Abstract

BiFeO3 forms continuous solid solution with PbTiO3 and this solid solution [(1-x)BiFeO3-xPbTiO3, BF-xPT] shows interesting phase transitions with change in composition, applied stress and temperature. The structure of BF-xPT changes from monoclinic [BF end, Cc space group x. 0.27] to tetragonal [PT end, P4mm space group for x>0.31], through a Morphotropic Phase Boundary (MPB) region [0.27<x<0.31 phases coexist region]. The external stresses can transform monoclinic compositions of BF-xPT partially to the tetragonal phase in the vicinity of the MPB leading to an extension of the width MPB region from .x.0.03 for annealed samples to .x. 0.17 for the stressed samples towards the BiFeO3 richer end. The magnetic structure changes abruptly from a non-collinear antiferromagnetic one to a collinear G- type antiferromagnetic as the nuclear structure of the ferroelectric phase changes from monoclinic in Cc space group for x.0.27 to tetragonal in P4mm space group for x. 0.31. The monoclinic compositions of BF-xPT undergo two magnetic phase transitions above room temperature, first one at Nl transition temperature TN, corresponding to paramagnetic to antiferromagnetic transition and the second one due to spin reorientation transition at TOPT in which the magnetic moments of Fe3+ sublattice reorient. The temperature dependent DC magnetization (M(T)) studies shows two distinct anomalies at TN and TOPT. The long range magnetically ordered phase (Gy, Fxz) stable at TOPT<T<TN changes to another long range ordered phase (Gxz, Fy) stable below TOPT, wherein the ferromagnetic component of the noncollinear magnetic structure undergoes a spin flop. The tetragonal compositions close to the MPB undergo an unusual ferroelectric to ferroelectric isostructural phase transition. The room temperature tetragonal phase (T1) of BF-xPT with large tetragonality undergoes a first order isostructural phase transition to another tetragonal phase (T2) with lower tetragonality without losing the P4mm space group symmetry. The T2 phase then transforms into paraelectric cubic phase at still higher temperature. The observed atomic displacements associated with this isostructural phase transition correspond to specific irreducible representations of the P4mm space group at its Brillouin zone centre and as such this transition may be phonon driven.