Influence of hydrostatic pressure on the dielectric properties of PZT-based materials

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Abstract

Lead zirconate titanate based piezoceramics and thin films are well-known for their excellent properties that make them good candidates for several commercial applications from piezoelectric transducers and actuators for the former, to MEMS systems or high-frequency components for the later. Whatever the configuration and the solid solution in the PZT system, strains and stresses play a crucial role in such lead-based ferroelectric materials as they can affect their crystal structure as well as their electronic, dielectric, ferroelectric and piezoelectric properties. The knowledge of the effect of hydrostatic pressures across the PZT phase diagram is therefore of primary importance in terms of reliability, accuracy, tunability and, finally, new functional applications. The present study reports on the pressure dependence of the longitudinal dynamic dielectric permittivity up to 2 GPa in the ferroelectric Ti-rich part of the phase diagram. In good agreement with detailed structural characterizations performed by X-ray and neutron diffraction as well as Raman spectroscopy, the pressure-induced changes observed in the dielectric response can be related to the ferroelectric tetragonal (FT), low-pressure (FMLP) or high-pressure (FMHP) monoclinic phases and/or associated to the specific ferroelectric FT -¿ FMLP -¿ FMHP phase transitions.