J. Phys. IV France **125** (2005) 309-311

DOI: 10.1051/jp4:2005125074

Thermal properties of $Sr_{0,3}Ba_{0,7}Ti_{1-y}Zr_yO_3$ ferroelectric ceramics: Dependence on sample's porosity*

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Abstract. The thermal properties of $Sr_{0,3}Ba_{0,7}Ti_{1-y}Zr_yO_3$ (BST30Zr) ferroelectric ceramics with different concentrations of Zr are studied by a Photoacoustic (PA) technique and the temperature relaxation method. The results of the measurements shows that the thermal conductivity of the samples increases linearly with the content of Zr, a behavior explained using the Maxwell-model for the dependence of this magnitude from sample's porosity.

1. INTRODUCTION

With the rapid and continuous trend to the miniaturization of electronic devices and components, it is of key importance the development of high quality ferroelectric ceramics for several applications [1]. Particularly those belonging to the $Sr_xBa_{1-x}TiO_3$ (BST) system are good candidates due to their outstanding properties. In the design of devices based on such a system, it is very important to take into account the thermal properties of the involved materials. In particular, it is of great importance the understanding of the interactions between microstructural aspects, such as porosity, which is ubiquitous in ceramic materials, and thermal properties, like the thermal conductivity [1]. As far as we know, the thermal properties of $Sr_{0.3}Ba_{0.7}TiO_3$ (BST30) ferroelectric ceramics doped with low concentrations of Zr have not been thoroughly investigated. For this reason, the aim of present work is the thermophysical characterization of $Sr_{0,3}Ba_{0,7}Ti_{1-y}Zr_yO_3$ (y=0, 0.03, 0.05, 0.1) ceramics.

2. EXPERIMENTAL PROCEDURE

The thermal diffusivity was measured using the Photoacoustic technique in the well known microphone version of the open PA cell (OPC) configuration [2]. The thermal diffusivity α_s of the sample can then be obtained as an adjustable parameter by fitting the experimental data (i.e., signal amplitude as a function of the modulation frequency) as has been described elsewhere [2].
For measurement of the specific heat capacity we have resorted to the temperature relaxation method, which is based in first disturbing a closed thermodynamic system from its state of equilibrium, and then observing the evolution in time of its absolute temperature [3].
From the values of α and C the thermal conductivity can be determined as $k=\alpha C$.

* This work was partially supported by CoNaCyT (Proj. 33586E), DGAPA-UNAM (Proj.. IN104000) and ALMA MATER (Proj.. 01-2001).