Development and Characterization of (1-x)Bi($Mg_{2/3}Sb_{1/3}$)O_3 – (x)$PbTiO_3$ Ceramics for Energy-Storage Applications

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Abstract

Piezoelectric materials convert the mechanical energy into electrical energy and vice versa and are utilized in a wide range of applications (i.e. actuators, transducers) because to short reaction speed, compactness, and precise displacement. Polycrystalline piezo-ceramics are more enticing technologically than single crystals since easier and inexpensive production, although they have yet to exhibit electrostrain levels greater than 1%. The morphotropic phase boundary (MPB) region plays a crucial role in such piezoelectric materials, where the ferroelectric phase coexists and cause ferroelectric-ferroelectric instability. In this report, we demonstrate the room temperature Rietveld analysis of Bismuth-based piezo solid solution with reduced lead content, (1-x)Bi($Mg_{2/3}Sb_{1/3}$)O_3 – (x)$PbTiO_3$ (BMS-PT), using Powder X-Ray Diffraction data in the range of x = 0.10 to 0.90. The MPB region for BMS-PT ceramics exhibits the coexistence of tetragonal + monoclinic phases in the composition range x = 0.56 to 0.61. The crystal structure of BMS-PT is monoclinic and tetragonal in lower (x < 0.35) and higher (x > 0.44) PT concentration ranges, respectively. Dependence of polarization versus electric field loop at x = 0.58 demonstrates a well-saturated hysteresis loop similar to the earlier reports on Pb($Mg_{2/3}Nb_{1/3}$)O_3. The compositions and surface morphology for prepared BMS-PT ceramics are characterized using scanning electron microscopy.