Synthesis of oxidic powder in nonequilibrium low-temperature plasma with increase of indicators of quality of process

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Abstract. Ways of synthesis of powders in low-temperature plasma define various approaches in the solution of technological tasks for receiving difficult oxidic connections with various quality of a product. Research of model of electrothermal reactor installation with generation of low-temperature plasma is of special interest for synthesis of oxidic powder with the raised quality indicators. This approach defines technology of receiving details from powder materials of modern production.

1. Introduction
Synthesis of uniform oxidic powder in low-temperature plasma is of special interest for the production technology of difficult oxidic chemical compounds and drew attention of many researchers because of a wide range of use in various areas of the industry. Realization of technology of synthesis of powder in plasma substantially allows increasing quality of ferritic powders. This approach allows to solve many production problems. This decrease in multistaging of technological process, its duration, increases of indicators of quality, etc. [1].

The conducted researches in this direction are caused by [2] relevance of synthesis of oxidic powder in nonequilibrium low-temperature plasma with the set quality indicators. The presented results allow to judge the correct approach in the solution of an objective. This way based on application of a plasmatron with the nonequilibrium gas category with liquid electrodes was investigated by a number of authors [1, 3], however in their results properties of the received oxidic powders aren't presented. Therefore the purpose of researches is synthesis of oxidic powder in nonequilibrium low-temperature plasma with the increased quality.

2. Experiment delivery.
On the basis of the offered model of electrothermal installation for powder synthesis, with the developed mathematical model of process of interaction of plasma with a liquid electrode installation was developed.

The electric discharge between firm and liquid electrodes is a source of low-temperature plasma. It allowed to receive optimum values of parameters of oxidic powder [1-5].

In figure 1 electrothermal installation for powder synthesis is presented. In the photo 1, and the electric discharge between the metal anode (materials of electrodes were used various became) and the
liquid cathode is visible (various chemical compositions of electrolyte were used). In the photo 1, the stable level of electrolyte on z coordinate is shown.

Distinctive feature of the digit camera is its spherical form with the device of stabilization of level of electrolyte. This approach allows to receive stability of parameters of an electric discharge that defines quality of oxidic powder.

Researches were conducted with an atmospheric pressure. Interelectrode distance within 0.01 - 0.03 m [6, 7].

![Photo 1](image1)

**Figure 1** - The photo of electrothermal installation with generation of low-temperature plasma for synthesis of oxidic powder

3. **The results of experimental studies.**

The analysis of the received oxidic powders showed dependence of their geometrical sizes on category current density. In figure 2 plasma with optimum value of density of current for obtaining the demanded quality of powder is visually presented.

![Photo 2](image2)

**Figure 2** - A shaping of low-temperature plasma between a firm and liquid electrode at various increase

In the photo 2, and the formed plasma at values of current is visible 400 mA. The enlarged photo (fig. 2, b) shows a mnogokanalnost of the received electric discharge. The number of channels is
defined by the speed of rotation of the anode of a plasmatron. And it depends on the size of current of an anchor of the engine of a direct current.

The analysis showed that increase of density of current results in instability of indicators of quality of an output product. Process of synthesis of powder stopped with a diameter of shaping more than 10-2 m because of a big manufacturing defect. Formation of large particles it is caused by an electrode overheat under the influence of plasma at the big density of current.

Formation of powder begins with emergence of the gas category between a firm electrode and electrolyte. With increase in density of current on an electrode the product yield of technological process increases in the beginning, and then reaches saturation (for steel at iT = 105 And/m). Further increase of iT leads to fusion lower a crescent crown of an electrode, i.e. temperature in a contact spot on an electrode becomes higher than melting temperature Tpl, and the melted oxide of metal comes off an electrode, getting a sphere form at the expense of force of a superficial tension of a drop with a diameter from 10-6 to 5 - 10^-4 m (fig. 3). The size of fractions of oxidic powder makes from 100 microns to 500 microns.

Figure 3 – The photo of the received oxidic powder

In figure 4 the photo of an end face of an electrode is shown. The erosion of a surface defines an exit of the final product, and the condition of a surface depends on a chemical composition of metal of an electrode.
4. Conclusion.
The way of synthesis of oxidic powder in nonequilibrium low-temperature plasma showed increase of indicators of quality of process. It is of special interest for technology of the difficult oxidic chemical compounds possessing special electrophysical and physicomechanical characteristics. Realization of this way substantially allows to increase quality of a product for receiving ferritic powders.

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