A NOVEL TEMPLATED GRAIN GROWTH APPROACH FOR THE PROCESSING OF ⟨001⟩-TEXTURED PMN-PT CERAMICS

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The processing of textured ceramics of $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PMN-PT) with compositions around the morphotropic phase boundary (MPB) has become a key issue over the last years in the effort of obtaining low-cost materials with piezoelectric properties comparable to those of single crystals [1]. Improved properties have been obtained in textured PMN-PT ceramics fabricated by templated grain growth (TGG), using anisometric templates of isostructural phases, such as $BaTiO_3$ [2]. High aspect ratio PMN-PT particles are not easy to obtain, and textured PMN-PT ceramics have also been processed using cube-shaped microcrystals grown in PbO flux as templates [3].

In this work, the feasibility of a novel homogeneous-TGG approach for the processing of textured ceramics of PMN-PT is demonstrated. Novelty rests on the use of a nanocrystalline powder synthesized by mechanochemical activation for the matrix, and also for obtaining cubic templates by exaggerated grain growth and TGG processes. Templates were (100) faceted cube-shaped microcrystals with average sizes of 30 and 12 μm [4], which were successfully aligned by tape casting for the processing of ⟨001⟩-textured PMN-PT ceramics. The approach used involves only conventional ceramic technology from a single source powder to obtain textured PMN-PT piezoceramics.

The rheological behavior and tape casting performance of the ethanol based slurries are presented [5]. Suspensions were prepared up to solid contents of 32 vol%, significantly higher than those usually reported for non-aqueous systems. The replacement of toxic solvents commonly used for tape casting of functional ferroelectric materials, often toluene, with ethanol, which is a safe and environmentally friendly solvent, is an additional advantage. The effect of a number of processing parameters, such as those of the lamination of tape stacks, on texture is established. An advanced combined approach, using quantitative texture analysis and the Rietveld method, is used to analyze the X-ray diffraction data in order to obtain accurate results on the global texture of the ceramics. The electrical and electromechanical properties of the materials are also presented.

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