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Degree of phase transformations in the conditions of polythermal synthesis of $SrBaFeMoO_{6-\delta}$

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ABSTRACT

The sequence of phase transformations during the crystallization of $SrBaFeMoO_{6-\delta}$ by the solid-phase technique from a stoichiometric mixture of simple oxides $SrCO_3$ þ $BaCO_3$ þ $0.5Fe_2O_3$ þ MoO_3 was studied. It has been established that the synthesis of barium – strontium ferromolybdate proceeds through a series of sequential - parallel stages. It was found that to minimize the effect of intermediate reaction products, it is necessary to use combined synthesis modes. As a result of using combined synthesis modes for annealing for 20 h and T¼ 1443 K in vacuum of 10^{-5} Torr at the pressure of residual oxygen gas 10^{-8} Pa, it was possible to obtain a single-phase barium – strontium ferromolybdate compound with superstructural ordering of iron and molybdenum cations.

1. Introduction

Solid solutions of double perovskites with the general formula $Sr_{2-x}Ba_xFeMoO_{6-\delta}$, which have high chemical stability in a reducing atmosphere, high Curie temperatures (380–420 K), and a significant degree of spin polarization of conduction electrons (~100%), as well as low values of the controlling magnetic fields (B < 0.5 T) are of great interest to specialists working in the field of spintronics [1–6]. Interest in such materials is due to the fact that these objects have unique and extremely important for practical applications magnetic and magneto-transport properties, and in some parameters, they surpass the known manganite-based systems. Nevertheless, the values of magneto-resistance (MR) and other important physical characteristics of $Sr_{2-x}Ba_xFeMoO_{6-\delta}$ used in microelectronics may differ between re-searchers, which, apparently, is associated with features of sample preparation techniques [7–12].

While analysing the accumulated data obtained in Refs. [13,14], the multi-stage crystallization process of $SrBaFeMoO_{6-\delta}$ was established, which is due to the complexity of phase transformations, low kinetics of phase formation, and weak mobility of $Fe^{3þ}$ and $Mo^{5þ}$ cations [15,16]. The other research works contain more information on the preparation of $SrBaFeMoO_{6-\delta}$ by the mechanico-chemical method with a high-temperature synthesis in a reducing gas environment [16–21]. At the same time, rigorous correlations between the functional characteristics of materials and their production conditions are practically absent in the performed studies. However, the formation of a single-phase $SrBaFeMoO_{6-\delta}$ compound under conditions of control over the defect formation processes and, accordingly, compound with reproducible physico-chemical properties needs analysis of the phase transformations occurring in the batch as well as studies of the kinetics of the degree of conversion of double perovskite during its crystallization. Therefore, lately, the attention of researchers has been drawn to deeper and more detailed approaches to the synthesis of double perovskites associated with the study of the sequence of phase transformations during their crystallization [11,13–19]. In this regard, investigations aimed at studying high-temperature phase transformations and determining the

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