

# **Fabrication of 85(Bi<sub>0.5</sub>Na<sub>0.5</sub>)TiO<sub>3</sub>-15BaTiO<sub>3</sub> green body with (001)-textured hexagonal BaTiO<sub>3</sub> particles using high magnetic field electrophoretic deposition (HM-EPD)**

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85(Bi<sub>0.5</sub>Na<sub>0.5</sub>)TiO<sub>3</sub>-15BaTiO<sub>3</sub> (85BNT-15BT) ceramic is representative lead-free piezoelectric ceramic due to its high Curie temperature (~250 °C) and suitability for mass production. To enhance piezoelectric properties, engineered domain structure have been studied which is achieved when crystal is orientated along non-polar direction. 85BNT-15BT ceramic have tetragonal symmetry and non-polar direction is [110] or [111] direction. However, there are very few reports for fabrication of [110] or [111] textured 85BNT-15BT ceramic.

In previous work, our group reported that [111]-textured BaTiO<sub>3</sub> (BT) ceramic was fabricated using electrophoretic deposition under high magnetic field (HM-EPD). However, BT ceramic has low Curie temperature ( $T_C \sim 130$  °C) and it is difficult to apply in real application. Therefore, we expected that [111]-textured 85BNT-15BT ceramic could be fabricated with HM-EPD method using textured BT particles as orientation seed. Under the magnetic field, particles are orientated along high magnetic susceptibility ( $\chi$ ) direction and the alignment driving force can be expressed as following:

$$\Delta E = \Delta\chi VB^2 / 2\mu_0 \quad - \text{Eq. 1}$$

where  $\Delta\chi$  is magnetic anisotropy,  $V$  is particle volume,  $B$  is magnetic field and  $\mu_0$  is magnetic permeability in vacuum. According to equation, driving force of magnetic alignment is proportion to magnetic anisotropy ( $\Delta\chi$ ), particle volume ( $V$ ) and magnetic field ( $B$ ). Therefore, to fabricate orientation seed, hexagonal BT powder was used because it is known that diamagnetic anisotropy ( $\Delta\chi$ ) is related to crystal anisotropy and hexagonal BT has large crystal anisotropy about  $c/a$  ratio = 2.44. For example, it was reported that [001]-textured hexagonal BT green body was fabricated with HM-EPD method under 12 T of magnetic field. In this case, [111]-textured tetragonal BT ceramic was fabricated from [001]-textured hexagonal BT green body during sintering procedure. Therefore, to fabricate [111]-textured BNT-BT ceramic, hexagonal BT powder was used for orientation seed and it was expected that 85BNT-15BT green body was fabricated with HM-EPD method which consisted with [001]-textured hexagonal BT particles.

In this work, to obtain highly oriented green body, 85BNT-15BT green bodies were fabricated with different particle size of hexagonal BT because particle volume ( $V$ ) is important factor according to equation 1. From the results, we obtained green body with randomly orientated BNT particles and [001]-textured BT particles with 83% of Lotgering factor. Detailed experimental results will be provided during presentation