# Domain Configuration in (1-$x$)Pb($Mg_{1/3}Nb_{2/3}$)$O_3$–$x$$PbTiO_3$ Ceramics analysed by Transmission Electron Microscopy

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In recent years the interest in relaxor ferroelectric materials has increased rapidly due to their multifunctional properties, including electromechanical (EM) responses, such as piezoelectric and electrostrictive, as well as electrocaloric (EC) effects. Among the complex perovskite materials, the B-site-disordered (1-$x$)Pb($Mg_{1/3}Nb_{2/3}$)$O_3$–$x$$PbTiO_3$ solid solution (PMN-PT) exhibits very large EM responses[1] and EC temperature changes[2]. Therefore, PMN-PT ceramic materials are being developed for possible use in actuator elements, in which both the EM and EC effects could be exploited.[3] The relaxor/ferroelectric properties of PMN-PT solid solutions strongly depend on their compositions and are influenced by the crystal and domain structures. However, most studies on domain morphology have been made on PMN-PT single crystals, while only a few analyses were performed on the domains in ceramics.[4,5]

In our contribution transmission electron microscopy (TEM) was used to investigate the domain structure in PMN-PT ceramics with $x$ = 0.1–0.4 compositions, prepared by mechanochemical activation, and to observe their changes when poling with an external electric field. By increasing the PT content, the crystal symmetry changes from pseudocubic in PMN towards a rhombohedral, then a monoclinic and, finally, a tetragonal symmetry. Following the changes in symmetry, the domains evolve from nano-sized domains in PMN towards 100-nm-sized 'square-shaped' rhombohedral domains, then to irregular monoclinic domains, and finally to micron-sized lamellar domains in tetragonal PMN-PT compositions.

The results obtained by TEM will be presented and compared to piezoresponse force microscopy results of the same compositions. Furthermore, the influence of an ex-situ applied electric field on the domain configuration will be shown and discussed.

**Literature:**

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