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ARC DISCHARGE PLASMA AS A WAY TO OBTAIN SILICON CARBIDE

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Silicon carbide due to a number of physico-mechanical, physicochemical and electrophysical properties attracts the attention of researchers in all the world. Silicon carbide is characterized by high hardness, high thermal conductivity, corrosion and radiation resistance, specific optical and biological characteristics [1]. On the one hand, a silicon carbide coating increases resistance to oxidation of carbon fibers; on the other hand, carbon fibers can used as a reinforcing additive at the process of creating SiC ceramics with increased crack resistance [2]. Thus, the current scientific production task is to develop methods for obtaining dispersed materials consisting of silicon carbide and carbon fibers. Currently, such composites are obtained by various methods. Among the drawbacks of the methods are the need to create a protective atmosphere that prevents oxidation of the initial components at the synthesis stage and significant duration of the process. A possible alternative could be the synthesis of the material in the arc plasma. DC arc plasma method in air atmosphere has been successfully used in recent years for obtaining carbon nanotubes. This paper shows the possibility of obtaining the cubic silicon carbide and carbon fibers phase material, as a processing result of the silicon and carbon powder precursor due to DC arc discharge treatment.

In order to implement the process of electric arc synthesis, a laboratory experimental plasma-chemical DC reactor was assembled. As a power source was used rectifier-inverter welding transformer brand Condor Colt 200. Graphite electrodes were connected due to power lines to the power source. The arc discharge was initiated by the short contact of the electrodes; operating current and voltage were fixed during the working cycle directly with a voltmeter and ammeter [3].

A series of experiments was accomplished using the experimental setup described above.

Typical X-ray diffraction pattern of the obtained material as a result of experiments series is shown in fig. 1. Qualitative analysis was performed by comparing the position of the diffraction maximum on the 2θ axis of the obtained picture with the reference data given in the PDF4+ database.

It should be noted that the qualitative analysis results of the X-ray diffraction patterns of the obtained materials are unchanged and valid for all the products obtained; the results of quantitative

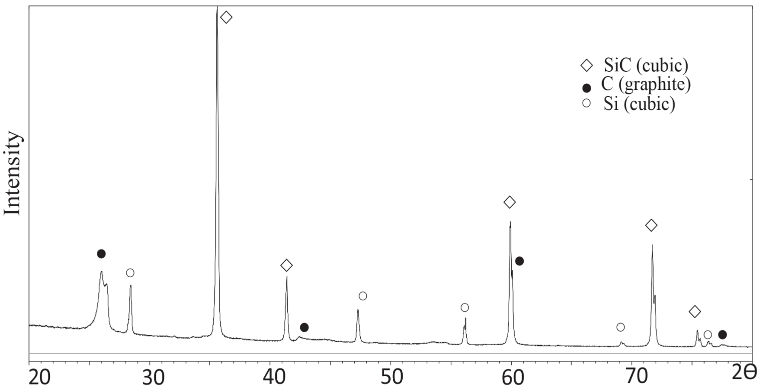

Fig. 1. *Typical X-ray diffraction pattern (CuKα)*

analysis indicate the dominance in the product of three crystalline phases: silicon carbide, silicon and graphite.

According to the presented data the product consists mainly of the cubic phase of silicon carbide (48,1 %) graphite carbon structures differing in the parameters of the unit cell (46,5 %) and silicon (5,4 %).

It can be concluded that it is possible to obtain a composite dispersed material based on carbon fibers and the cubic phase of silicon carbide in a DC arc discharge plasma. Within the framework indicated in this paper, studies are being conducted on the control of phase composition of the product and its consolidation into high-density ceramics with given properties. According to the literature review, evidence of obtaining such materials was not found without the use of vacuum-gas equipment to protect components and synthesis products from oxidation. As a result, this approach leads to positive economic effect and relatively high method performance.

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MATHEMATICAL MODELING OF CATALYTIC REFORMING PROCESS

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At present, the main tasks of the oil refining industry are increasing production volumes of petroleum products, the expansion of product range, and quality improvement [1]. Changing in petroleum refining technology are due to an increase in the share of refined sulfur, high-sulfur and high-paraffin oils. Simultaneously, the requirements for modern gasoline quality are getting severer. In this regard, secondary processes, especially catalytic ones, have taken increasing priority, among which the catalytic reforming process is of particular importance [2].

The method of mathematical modeling has found wide application in chemical technology. It enables to carry out computational experiments of complex chemical processes at low costs [3], to monitor the operation of industrial facilities and to carry out optimization.

The purpose of this research was to design a mathematical model of the catalytic reforming process. The research objects were three catalytic reforming units.

At the first stage of research, six main types of reactions were considered to develop a formalized scheme of chemical transformations taking place in the catalytic reforming process: six-membered naphthene dehydrogenation, five-membered naphthene dehydroisomerization, paraffin dehydrocyclization, paraffin, naphthene and aromatic isomerization, hydrocracking, hydrodealkylation. All theoretically possible chemical reactions were registered. The result was a list of 948 theoretically possible reactions.

At the second stage of research, the chromatograms of hydrogenate (raw material) and stable catalyzate (product) within the period from 2015 to 2016 years were analyzed. Substances, which concentration was less than 1 wt. %, were combined and presented as pseudo-components. As a result, a list of 55 components (40 individual and 15 pseudo-components) involved in catalytic reforming process was made. Thus, after aggregation the list of chemical reactions was shortened to 505.

The next step was the calculation of the thermodynamic parameters of chemical reactions in the