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Synthesis of (111) textured lead-free piezoelectric ceramics through template grain growth process

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Piezoelectric devices in consumer applications are being required to eliminate the lead due to its toxic nature to human health. This has led to significant emphasis on the development of lead-free piezoceramic materials that can match performance of current lead-based compositions. However the performance of all the known lead free remains inferior. A promising approach for enhancing the piezoelectric shear d15 response of lead-free piezoceramics is to synthesize the (111) grain oriented material by using the template particles with high (111) crystallographic orientation. In this work, we report the synthesis of (111) oriented $BaTiO_3$ (BT) template particles and their application towards deriving the (111) textured lead-free piezoelectric ceramics. BT particles were synthesized by two-step molten salt synthesis method (MSS) from plate-like $Ba_6Ti_{17}O_{40}$ (B6T17) precursor through topochemical microcrystal conversion (TMC) method. In order to identify the largest developed planes of the TMC-synthesized BT particles, X-ray diffraction measurement technique (OPL-XRD) was applied. The prepared BT particles were embedded in the slurry and then subjected to the tape casting. During casting, the templates are aligned by shear force in the preferred orientation. The samples were found to exhibit higher intensity for the (111) Bragg reflection in the XRD spectra suggesting good orientation of $BaTiO_3$ particles along the <111> direction. These (111) oriented BT templates were next used for synthesizing (111) grain oriented lead-free piezoelectric ceramics.

Biography

Pelin Berik received her PhD degree from Johannes Kepler University Linz in Austria in 2013. She was awarded Erwin Schrödinger fellowship from Austrian Science Fund (FWF) in 2014. She is currently a postdoctoral fellow at Virginia Polytechnic Institute and State University, Center for Energy Harvesting Materials and Systems (CHEMS) for a research project supported by Austrian Science Fund (FWF Project J3620-N30 “Development of novel lead-free piezoceramic shear and torsion transducers”).

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