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Correlation between the structure and dielectric constant of $Bi_{0.5}(Na_{1-x}Li_x)_{0.5}TiO_3$ ($0 \leq x \leq 0.20$) solid solutions

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Abstract

Bismuth sodium titanate $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) is a lead-free piezoelectric ceramic material with high Curie temperature. The effect of substitution of the smaller ion Li^+ for the larger ion Na^+ in $Bi_{0.5}(Na_{1-x}Li_x)_{0.5}TiO_3$ ($0 \leq x \leq 0.20$) on the structure of BNT is studied using powder X-ray diffraction (XRD) and Raman spectroscopy. The Rietveld refinement analysis of the powder XRD patterns showed that all the compositions formed under the monoclinic Cc space group, with the lattice parameters showing minor changes above $x > 0.08$. Raman spectral parameters such as position and intensity of a peak also showed a similar trend in the same Li concentration range with increasing Li content. A corresponding change in the variation of the dielectric constant with increasing Li content is also observed, suggesting a close correlation between the crystal structure and dielectric properties of the different compositions in the $Bi_{0.5}(Na_{1-x}Li_x)_{0.5}TiO_3$ solid solution series.

Keywords:

$Bi_{0.5}Na_{0.5}TiO_3$, bismuth sodium titanate, dielectrics, lead-free ferroelectrics, Li substitution, Raman spectroscopy, structure-property correlation,

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