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ABSTRACT

This article reports the influence of sintering temperature on the structural, dielectric and ferroelectric properties of lead-free $Ba_{0.98}La_{0.01}Na_{0.01}TiO_3$ ceramics synthesized by conventional solid-state reaction technique. The calcination of the ceramic powders has been accomplished using microwave system at 1000^{o}C for 30 minutes and sintered at four different temperatures, i.e., 1250, 1300, 1350 and 1400^{o}C for 4h. The XRD analysis along with Rietveld refinement confirms that all samples show a single phase tetragonal structure. The confirmation of tetragonal phase structure has been carried out using Raman study. The elemental composition and chemical states of the sintered pellets have been determined using XPS study. The investigation of Scanning Electron Microscopy (FE-SEM) revealed that the grain size increases with rising sintering temperature. The temperature and frequency dependence of dielectric properties has been investigated using Impedance spectroscopy in the frequency range of 60Hz - 1MHz and temperature range of RT to 150^{o}C. The $Ba_{0.98}La_{0.01}Na_{0.01}TiO_3$ ceramic sintered at 1350^{o}C obtains the optimum dielectric constant of 2583 and dielectric loss <0.02 due to the superior incorporation of Na^+, La^{3+} and suitable sintering temperature which is highly essential for the fabrication of ceramic capacitors. The studies of the temperature dependent dielectric permittivity indicate phase transition with a clear shift in the Curie temperature towards higher temperature side with sintering temperature. The ferroelectric properties of all sintered samples have been investigated at room temperature.

Keywords: Sintering temperature; Co-substitution; Raman modes; XPS; Grain size, Dielectric constant, Ferroelectric.