

# Composition Dependence of Local Piezoelectric Nonlinearity in Lead Nickel Niobate – Lead Zirconate Titanate Films

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**Abstract:** The composition dependence of dielectric and piezoelectric nonlinearities were characterized in epitaxially grown (0.3) Pb(Ni(0.33)Nb(0.67))O(3)-(0.7)Pb(Zr(x)Ti(1-x))O(3) thin films deposited on SrTiO(3). Tetragonal, morphotropic phase boundary (MPB) and rhombohedral films were prepared by changing the Zr/Ti ratio. The relative dielectric permittivity  $\epsilon(r)$  and the converse piezoelectric coefficient  $d(33,f)$  were found to follow the Rayleigh law. The local piezoelectric nonlinearity map showed the formation of micron-sized clusters of higher nonlinear activity for the MPB and rhombohedral compositions. The ratios of the irreversible to the reversible Rayleigh constants  $\alpha(\epsilon)/\epsilon(\text{init})$  and the spatially averaged  $\alpha(d)/d(33,\text{init})$  ratio were larger for the rhombohedral and MPB compositions compared to the tetragonal composition. The larger dielectric and piezoelectric nonlinearities observed for the rhombohedral sample are interpreted in terms of a higher domain wall mobility due to a smaller ferroelectric distortion and superior crystal quality.

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