Texturation of $Pb(Mg_{1/3}\ Nb_{2/3})O_3$-$PbTiO_3$

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It is well known now that $Pb(Mg_{1/3}\ Nb_{2/3})O_3$-$PbTiO_3$ (PMN-PT), $Pb(Zn_{1/3}\ Nb_{2/3})O_3$-$PbTiO_3$, [1,2] $PbZr_{1/2}Ti_{1/2}O_3$ (PZT) [3] and many other single crystals exhibit the highest piezoelectric reponse along nonpolar directions. Rhombohedral compositions, for example, show the highest piezoelectric coefficients when poled along the <001> quasicubic direction and not the polar quasicubic direction <111>. This is due to the effect of the shear coefficients. Similar effect has been shown to be present in polycrystalline textured materials (PZT) [4]. There is then an interest to produce ceramics with oriented grains. However, texturing is difficult to achieve in relaxor-ferroelectrics because the grain shape in the cubic phase where sintering takes place is isotropic. TGG (templated grain growth) has been successfully used to grow different textured ceramics, such as $Bi_4Ti_3O_{12}$, $PbNb_2O_6$, and $(Sr,Ba)Nb_2O_6$) [5-7]. Heteroepitaxial growth of PMN-PT with orientation > 0.9 has been accomplished with single crystal templates of $BaTiO_3$ [8], $SrTiO_3$, [9] but the effect of template particles and second phases on the properties should be reduced. In this work, other template materials have been considered and are reviewed. Lead niobates were candidates because they have a strongly anisotropic shape and do not introduce foreign elements in the PMN-PT were they could eventually dissolve at the end of the sintering. We used the molten salt method to prepare needles of $PbNb_2O_6$ of length around 15 μm and diameter 3 μm and platelets of $Pb_2Nb_2O_7$ with diameters around 15 μm and thickness 1 μm. The different texturing methods and the effect of the templates on the grain growth of PMN-PT prepared by tape casting are discussed.

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