Development of $BaTiO_3$-$Bi(Mg_{1/2}Ti_{1/2})O_3$-$BiFeO_3$ ceramics by various ceramic processing for enhanced piezoelectric properties

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The $BaTiO_3$-$Bi(Mg_{1/2}Ti_{1/2})O_3$-$BiFeO_3$ ceramic is the one of the new candidates for replacing lead-based piezoelectric ceramics, because of their high Curie Temperature (T_C) [1]. During processing, however, the presence of defects may form defect complexes which pin domain walls and thus decrease ferroelectric and piezoelectric properties [2].

In this work, Mn-added $0.3BaTiO_3$-$0.1Bi(Mg_{1/2}Ti_{1/2})O_3$-$0.6BiFeO_3$ (0.3BT-0.1BMT-0.6BF) ceramics were investigated by various ceramic processing such as annealing and quenching processes, and A-site non-stoichiometry compositions for enhanced ferroelectric and piezoelectric properties. A 0.3BT-0.1BMT-0.6BF powder was produced by Nippon Chemical Industrial. For the study on A-site non-stoichiometry compositions, the 0.3BT-$0.1Bi_x(Mg_{1/2}Ti_{1/2})O_3$ (B_xMT)-0.6BF (x = 0.93, 1.00, 1.07, and 1.10) ceramics were prepared by the solid-state synthesis of BT, BF, Bi_2O_3, MgO, and TiO_2 powders. The ceramics were post-annealed at temperature T_a=600~800°C for 1~30h, and then furnace-cooled or quenched to room temperature.

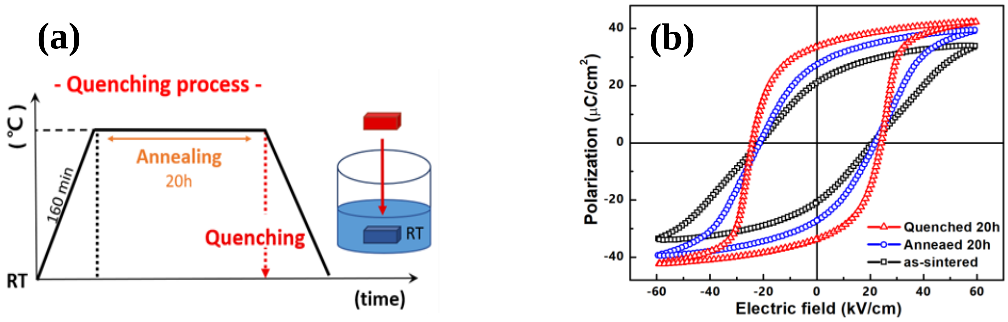

Figure 1. (a) The schematic diagram of an annealing and quenching process. (b) the *P-E* hysteresis loops of as-sintered 0.3BT-0.1BMT-0.6BF ceramic, and 0.3BT-0.1BMT-0.6BF ceramics annealed and quenched at 800°C for 20h.

Figure 1(b) shows the *P-E* hysteresis loops of as-sintered, annealed, and quenched 0.3BT-0.1BMT-0.6BF ceramics. The largest remanent polarization was observed for the quenched ceramics due to the effects of domain wall de-pinning and defect distributions.

The model of defect dipole behavior, piezoelectric properties, grain size, relative density and so on as a function of annealing temperature and time will be also presented.

[References]

[1] I. Fujii et al, Japanese Journal of Applied Physics, 50, 09ND07 (2011)

[2] T. Rojac et al, Journal of Applied Physics, 108, 074107 (2010)