The Serbian Society for Ceramic Materials
Institute for Multidisciplinary Research (IMSI), University of Belgrade
Institute of Physics, University of Belgrade
Center of Excellence for the Synthesis, Processing and Characterization of Materials for use in Extreme Conditions “CEXTREME LAB” - Institute of Nuclear Sciences “Vinča”, University of Belgrade
Faculty of Mechanical Engineering, University of Belgrade
Center of Excellence for Green Technologies, Institute for Multidisciplinary Research, University of Belgrade
Faculty of Technology and Metallurgy, University of Belgrade

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Branko Matović
Aleksandra Dapčević
Vladimir V. Srdić

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THE INFLUENCE OF Ti-DOPING ON STRUCTURAL AND MULTIFERROIC PROPERTIES OF YTTRIUM MANGANITE CERAMICS

Olivera Zemljak[1], Danijela Luković Golić[1], Milica Počuča-Nešić[1], Aleksandra Dapčević[2], Damir Pajić[3], Pavla Šenjug[3], Goran Branković[1], Zorica Branković[1]

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Hexagonal ($P6_3cm$) yttrium manganite, $YMnO_3$, is a multiferroic material with ferroelectric transition at $T_C \approx 900$ K and antiferromagnetic transition at $T_N \approx 70$ K [1]. Multiferroic behavior attracts a lot of attention because of its potential for various applications [2]. The application possibilities are limited by large microcracking and microporosity of $YMnO_3$ ceramics [3].

In this work, the influence of Ti-doping on structural, ferroelectric and magnetic properties of $YMnO_3$ ceramics was investigated. $YMn_{1-x}Ti_xO_{3+\delta}$ (x = 0, 0.04, 0.08, 0.10, 0.15, 0.20) powders were prepared using sol-gel, polymerization complex method from citrate precursors, which were then calcinated at 900 °C for 4 h. The ceramic samples were obtained after sintering for 2 h at: 1400 °C for $YMnO_3$, $YMn_{0.96}Ti_{0.04}O_{3+\delta}$, $YMn_{0.92}Ti_{0.08}O_{3+\delta}$ and $YMn_{0.90}Ti_{0.10}O_{3+\delta}$; 1450 °C for $YMn_{0.85}Ti_{0.15}O_{3+\delta}$; 1470 °C for $YMn_{0.80}Ti_{0.20}O_{3+\delta}$. X-ray diffraction (XRD), transmission and scanning electron microscopy (TEM and SEM) were used for structural and microstructural analysis of samples. Ferroelectric measurements of P(E) loops and leakage currents, and magnetic measurements of zero field cooled (ZFC) and field cooled (FC) $M(T)$ curves, as well as $M(H)$ curves, were enabled multiferroic characterization of ceramic samples.

The samples x = 0 and 0.04 are crystallized in a single phased hexagonal structure, ($P6_3cm$), the samples x = 0.08 and 0.10 exhibited the presence of both hexagonal phase and rhombohedral phase ($R3c$), and the samples x = 0.15 and 0.20 are crystallized in rhombohedral 1×1×3 superstructure. Ti-doped $YMnO_3$ ceramic samples showed reduced density of microcracks, and inter- and intragranular pores, and large increase in relative density (greater than 90 %) for $YMn_{1-x}Ti_xO_{3+\delta}$ (x = 0.10, 0.15 and 0.20) samples. Leakage currents for most of doped samples were lower than leakage current of undoped sample, but the ferroelectric response was not significantly improved. Doping of $YMnO_3$ with nonmagnetic Ti^{4+} led to suppression of antiferromagnetic ordering visible through decrease of the Néel temperature and Weiss parameter and the appearance of weak ferromagnetism.

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THE DEFECT STRUCTURE AND ELECTRICAL PROPERTIES OF THE SPARK PLASMA SINTERED ANTIMONY-DOPED BARIUM STANNATE

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Barium stannate, $BaSnO_3$ (BSO), is a perovskite-type alkaline earth metal stannate with almost ideal cubic structure. Appropriate doping can alter this wide band gap material's electrical characteristics and change it either into a proton conductor or n-type semiconductor. In the case of Sb doping on Sn site, BSO becomes n-type semiconductor with high electrical conductivity at 25 °C.

The major drawback of BSO-based ceramics is its low density. The conventional solid state procedure requires long thermal treatments with several intermittent grinding and heating steps at temperatures up to 1600 °C [1].

To overcome this problem, we used Spark Plasma Sintering technique (SPS) for the preparation of $BaSn_{1-x}Sb_xO_3$, (x = 0.00 (BSSO0) and 0.08 (BSSO8)) ceramic samples. The samples structural properties were investigated using XRD (X-Ray Powder Diffraction), XPS (X-Ray Photoelectron Spectrophotmetry) and SIMS (Secondary Ion Mass Spectrometry) analyses. XPS analysis revealed the existence of many structural defects, including mixed oxidation states of tin (Sn^{2+}/Sn^{4+}) and oxygen vacancies (V_O) in both BSSO samples.

The electrical properties of the BSSO ceramic samples were investigated in the temperature range of 4–300 K. The presence of oxygen vacancies in the BSSO0 sample led to the absence of the standard activated semiconductor behavior, showing almost linear temperature-dependent resistivity in the examined temperature range. On the other hand, the BSSO8 sample showed almost