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*Structural, dielectric, electromechanical, piezoelectric, elastic and ferroelectric properties of lanthanum and sodium Co-substituted barium titanate ceramics*

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**ABSTRACT**

In this paper, the polycrystalline ceramics  $\text{Ba}_{(1-x)}(\text{La}, \text{Na})_x\text{TiO}_3$   $0 \leq x \leq 0.08$  were synthesized by microwave assisted heating of the starting materials. Room temperature X-ray diffraction along with Rietveld refinement analysis confirmed the formation of single-phase polycrystalline compound with the tetragonal crystal structure. A dense microstructure with several grains having different size distribution throughout the sintered pellet has been observed. The incorporation of  $\text{La}^{3+}$  and  $\text{Na}^+$  ions in  $\text{BaTiO}_3$  enhanced the room temperature relative permittivity. The studies of the temperature dependence of dielectric permittivity indicate ferroelectric-paraelectric phase transition with a clear shift in the Curie temperature ( $T_c$ ) of  $\text{BaTiO}_3$  towards lower temperature side on co-substitution. The co-substituted sample with  $x=0.08$  exhibited superior dielectric constant ( $\epsilon'=4226$ ) with low dielectric loss ( $\tan\delta=0.0113$ ) which is highly essential for the fabrication of ceramic capacitors. Resonance and antiresonance characteristics of impedance and phase for poled  $\text{Ba}_{(1-x)}(\text{La}, \text{Na})_x\text{TiO}_3$  samples have been investigated in the frequency range of 300 kHz-1 MHz. Based on IRE standards for piezoelectric ceramics the piezoelectric response has been discussed. The room temperature P-E loop is investigated at an applied electric field of 80kV/cm at 33Hz frequency using Precision Premier II.

**Keywords:** Co-substitution; Grain size; Electromechanical; Piezoelectric; Elastic, Diffuse phase transition; Ferroelectric.

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