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The interplay of phases, structural disorder and dielectric behavior in Al doped $BiFeO_3$-$BaTiO_3$ ceramics

Jiangguli Peng[1, 2, 3], Jiangtao Zeng[1], Liaoying Zheng[1], Guorong Li[1], Nader Yaacoub[3], Mohamed Tabellout[3], Alain Gibaud3 and **Abdelhadi Kassiba[3]**

[1]Shanghai Institute of Ceramics-CAS China

[2]University of Chinese Academy of Sciences, China

[3]Institute of Molecules at Materials in Le Mans, France

Al doped $BiFeO_3$-$BaTiO_3$ (BFA-BT) systems with a defined composition were prepared by solid-state method. The enhanced spontaneous and remnant polarization were achieved in $BiFe_{0.970}Al_{0.030}$-$BaTiO_3$ with 36.8 μC/cm2, 31.5 μC/cm^2 respectively. From SEM and XRD analyses, the high-density of the ceramics and the high lattice parameters ratio c_t / a_t traducing large distortions of the rhombohedral phase play a dominant role in the enhanced piezoelectric properties. The high polarization and large strain were achieved in the $BF_{0.970}A_{0.030}$-BT system. ^{57}Fe Mössbauer spectra revealed the large disorder of Fe^{3+} at B sites preferentially occupied by more Al^{3+} doping ions, forming the diffusive phase transition for dielectric behaviors in samples. Grain and grain-boundary effects were pointed out from the dielectric modulus and a related thermal evolution. AC capacitances indicated two relaxation processes marked by the grains and interfaces involved in the polycrystalline ceramics for highly doped systems. The work will be significant to illuminate the interplay between structures and properties in ferroelectric materials.

pjguli@student.sic.ac.cn