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Department of Physics

Mother Teresa Women's University

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Copies can be had from

Dr. K. Prabha

Assistant Professor of Physics

Mother Teresa Women's University, Kodaikanal-624601.

CP12. Electrochemical Studies of BFO-BTO Nanocomposites at Room Temperature

Joana Preethi. A[1] and M. Ragam[a)1]

[1]The *Research Centre of Physics, Fatima College (Autonomous), Affiliated to Madurai Kamaraj University, Madurai, Tamil Nadu, India*

[a)]Corresponding author: mraagam.physics@gmail.com

ABSTRACT

In this work, pure BFO and BFO-BTO nanocomposites are prepared using sol-gel auto combustion route in the empirical relation (1-x)BFO-(x)BTO where x=0.01, 0.03. The prepared nanostructures were studied for the changes in the structural, morphological and electrochemical studies due to composite formation at room temperature. The XRD analysis revealed the microstructural properties of the pure BFO and BFO-BTO nanocomposites. The size of the nanocomposites decreased to 57nm on increased BTO concentration. SEM images revealed agglomerated nanostructures which became more coagulated on increased BTO concentration that can be correlated to the microstrain from the XRD data. The specific capacitance was calculated from the CV graphs which showed decreased specific capacitance when compared to pure BFO. But, the specific capacitance values increased on increased molarity of the electrolyte. By further tuning the properties, these BFO-BTO nanostructures emerge as useful potential candidate for energy storage applications.

1. INTRODUCTION

With the ability of tuning the co-existing ferroic properties, multiferroics have gained a lot of interest in various fields like solar energy conversion, electrochemical energy storage, spintronics, magnetic data storage, gas sensors, biosensors, ferroelectric field-effect transistors (FeFETs) and actuators [1,2]. BFO is one of the most widely studied multiferroic material due to its room temperature ferroelectric and anti-ferro magnetic properties. Though BFO is known for all the significant properties of a multiferroic material, its exhibits some drawbacks like leakage current, high tangent loss due to impurities and oxygen vacancies [3,4],. In composites, interfaces between different ferroelectrics or ferroelectric-ferromagnetic interface generate extra interaction energies including elastic, electrostatic, and gradient energies that pave way for a number of applications by tuning the properties simultaneously.

In this work, we have chosen BTO to anchor to the BFO nanostructures. Barium titanate is a ferroelectric ceramic material, with photorefractive effect and piezoelectric properties, used in capacitors, electromechanical transducers and nonlinear optics. Hence, BTO is believed to enhance the properties of BFO. Here, pure BFO and BFO-BTO composites are prepared using sol-gel auto combustion technique. The structural, morphological and electrochemical properties of the prepared nanostructures are studied and analyzed.

2. EXPERIMENTAL PROCEDURE

The pure BFO and BFO-BTO nanocomposites were synthesized using the sol gel- auto combustion technique. The BFO-BTO nanocomposites were prepared in varying concentrations following the chemical representation

(1-x)BFO-(x)BTO were x=0.01 and 0.03.

2.1 Preparation of Pure BFO

To prepare pure BFO, the nitrate salts of bismuth and iron were dissolved in nitric acid in the ratio 1:1. Citric acid is added to the solution in the ratio 1:6 of the metal ions. The pH of the resulting solution is adjusted to 5.5 by the addition of aqueous ammonia under constant stirring. After the desired pH is reached,