

Textured Piezoelectric Ceramics in Fiber and Ribbon Form

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Crystallographic grain orientation in textured polycrystalline ferroelectric ceramics is a simple way to obtain significant enhancements in the piezoelectric properties. Templated grain growth (TGG) is a time efficient method for the fabrication of textured ceramics with properties that are comparable to single crystals in certain crystallographic directions. TGG relies on nucleation and growth of a certain amount of rod-like or plate-like seeds which are aligned in a fine powder matrix by extrusion or tape casting. During heat treatment, these anisotropic seeds grow at the expense of fine matrix grains, which leads to the development of high crystallographic grain orientation. Highly oriented ribbon form $\text{Pb}(\text{Mg}_{1/3}\text{Nb}_{2/3})\text{O}_3\text{-PbZrO}_3\text{-PbTiO}_3$ (PMN-PZT), and fiber form $\text{Sr}_{0.61}\text{Ba}_{0.39}\text{Nb}_2\text{O}_6$ (SBN61) and $\text{KSr}_2\text{Nb}_5\text{O}_{15}$ (KSN) ceramics have been produced by combination of novel alginate gelation and the well-established templated grain growth process and the texture development during the process was investigated. The alginate gelation is a novel fiber or ribbon drawing process that involves extrusion and instant gelation of a sodium-alginate containing water based ceramic slurry. The resulting ceramics show texture levels up to 90%, and significant enhancements in the piezoelectric properties relative to randomly oriented ceramics with comparable densities. For example, piezoelectric coefficients of textured piezoelectrics are 2 - 3 times higher than polycrystalline ceramics and remnant polarization value as high as 90% of the single crystal values.

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