Textured Ceramics of Morphotropic Phase Boundary $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ by a Novel Homogeneous-Templated Grain Growth Approach

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The processing of textured $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ (PMN-PT) ceramics with composition in the morphotropic phase boundary (MPB) region has become highly topical during the last few years in an attempt to obtain ceramic materials with piezoelectric coefficients comparable to those of single crystals. Excellent piezoelectric properties have been obtained for textured PMN-PT ceramics processed by templated grain growth (TGG), with the use of anisotropic templates of also perovskite structure $SrTiO_3$ [1]. Texturing has also been accomplished with PMN-PT templates, in this case with the use of cubic microcrystals of several tens of microns grown in PbO flux [2].
In this communication, we report a novel homogeneous (from PMN-PT templates) TGG approach for the processing of textured $Pb(Mg_{1/3}Nb_{2/3})O_3$-$PbTiO_3$ ceramics. Novelty rests on the use of a nanocrystalline powder synthesized by mechanochemical activation for the matrix, and also for obtaining the cubic templates. Templates were (100) faceted cube-shaped microcrystals with an average size of ~ 10 μm obtained by exaggerated grain growth. Larger templates of ~ 30 μm were obtained by TGG of the nanocrystalline powder from the former microcrystals. The templates were successfully aligned within the matrix by tape casting, and made grow for texturing. An ethanol based system was developed for the tape casting, which is more environmentally friendly and less hazardous to health than toluene based slurries.
This approach only involves conventional ceramic technology from a single source powder to process ⟨001⟩ textured MPB PMN-PT ceramics. The effect of the processing parameters on texture was studied, and the electrical and electromechanical properties of the materials are presented.

[1] S. Kwon, E. M. Sabolsky, G. L. Messing, and S. Trolier-McKinstry, J. Am. Ceram. Soc., **88** 312 (2005).
[2] M. P. Thi, H. Hemery and H. Dammak, J. Eur. Ceram. Soc., **25** 2433 (2005).

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