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Lead-free Ceramics on the Base of Sodium-Bismuth Titanate and Sodium-Potassium Niobate

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Influence of cation substitutions on stoichiometry, structure parameters, dielectric, ferroelectric, and piezoelectric properties of ceramics based on $(Na_{0..5}Bi_{0.5})TiO_3$ (NBT) and $(K_{0.5}Na_{0.5})NbO_3$ (KNN) perovskites was studied. The samples were characterized using the X-ray Diffraction, Scanning Electron Microscopy (SEM), Second Harmonic Generation (SHG), Dielectric Spectroscopy, and Atomic Force Microscopy in Piezorespone Force Microscopy mode (PFM) methods.

Ceramic samples in systems $(Na_{0.5}Bi_{0.5})TiO_3$ - $BaTiO_3$ (NBT-BT) and $(K_{0.5}Na_{0.5})NbO_3$ – $BaTiO_3$ (KNN-BT) additionally modified by Li^+, Mn^{3+}, Ni^{3+} and Fe^{3+} cations (1-5 mol.%) were prepared by the two-step solid-state reaction method at temperatures of 700 – 1400 K.

Ferroelectric phase transitions near ~ 400 K and ~ 550 K (NBT) and at ~700 K (KNN) were revealed in the dielectric permittivity versus temperature curves of ceramics studied. Remnant hysteresis loops were received for separate grains in the samples using switching spectroscopy PFM method. Local PFM hysteresis loops for the samples studied were observed indicating ferroelectric polarization switching at nanoscale. Increase in the spontaneous polarization value was proved for modified ceramics using the SHG method.

Non monotonous changes of the dielectric parameters ε_{rt}, $\tan\delta_{rt}$ and maximum effective local d_{33} values were observed in modified BNT- and KNN-based compositions confirming their prospects for new lead-free materials development.

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