

Enhancement of the electromechanical response in ferroelectric ceramics by design

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It is demonstrated based on continuum mechanics modeling and simulation that it is possible to obtain polycrystalline ceramic ferroelectric materials which beggars single crystals in electromechanical properties. The local inhomogeneities at the ferroelectric domain-scale level due to spontaneous polarization and the underlying anisotropy are taken into consideration in the framework of mathematical homogenization of physical properties in ferroelectric materials. The intrinsic randomness of the spatial distribution of polarization is shown to be judiciously employed for the design of better polycrystalline ferroelectrics. The noncollinear rotation of the net polarization-vectors embedded in crystallites of the ceramic ferroelectrics is demonstrated to play the key role in the enhancement of physical properties.

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