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Prof. Ekaterina Politova
L.Ya.Karpov Institute of Physical Chemistry,
Russia

Microstructure and Properties of Lead-Free Perovskite Ceramics on the Base of KNN and BNT Perovskites

E.D. Politova1, G.M. Kaleva1, A.V. Mosunov1, N.V. Sadovskaya1, D.A. Kiselev2, A.M. Kislyuk2, S. Yu. Stefanovich1,3, P.K. Panda
1L.Ya.Karpov Institute of Physical Chemistry, Vorontsovo pole str. 10, Moscow 105064 Russia,
2National University of Science and Technology "MISiS", Leninskii pr. 4, Moscow 119991 Russia,
3Lomonosov Moscow State University, Leninskie gory 1, Moscow 119992 Russia,
4National Aerospace Laboratories, Kodihalli, Bangalore-560017 India

We studied influence of cation substitutions and preparation conditions on structure parameters, microstructure, dielectric, relaxor ferroelectric, and piezoelectric properties of solid solutions in the systems based on (K0.5Na0.5)NbO3 (KNN) and (Na0..5Bi0.5)TiO3 (NBT) lead-free perovskites. Ceramic samples of modified KNN and NBT compounds were prepared by the two-step solid-state reaction method at temperatures of 900 – 1500 K. Li+, Ba2+, Mn3+, Ni3+, Fe3+, Sb5+, and W6+ cations were added in A- and B-sites of perovskite lattice. To improve density of ceramics overstoichiometric KCl and LiF additives were used. The samples were characterized using the X-ray Diffraction, Scanning Electron Microscopy, Second Harmonic Generation (SHG), Dielectric Spectroscopy (DS), and Atomic Force Microscopy in Piezorespone Force mode (PFM) methods. Changes in the unit cell volume and microstructure were observed in modified ceramics depending on substituting cations. Ferroelectric phase transitions were confirmed using the DS and SHG methods. Effects of dielectric relaxation related to the presence of both polar nanoregions and oxygen vacancies were observed. At the room temperature, non monotonous changes of dielectric parameters and spontaneous polarization values were proved for modified ceramics. Using PFM method high values of effective piezoelectric coefficient (d33 ~ 300 pm/V) were observed in some KNN-based ceramics. The results obtained confirmed prospects of new lead-free materials development on the base of modified KNN- and NBT-based compositions.

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Dr. Jingzeng Zhang
University of Windsor,
Canada

Plasma-Texturing Surface Treatment of Cast Iron for Friction Reduction

R. Cai1, W. Zha1, J.Z. Zhang1, X. Nie1,*
1University of Windsor, Windsor, Ontario, N9B 3P4, Canada.

A new surface texturing technique, based on liquid plasma discharging in an aqueous electrolyte, is proposed to modify the surface morphology of cast iron. During the process, cast iron sample serves