

Abstract

One of the extensively studied materials i.e., ferroelectric materials are electrical insulators having a wide range of industrial applications. Among ferroelectric materials, lead iron niobate $\{Pb(Fe_{0.5}Nb_{0.5})O_3\}$ is one of the potentially useful materials with a highly polar perovskite structure (ABO_3). It is simple to prepare pure-phase $Pb(Fe_{0.5}Nb_{0.5})O_3$ ceramics with high density. However A/B-site substitution by appropriate cation acts as stress stabilizer. This work is mainly focused on the synthesis and characterization of yttrium, ytterbium and vanadium modified lead iron niobate ceramics. Modification of A site (by Y^{3+} and Yb^{3+}) and B site (by V^{5+}) is carried out in order to know the suitability of the substituting elements for the enhancement of various (structural, microstructural, dielectric, ferroelectric, piezoelectric and impedance) properties. The synthesis process is carried out by solid state reaction method. HRXRD pattern exhibits that A-site modifications do not distort or change the monoclinic structure of $Pb(Fe_{0.5}Nb_{0.5})O_3$, whereas B-site modification changes the cell parameters of parent monoclinic system appreciably, thereby affecting the ferroelectric phase transition temperature (T_c). It is also observed that the value of remnant polarization increases with increase in value of yttrium and ytterbium at A-site whereas hysteresis loop is getting suppressed upon addition of vanadium substitution at B-site. Complex impedance spectra indicate the possibility of the bulk and grain boundary contribution at higher temperatures and also about the temperature dependant relaxation phenomena. Modulus analysis results agree well with complex impedance predictions for electrical transport processes in the system.

Keywords: Ferroelectric, Multiferroic, Thermal Properties, Structural Properties, Dielectric Behaviour, Electrical Properties, Conductivity Analysis.