Effect of Ca^{2+} substitution on impedance and electrical conduction mechanism of $Ba_{1-x}Ca_xZr_{0.1}Ti_{0.9}O_3$ ($0.00 \leq x \leq 0.20$) ceramics

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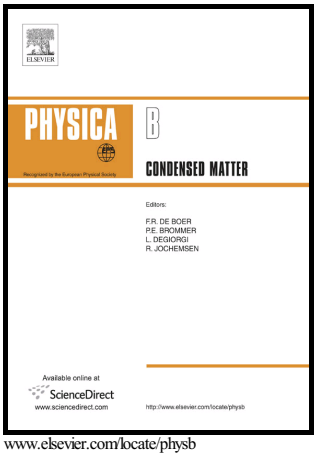

www.elsevier.com/locate/physb

PII: S0921-4526(16)30597-X
DOI: http://dx.doi.org/10.1016/j.physb.2016.12.021
Reference: PHYSB309762

To appear in: *Physica B: Physics of Condensed Matter*

Received date: 8 November 2016
Revised date: 13 December 2016
Accepted date: 14 December 2016

Cite this article as: Tanusree Mondal, Sayantani Das, T. Badapanda, T.P. Sinha and P.M. Sarun, Effect of Ca^{2+} substitution on impedance and electrica conduction mechanism of $Ba_{1-x}Ca_xZr_{0.1}Ti_{0.9}O_3$ ($0.00 \leq x \leq 0.20$) ceramics *Physica B: Physics of Condensed Matter* http://dx.doi.org/10.1016/j.physb.2016.12.021

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Abstract

The Ca modified $Ba_{1-x}Ca_xZr_{0.1}Ti_{0.9}O_3$ (BCZT) system for x = 0.00 - 0.20 is synthesized by the high-temperature conventional solid state reaction method. The morphotropic phase boundary (MPB) between the tetragonal and the structure cubic is obtained at room temperature for the composition x = 0.15. The doping of Ca facilitates the enhancement of the homogeneity of the microstructure and the growth of the grain size. The phase transition was also confirmed by Raman spectroscopy. In order to explore the effect of Ca concentration variation on the conduction mechanism of $BaZr_{0.1}Ti_{0.9}O_3$ (BZT) ceramic, the frequency dependent ac impedance spectroscopy technique is used at various temperatures. The effect of Ca doping on the electrical properties of BZT is clearly noticeable. The resistance of the grain and the grain boundary is increased as a consequence of the increase in the activation energy of Ca substituted BZT samples. The enhanced resistivity of the Ca substituted materials is explained in terms of the decrease in the mobility of the charge carriers associated with the lattice distortion. The electric modulus analysis reveals the enhanced capacitance of BCZT ceramics which is in good agreement with the results obtained from complex impedance analysis.

Keywords: Electroceramics, Barium titanate–zirconate, Raman spectrum, Impedance spectroscopy, Dielectric relaxation, ac-conductivity.