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EXPLORING THE POSSIBILITIES FOR LEAD-FREE FERROELECTRICS THROUGH TEXTURED MICROSTRUCTURE ENGINEERING, Christopher B. DiAntonio*, Sandia National Laboratories, Albuquerque, New Mexico

The investigation of lead-free piezoelectric ceramic compositions has recently gained an increased level of interest due to the efforts to reduce lead based components. Lead-based manufacturing is increasingly becoming cost prohibitive and a growing need exists for lead-free ferroelectrics with comparable or superior properties. The most widely used piezoelectric/ferroelectric ceramic material today, including specialized advanced ceramics, consists of $PbTiO_3$-$PbZrO_3$ (i.e. PZT-system). It has become imperative to integrate a processing strategy with a lead-free ferroelectric material capable of competing with or surpassing the properties of lead-based compositions. The final properties, as for all ceramic materials, are highly influenced by the processing steps and forming techniques used to construct the end component. Texturally modified, oriented ceramic compositions, exhibit enhanced and highly anisotropic properties that, depending on the system, match and even surpass those of an optimum modified lead-based composition. In this work we report on the development and use of texturing processes to produce grain-oriented polycrystalline ceramics with modified orientation-dependent properties. Many physical properties of crystalline materials are strongly dependent on the crystal orientation of the materials and the potential benefits from this textural modification are not fully realized. This work deals with the fabrication of a perovskite-type non-lead based polycrystalline ceramic through a template-induced texturing process using morphologically controlled platelets. The focus vehicle lies with the layer-structured perovskites, particularly the bismuth layered and alkali niobate-based solid solution ferroelectrics. Templated grain growth is being used to produce preferably oriented polycrystals. Template synthesis is accomplished by employing a molten salt synthesis technique where molten salts are used as reaction aids to prepare complex oxides from their constituent oxides. The intent is that the use of templates and an appropriate forming process results in the fabrication of a functional material with enhanced dielectric, piezoelectric, and electromechanical coefficients. Efforts on characterizing the connection between textured processing and electrical behavior for compositions in the lead-free $(Na_{1/2}Bi_{1/2})TiO_3$-$Bi_4Ti_3O_{12}$-$BaTiO_3$ ternary system will be presented.

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ORAL PRESENTATION

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