OPTIMIZATION OF PLASMA DYNAMIC SYNTHESIS PROCESS FOR INCREASING THE YIELD AND PURITY OF ε-FE_2O_3 (EPSILON) PHASE

IVAN SHANENKOV[1], ALEXANDER SIVKOV[1], ALEXANDER IVASHUTENKO[1], MAXIM GUKOV[1], LIPING LI[2], GUANGSHE LI[2], WEI HAN[2]

[1]National research Tomsk polytechnic university, 30 Lenin av., Tomsk, 634050, Russia, +79069561366, Swordi@list.ru
[2]Jilin university, 2699 Qianjin St., Changchun, 130012, PR China

Iron oxides are among the most common used materials in the various fields of science and technology [1]. Among the known non-hydrated phases, the production of the epsilon phase of iron oxide (ε-Fe2O3) causes the greatest difficulties, since it is associated with the need to synthesize in a very narrow temperature range while maintaining the nanoscale state [2, 3]. This material also causes great scientific interest, since it has been established that this phase has the largest coercive force among all known simple metal oxides and is capable of absorbing electromagnetic radiation in the millimeter wavelength range [4, 5].

Earlier [6], the possibility was convincingly proved to obtain this unique iron oxide modification using a plasma dynamic synthesis method based on the use of low-temperature iron-containing plasma generated by a coaxial magnetic plasma accelerator [7, 8] and flowing into an oxygen atmosphere. The special features of the synthesis process (high plasma flow speed ~3 km/s and high cooling rate ~10^8 K/s) make it possible to preserve the necessary epsilon phase during high-speed sputtering from the boundary of the head shock wave of an ultrafast plasma flow as well as to achieve an output of at least 50 wt. %

In this work, the possibility was studied to increase further the yield of the epsilon phase of iron oxide in the composition of the heterophase synthesis product. For this, key features of the process were revealed that affect the production of ε-Fe2O3, which include the need to increase the lifetime of the quasi-stationary flow regime and the energy input to the system. Taking into account these data, appropriate design and circuit solutions for the system have been implemented that make it possible to obtain iron oxide powder with an output purity of epsilon phase of at least 90 wt. %. Another advantage was found to be an increase in the mass yield of the necessary phase.

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