THE INFLUENCE OF «FREQUENCY OPERATION» MODE OF COAXIAL MAGNETOPLASMA ACCELERATOR ON THE PHASE COMPOSITION IN THE «FE-O» SYSTEM

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In the "iron-oxygen" system, there are 6 known phases of iron oxides such as α-Fe_2O_3 (hematite), β-Fe_2O_3, γ-Fe_2O_3 (maghemite), ε-Fe_2O_3, FeO and Fe_3O_4 (magnetite), which have different structural and physical properties. Among them, ε-Fe_2O_3 phase is of the greatest practical interest due to its unique magnetic properties. For example, ε-Fe_2O_3 phase has the highest coercivity among all known simple metal oxides (~ 23 kOe) [1]. Also it has the ferromagnetic resonance at the frequency of 182 GHz [2]. Nonetheless, the production of epsilon phase is a difficult scientific task, because of the fact that they can exist only in a nanoscale state and thermodynamically unstable.

It is known that the method of plasmodynamic synthesis can be used to obtain the epsilon phase of iron oxide [3], however its yield in the final product is not enough to study its properties correctly. This is due to the fact that the product of plasma dynamic synthesis generally consists of three phases (magnetite, hematite and epsilon phase). The presence of other iron oxide phases is able to contribute an error in the measured parameters. Thus, in this paper we considered the possibility to increase the yield of epsilon phase by means of using the "frequency" operation mode of the coaxial magnetoplasma accelerator (CMPA). This “frequency” mode is realized by feeding to the CMPA with several consequitive discharged pulses of power supply.

The influence of “frequency” mode was studied by implemening the plasma dynamic synthesis in a series of experiments differing by the number of power supply pulses (from 1 to 4). The ultrafine powdered products obtained in every experiment were investigated using the X-ray diffractometry and scanning electron microscopy methods. The quantitative estimation of phase content was carried out using PDF2+ database and “PowderCell 2.4” software. It was found that the yield of epsilon phase strongly depends on number of pulses. For example, with increasing in the number of pulses from 2 to 4 the ε-Fe_2O_3 content was increased from 35,0 to 65,0 %. It is also should be noted that the product mass in the case of 1 power supply pulse was too insufficient to study its phase composition. Such process feature is connected with the initial energy parameters, which were chosen in such a way to increase the lifetime of the CMPA electrode system. Thus, it was found that the yield of epsilon phase in the considered system directly depends on the number of power supply pulses.

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