

Enhanced Piezoelectric Properties in [001]_c Textured PIN-PMN-PT Ternary Ceramics

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Highly [001]_c oriented Pb(In_{1/2}Nb_{1/2})O₃-Pb(Mg_{1/3}Nb_{2/3})O₃-PbTiO₃ (PIN-PMN-PT) relaxor ferroelectric ceramics with texture fraction ~98% have been successfully textured by templated grain growth using BaTiO₃ (BT) platelets. The effects of dopants and template amounts on the densification behavior, texture evolution, microstructure development, and dielectric, piezoelectric and ferroelectric properties were investigated. The results show that the addition of CuO sintering aid was very effective in achieving highly oriented and dense PIN-PMN-PT ceramics at much lower texturing temperatures with shorter holding time. With maintaining the same texture quality, lowering BT concentration reduced the adverse effect of heterogeneous template on the property of textured ceramics. A significant enhancement in the magnitude of piezoelectric response ($d_{33} \sim 1013 \text{ pC/N}$) was obtained in the textured ceramics, which is about 2.4 times higher than that of randomly oriented ceramics. The domain structure of the textured ceramics was characterized by piezoelectric force microscopy, and domain contribution to the enhanced piezoelectric response in the textured PIN-PMN-PT ceramics was analyzed. The high quality textured ternary ceramics are very promising for new-generation electromechanical devices with high performance and wide temperature usage range.