Mechanically Activated Synthesis of a 0.65PMN-0.35PT Solid Solution

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Lead magnesium niobate $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN) is an extensively studied relaxor material because of its high dielectric constant and electrostrictive effect, its excellent voltage stability and its low sintering temperature. The addition of lead titanate $PbTiO_3$ (PT) improves the dielectric properties of PMN and thus the composition PMN-PT has advantages for applications in multilayer capacitors, actuators, sensors and electro-optic devices. PMN-PT exhibits a morphotropic phase boundary in the range of 30 to 36 mol % PT in PMN.

A perovskite 0.65 $[Pb(Mg_{1/3}Nb_{2/3})O_3]$ – 0.35 $[PbTiO_3]$ (PMN-PT) solid solution was prepared via a mechanical-activation-assisted synthesis route from PbO, MgO, Nb_2O_5 and TiO_2 under a high mill loading. The kinetics of the PMN-PT synthesis was studied using x-ray powder diffraction, scanning and transmission electron microscopy, diffrential thermal analysis/thermogravimetry and diffrential scanning calorimetry analysis. The oxide mixture underwent conversion to a pyroclore-free solid solution of PMN-PT after 64 hours of milling. The powder was sintered at 1200^{o}C for 2 hours. The sintered samples were single phase with a perovskite structure. The ferroelectric and dielectric properties of the PMN-PT prepared using mechanochemical synthesis exhibits a similar behaviour to PMN-PT prepared using a standard columbite method.