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Avadhesh Kumar Yadav, C.R. Gautam, Prabhakar Singh



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Effect of donor and acceptor dopants on crystallization, microstructural and dielectric behaviors of barium strontium titanate glass ceramics

Avadhesh Kumar Yadav^{1,*}, C. R. Gautam² and Prabhakar Singh³

¹*Department of Physics, Dr. Bheem Rao Ambedkar Government Degree College, Anaugi, Kannauj (India)*

²*Department of Physics, University of Lucknow, Lucknow-226007 (India)*

³*Department of Physics, Indian Institute of Technology (Banaras Hindu University), Varanasi-221005 (India)*

*E-mail: yadav.av11@gmail.com

Abstract

Bulk transparent barium strontium titanate borosilicate glasses in glass system (65-x)[(Ba_{0.6}Sr_{0.4}).TiO₃]-30[2SiO₂.B₂O₃]-5[K₂O]-x[A₂O₃], A = La, Fe (x = 2, 5 and 10) were prepared by rapid melt-quench technique and subsequently, converted into glass ceramics by regulated heat treatment process. The phase identification was carried out by X-ray powder diffraction and their surface morphology was studied by scanning electron microscopy. The dielectric properties were studied by impedance spectroscopic technique. Investigated glass samples were crystallized into major and secondary phases of Ba_{1.91}Sr_{0.09}TiO₄ and Ba₂TiSi₂O₈, respectively. A very high dielectric constant having value upto 68000 was found in glass ceramic sample BST5K10F. This high value of dielectric constant was attributed to interfacial polarization, which arose due to conductivity difference among semiconducting crystalline phases, conducting grains and insulating grain boundaries. Donor dopant La₂O₃ and acceptor dopant Fe₂O₃ play an important role for enhancing crystallization, dielectric constant and retardation of dielectric loss in the samples. Moreover, higher value of dielectric constant and lower value of dielectric loss was found in Fe₂O₃ doped samples in comparison to La₂O₃ doped samples.

Keywords: Barium Strontium Titanate; X-ray Diffraction; Scanning Electron Microscopy; Dielectric Behavior

Introduction

In a past few decades, the primary focus in the field of glass ceramic technology was to enhance the energy storage capability due to current and future demands. In this series, many efforts have been made by researchers and scientists. Although, the conventional

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