In-situ Poling and the Strong Post-poling Relaxation of non-180° Domain Texture in Bismuth Ferrite Ceramics

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Bismuth Ferrite, $BiFeO_3$ is currently a highly investigated material due to its multiferroic properties (i.e., coexistence of magnetic and ferroelectric order). As a ferroelectric, $BiFeO_3$ has high spontaneous polarization (Ps ~ 100μC/ cm^2) and high Curie temperature (Tc = 825°C). The remarkably high T_C of $BiFeO_3$ in comparison with other ferroelectrics such as $BaTiO_3$ (Tc ~ 130°C) and commercial $Pb(Zr,Ti)O_3$ (PZT) (Tc ~ 360°C) has made it attractive for high-temperature applications where the current market dominating piezoelectrics cannot be used. Moreover, the global restrictions on lead-based materials have further enhanced the potential of $BiFeO_3$ ceramic as a lead-free alternative for electro-mechanical applications.

However, the domain dynamics in bulk $BiFeO_3$ are not well understood because of the difficulties in processing high-purity bulk ceramic and the high electrical conductivity that usually exists. In this study, BFO ceramics with a high phase purity and reduced conductivity, by doping 0.1%wt Co into the structure, were obtained. Time-resolved *in situ* x-ray diffraction was used to study the electric-field-induced structural changes in the bulk BFO ceramic. A severe post-poling relaxation of switched non-180° ferroelectric domains has been observed *in situ* under strong-field poling. Detailed studies revealed that this effect may be due to the configuration of defect dipoles inside the material, $(V'_{Fe} - V_O^{\cdot\cdot})^{\cdot}$ and/or $(V'_{Bi} - V_O^{\cdot\cdot})^{\cdot}$. Quenching and extending the poling time are proposed as efficient ways to tackle this relaxation.

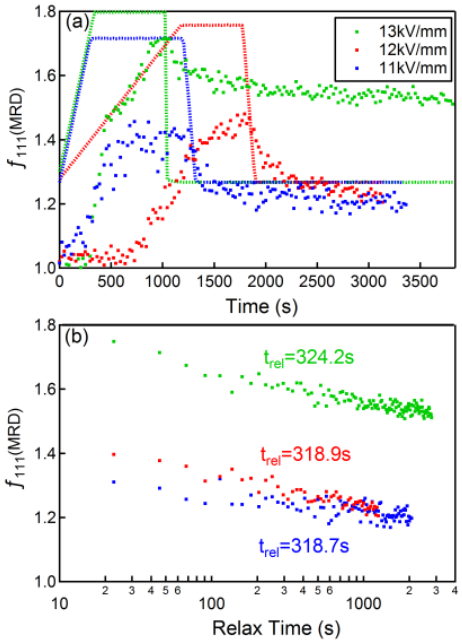

Figure 1 $(111)_{pc}/(11\bar{1})_{pc}$ non-180° ferroelectric domain texture development under different circumstances: (a) quantified multiple of random distribution (MRD) domain texture f_{111} during field application as a function of time; (b) post-poling relaxation after removal of the electric field in a log time scale.