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The Influence of Mechanochemical Activation and Thermal Treatment on Magnetic Properties of the $BaTiO_3$-Fe_xO_y Powder Mixture

Z. Ristanović[1], A. Kalezić – Glišović[2*], N. Mitrović[2], S. Đukić[2], D. Kosanović[3], A. Maričić[2]

[1]Technical College of Vocational Studies, Svetog Save 65, 32 000 Čačak

[2]Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems, Faculty of Technical Sciences Čačak, University of Kragujevac, Svetog Save 65, 32 000 Čačak, Serbia

[3]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia

Abstract:

Powder mixture of 50 mass % of barium titanate ($BaTiO_3$) and 50 mass % of iron (Fe) was prepared by solid-state reaction technique, i.e. ball milled in air for 60 min, 80 min, 100 min, 120 min and 150 min. During mechanochemical activation it was observed the iron powder transitsion to iron oxides. Depending on the activation time the content of iron oxides FeO, Fe_2O_3 and Fe_3O_4 varies. Simultaneously, with the content change of the activated system, magnetic properties change as well. The XRD analysis of milled samples shown that as the activation time increase, the iron oxide percentage increases to, whereby the percentage of $BaTiO_3$ in a total sample mass decreases. The percentage of iron oxides and $BaTiO_3$ in annealed samples changes depending on annealing temperature. The thermomagnetic measurements performed by Faraday method shown that the powder mixture milled for 100 minutes exhibit maximum magnetization prior to annealing. The increase of magnetization maximum was observed after annealing at 540 ^oC with all milled samples, and at room temperature it has enhancement from 10 % to 22 % depending on the activation time. The samples milled for 100 min and 150 min and then sintered at 1200 ^oC exhibit magnetoelectric properties

Keywords: *$BaTiO_3$-Fe_xO_y powder mixture, Mechanochemical activation, Thermomagnetic properties, Magnetoelectric properties.*

1. Introduction

Correlation of magnetic and electric phenomena brings together few effects that attracted considerably research attention in last decade (magnetoresistance MR [1-3], magnetoimpedance MI [4-6] and dc Joule heating [7-9]). Denoted effects were investigated with the aim to evaluate potential of amorphous or nanocrystalline ferromagnetic alloys as materials for different applications [10-12]. Very interesting combination of amorphous ribbon with piezofiber laminates [13, 14] involves magnetoelectric (ME) composites as a new generation of multifunctional materials. Wang et al. [13] presented Metglas/PMN-PT fiber

*) **Corresponding author**: aleksandra.kalezic@ftn.kg.ac.rs