Texture Development and Dielectric Properties of SrBi2Ta2O9 Ceramics Processed by Templated Grain Growth

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Abstract

Following the current interest in developing lead-free piezoelectric components, bismuth layer structure ferroelectrics (BLSF) have emerged as promising materials for high-temperature piezoelectric applications due mainly to its high Curie temperature [1]. Thus, the study of highly textured BLSF ceramics is of fundamental importance to tailor its piezoelectric and dielectric properties, aiming to reach an improved sensing and actuating performance. One promising route for controlled texture development is templated grain growth (TGG) [2,3]. However, the synthesis of SBT crystals is generally difficult, and thus, to the best of our knowledge, this technique has not been reported for SBT so far. In this work, SrBi2Ta2O9 textured ceramics were produced by TGG using anisotropic SBT platelet crystals previously obtained by self-flux solution method [4]. Template particles with dimensions of 50 x 50 x 5 mm3 were embedded in a fine-grained matrix containing 3 wt% of Bi2O3 excess and partially aligned by conventional uniaxial pressing. Textured SBT ceramics (characterized by a Lotgering factor 0.4) were obtained after sintering at 1250 °C for 2 h. Microstructure evaluation and XRD characterization allowed to access the influence of the uniaxial pressing and sintering conditions on the texture development. Enhanced ferroelectric properties were measured perpendicularly to the uniaxial pressing direction of the ceramics, revealing the influence of the grain orientation, anisotropy and texture degree on the dielectric properties and phase transition. This fact was attributed to the increased contribution from the highly polarizable a,b-plane allowed by the favorable alignment of grains in the direction of the applied electric field.

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