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ABSTRACT BOOK

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Structure and ferroelectric properties of KNN- based perovskite ceramics

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Lead-free ferroelectric materials on the base of $(K_{0.5}Na_{0.5})\,NbO_3$ (KNN) are being intensively studied in order to replace widely used the Pb-based ones [1–3]. In this work, effects of modification of compositions by donor and acceptor dopants in the A- and B-sites of perovskite lattice on structure, dielectric, ferroelectric and piezoelectric properties of ceramics from Morphotropic Phase Boundary in the systems $(K_{0.5}Na_{0.5})\,NbO_3$ (KNN) and $(K_{0.5}Na_{0.5})\,NbO_3$ — $BaTiO_3$ (KNN-BT) additionally doped by Ni^{3+} cations have been studied. Ceramic samples were prepared by the two-step solid-state reaction method at temperatures T_1 = 1073 K (6 h), T_2 = 1223 K (6 h), T_3 =1423 K (2 h).

The samples were characterized using the X-ray Diffraction, Second Harmonic Generation (SHG), and Dielectric Spectroscopy methods. Microstructure of the samples was examined by the Scanning Electron Microscopy (SEM) method and the surface morphology and as-grown domain structure of the samples were characterized by the Piezoresponse Force Microscopy (PFM) method.

Depending on composition and sintering conditions changes in the unit cell volume were observed. Ferroelectric phase transitions were revealed at T_{pt} ~ 400 K and at T_m ~ 600 K in the dielectric permittivity versus temperature curves. An increase in the $BaTiO_3$ content leads to slight decrease in the T_m and T_{pt} values. Increase in the spontaneous polarization value was observed in modified ceramics using the SHG method. At the room temperature, non monotonous changes of dielectric parameters and spontaneous polarization values were observed in modified compositions studied. Using the PFM method the as-grown domain structure was observed in ceramics prepared. The hysteresis behavior of the piezoresponse of the ceramic confirmed their ferroelectric switching behavior. Finally, effective d_{33} piezoelectric coefficient values reached d_{33}=300 pm/V in the KNN-BT ceramics and d_{33}=200 pm/V in the samples additionally doped by Ni^{3+} cations. The results obtained confirmed prospects of new lead-free materials development by modification of the KNN- based compositions close to the MPB by the aliovalent cation substitutions.

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