Grain size dependence of properties in lead nickel niobate-lead zirconate titanate films

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Abstract: A chemical solution deposition procedure was developed for lead nickel niobate-lead zirconate titanate (0.3)Pb($Ni_{0.33}Nb_{0.67}$)O_3-(0.7)Pb($Zr_{0.45}Ti_{0.55}O_3$) ferroelectric thin films. On tailoring the heat-treatment conditions and excess lead content, the average grain diameters could be varied from 110 to 270 nm. Dielectric permittivities ranging from 1350 to 1520 and a transverse piezoelectric coefficient $e_{31,f}$ as high as -9.7 C/m^2 were observed for films of about 0.25 mu m in thickness. The permittivity and piezoelectric response increased for samples with larger grain size. Higher thermal budgets also imposed higher levels of in-plane tensile stress on the perovskite layer; the imposed stress reduced the remanent polarization for the samples. Nonetheless, samples processed at higher temperatures showed larger average grain diameters and higher extrinsic contributions to the properties.