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ORAL
PRESENTATIONS

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Structure, dielectric, ferroelectric and piezoelectric properties of modified lead-free perovskite ceramics

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Lead-free perovskite oxides promising for development of materials for various applications based on perovskites $(K_{0.5}Na_{0.5})NbO_3$ (KNN), $BaTiO_3$ (BT), $BaZrO_3$ (BZ), $NaNbO_3$ (NN), $(K_{0.5}Bi_{0.5})TiO_3$ (KBT) and $(Na_{0.5}Bi_{0.5})TiO_3$ (NBT) were intensively studied last years in order to replace the widely used Pb-based ones.

We studied influence of cations substitutions and preparation conditions on phase content, structure, microstructure, dielectric, ferroelectric, and local piezoelectric properties of KNN and NBT compositions from Morphotropic Phase Boundaries modified by BT, NN, KNN, and KBT oxides up to 10 mol %.

Ceramic samples were prepared by the solid-state reaction method at temperatures up to 1450 K and characterized using X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Second Harmonic Generation (SHG), Dielectric Spectroscopy (DS) and Piezoresponse Force Microscopy (PFM) methods.

The unit cell volume changes and crystallite size distributions were observed by the XRD method in ceramics. In NBT-BT samples increase in the volume-weighted crystallite size distribution function was observed with KBT additive increasing, thus indicating to changes in relative content of polar nanoregions in tetragonal nonpolar matrix.

Ferroelectric phase transitions at ~ 400 – 700 K were confirmed by the DS and SHG methods. Decrease in temperatures of phase transitions was observed in the NBT- and KNN-based samples with additives content increasing. In NBT-based ceramics effects of dielectric relaxation were observed at temperatures > 800K caused by formation of oxygen vacancies in compositions with aliovalent substitutions.

Using the PFM method increase in effective d_{33} piezoelectric coefficient in some ceramics studied correlated with increase in dielectric permittivity and spontaneous polarization values was observed at the room temperature thus confirming improvement of functional properties and prospects of new lead-free piezoelectric and electrocaloric materials development on the base of modified KNN- and NBT-based compositions.

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