Presented at the 12th European Meeting on Ferroelectricity, Bordeaux (Francia), 26 giugno – 1 luglio 2011

THERMAL DEPOLARIZATION OF LEAD-FREE $(Bi_{0.5}Na_{0.5})_{0.94}Ba_{0.06}TiO_3$ PIEZOCERAMICS MONITORED BY SHEAR RESONANCE OF THICKNESS-POLED PLATES

Lorena Pardo[1]*, Elisa Mercadelli[2], Alvaro García[1], Klaus Brebøl[3] and Carmen Galassi[2]

[1] *Instituto de Ciencia de Materiales de Madrid. Consejo Superior de Investigaciones Científicas (ICMM-CSIC). Cantoblanco. 28049- Madrid (Spain)*
[2] *National Research Council, Institute of Science and Technology for Ceramics (CNR-ISTEC). Via Granarol, 64. I-48018 Faenza (Italy)*
[3]*Limiel ApS. Langebæk. (Denmark)*
**E-mail address:lpardo@icmm.csic.es*

Abstract

Submicron-structured $(Bi_{0.5}Na_{0.5})_{0.94}Ba_{0.06}TiO_3$ ceramics, at the Morphotropic Phase Boundary of the solid solution, were prepared from nanometric powder synthesized by sol gel auto-combustion at 500ºC. Samples were obtained by hot-pressing (800ºC-2h) and subsequent recrystallization at moderate temperature (1050ºC-1h) [1]. Accurate resonance measurements at the uncoupled shear mode of thickness-poled plates and their analysis by Alemany software [2] were carried out to obtain electromechanical coupling factors (k_{15}) and piezoelectric (e_{15}, d_{15}) and elastic (s^E_{55})coefficients. Evolution of these as a function of the temperature was determined to study the depolarization process. Results show that irreversible depoling starts from a temperature higher than 120ºC. Shear resonance modes are measurable well above the reported depolarization temperature (100ºC). A value of d_{15}=105 $pC.N^{-1}$ was measured at 160ºC. This is most probably due to a difuse phase transition from a field-induced ferroelectric (FE) phase to the low temperature non-polar phase at zero field (LTNPZF) phase. The macroscopic ferro-piezoelectricity observed may arise from the coexistence of the FE phase at the nano-scale in the LTNPZF phase.

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[2] L. Pardo, A. García, F. Montero de Espinosa and K. Brebøl. "Shear Resonance Mode Decoupling to Determine the Characteristic Matrix of Piezoceramics For 3-D Modelling". *IEEE Trans UFFC* (in press, 2011)