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Tanusree Mondal, Sayantani Das, T. Badapanda, T.P. Sinha, P.M. Sarun

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Effect of Ca^{2+} substitution on impedance and electrical conduction mechanism of Ba₁. _xCa_xZr_{0.1}Ti_{0.9}O₃ (0.00 \leq x \leq 0.20) ceramics Tanusree Mondal¹, Sayantani Das², T. Badapanda³, T. P. Sinha⁴, P.M. Sarun^{1*}

¹Functional Ceramics Laboratory, Department of Applied Physics, Indian Institute of Technology (ISM), Dhanbad – 826004, India

²Department of Physics, University of Calcutta, 92, Acharya Prafulla Chandra Road, Kolkata-700009, India

³Department of Physics, C.V. Raman College of Engineering, Bhubaneswar, Odisha, India-7520544

⁴Department of Physics, Bose Institute, 93/1, Acharya Prafulla Chandra Road, Kolkata - 700009, India

*Corresponding author's , Tel: +91-326-2235887, Fax: +91-326-2296563. email: sarun.res@gmail.com

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.

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