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

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Abstract

Bulk transparent barium strontium titanate borosilicate glasses in glass system (65-x)[($Ba_{0.6}Sr_{0.4}$).TiO_3]-30[2SiO_2.B_2O_3]-5[K_2O]-x[A_2O_3], 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 $Ba_{1.91}Sr_{0.09}TiO_4$ and $Ba_2TiSi_2O_8$, 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 La_2O_3 and acceptor dopant Fe_2O_3 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 Fe_2O_3 doped samples in comparison to La_2O_3 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