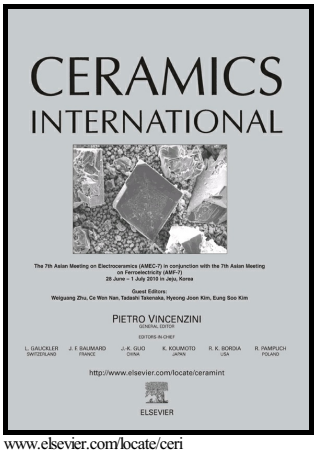

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Electrical Relaxation and Conduction Mechanisms in Iron Doped Barium Strontium Titanate

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ABSTRACT

Polycrystalline $Ba_{0.7}Sr_{0.3}Ti_{(1-x)}Fe_xO_3$ (x=0.1) (BSTF) ceramics, synthesized via solid-state reaction route were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and complex impedance spectroscopy (CIS). The Rietveld refinement of the XRD data confirmed the presence of tetragonal and cubic phases in the prepared sample. The SEM image revealed that the sample has well distributed grains along with some degree of agglomerations. The electrical behaviour of the BSTF ceramic has been studied by complex impedance spectroscopy (CIS) as a function of frequency (1 Hz to 1 MHz) at different temperatures (RT to 700K). Two semicircular arcs observed in the Cole-Cole plot confirm the contribution from the grain and grain boundary in overall impedance. Both the electrical as well as ac conduction phenomena take place via correlated barrier hopping (CBH) authenticated by detailed complex modulus analysis and ac fitted conductivity respectively. The values of activation energies calculated from electrical impedance, modulus, and conductivity data clearly reveal that the relaxation and conduction processes in BSTF ceramic are induced by doubly ionized oxygen vacancies.

1. INTRODUCTION

Ferroelectrics have always attracted considerable attention of scientific community as they have wide range of applications in pyroelectric detectors, electro-optic devices, non-volatile memories and dynamic random access memories (DRAMS) etc.[1–3] The most experimentally and theoretically investigated ferroelectric material is barium strontium titanate ($Ba_{1-x}Sr_xTiO_3$; BST) because it is a prototype ferroelectric, used extensively as capacitor in electronic industry and is the important candidate for dielectric material in dynamic random access memory technology due to its excellent properties such as high dielectric constant, low leakage current and tunable Curie temperature (T_c).[3–7] Although