Ba(Fe_{1-x}Ga_x)_{0.5}Nb_{0.5}O_3$) ceramics were fabricated and their properties were investigated. All ceramics showed perovskite structure with cubic symmetry and the solubility of Ga in BFN ceramics had a limit at x = 0.2. Examination of the dielectric spectra indicated that all ceramic samples presented high dielectric constants which were frequency dependent. The x=0.2 ceramic showed a very high dielectric constant (ε_r>240,000 at 1 kHz) while the x=0.4 sample exhibited high thermal stability of dielectric constant with low loss tangent from room temperature to 100°C with ε_r>28,000 (at 1 kHz) when compared to other samples. By using a complex impedance analysis technique, bulk grain, grain boundary, and electrode response were found to affect the dielectric behaviour which could be related to the Maxwell–Wagner polarization mechanism

Finally, strontium iron niobate $Sr(Fe_{0.5}Nb_{0.5})O_3$ doped with BFO ceramics were synthesized via a solid state reaction technique. All ceramic showed perovskite structure with an orthorhombic phase. Examination of the dielectric spectra indicated that all ceramic samples presented high dielectric constants which were frequency dependent. The x=0.05 ceramic showed a very high dielectric constant (ε_r>40,680 at 1 kHz). By using a complex impedance analysis technique, bulk grain, grain boundary, and electrode response were found to affect the dielectric behaviour which could be related to the Maxwell–Wagner polarization mechanism. Further, ferroelectric behavior was improved for higher amount BFO contented samples