Grain Oriented $CaBi_4Ti_4O_{15}$ Piezoceramics Prepared by the Screen-printing Multilayer Grain Growth Technique

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With increasing concern in the environmental issues worldwide, the research on lead-free ferroelectric oxides now is vital in searching new substitutions for the widely used PZT, PMNT-PT and PMZN-PT ceramics. The relative low piezoelectric coefficients of bismuth layer structure ferroelectric (BLSF) ceramics limit the applications. Multicrystal grain orientation is an effective way to improve the piezoelectric ceramic properties. In BLSF family, grain oriented $MBi_4Ti_4O_{15}$ ceramics are expected to possess better piezoelectric properties.

The grain oriented BLSF ceramics have superior ferroelectric and piezoelectric properties to the randomly oriented ceramics. The grain oriented $CaBi_4Ti_4O_{15}$ ceramics were prepared by the screen-printing multilayer technique without any template particles. The influences of sintering time, temperature, and the particle size of raw materials on grain orientation were studied. The degree of grain orientation and the grain morphologies were examined using XRD and SEM techniques. At sintering temperatures of 1000-1120ºC, orientation degree increases with sintering temperature and keep constant at temperatures of 1120-1150ºC. The orientation degree increases rapidly with sintering time at beginning and gradually reaches the highest value for 4 hrs at the sintering temperature. It was found that the particle size of starting materials is the important factor for grain orientation. Highly oriented ceramics can be obtained only when using nanosized starting materials. Without the use of template particles and pressure densification process, the screen-printing multilayer grain growth technique is a new approach to fabricate highly textured piezoceramics at low cost.