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## OBTAINING CHROMO-TITANIUM COATINGS UNDER CONDITIONS OF SELF-PROPAGATING HIGH-TEMPERATURE SYNTHESIS

**Introduction** The development of modern technology requires the creation of new structural materials with a set of properties such as high strength, corrosion resistance, wear resistance, etc. However, the use of expensive metals and alloys with such properties is not always economically feasible. Given this, one of the urgent problems is to improve the physicochemical properties of chromium-based materials. The chromo-titanium process is an effective method of increasing the reliability and durability of machine parts, tools and process equipment by creating chromium layers on the surface of machined parts that have a unique set of physicochemical properties. [1-2]

In this work the technology of chemical-thermal processing of steels in the conditions of high-temperature synthesis (SHS), combined with chemical gas transport reactions is considered. SHS is a high-intensity exothermic interaction of chemical elements in the condensed phase, capable of involuntary propagation in the form of a combustion wave.

**The aim of this work** was to develop compositions of powder SHS mixtures for the application of multicomponent coatings based on titanium in thermal spontaneous combustion, study of physicochemical processes of coating formation, determination of optimal technological parameters of SHS process at complex saturation, study of their influence on layer growth kinetics and evaluation quality.

**Research materials.** Chemical-thermal treatment of carbon steels was carried out in an open type reactor in the operating temperature range of 950 – 1050 ºC with an isothermal exposure time of 30 – 60 minutes.

The thickness of the hardened layers was studied using a Neophot – 21 and Neophot – 32 light microscope with an increase of ×150 – ×500. The microstructure was detected by etching in a 3 % alcoholic solution of picric acid (TU 6-09-08-317-80). To identify the grain boundaries of ferrite, a 4% alcohol solution of nitric acid was used.

The elemental composition was studied by X-ray microanalysis using a JEOL Superprob-733 microanalyzer. To calculate the equilibrium composition of the system products, the applied software packages “ASTRA 4” and “TERRA” were used [3].

**Research results and discussion.** Analysis of the reactions occurring during thermal spontaneous combustion of SHS-charges, the results of metallographic studies of the phase composition of the layers allowed to determine the scheme of formation of coatings. The process can be divided into several stages: inert heating of the reaction mixture to the ignition temperature; thermal spontaneous combustion; heating of products; isothermal exposure; cooling. Obtaining coatings under conditions of high-temperature synthesis occurs under non-stationary conditions, when neither thermal nor chemical equilibrium until the complete

completion of the process and cooling of the products is impossible. The rates of chemical processes are determined by kinetic laws that depend on temperature and diffusion factors.

The processing efficiency is determined by the time parameters of the processing process and the thermophysical characteristics of the charge. It has been experimentally established that with increasing saturation temperature and increasing the duration of isothermal exposure, the thickness of the diffusion layer increases.

**Conclusions.** Tests of SHS coatings for corrosion resistance showed an increase of 1.6-1.8 times this indicator, compared with diffusion coatings obtained under isothermal conditions.

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## FORMATION OF DOPED MOLYBDENUM COATINGS IN THE SHS

**Introduction** One of the main, widely known and most promising ways to strengthen the surface of steel products is chemical heat treatment (CHT). Currently, the technology of strengthening the surfaces of parts working in conditions of constant friction and high temperatures due to coatings of solid chromium, iron, nickel, copper, zinc and other metals and alloys, while the most promising method of increasing heat resistance and corrosion resistance of parts is molybdenum coatings. The introduction of molybdenum in the composition of steels significantly increases their corrosion resistance and, more importantly, resistance to the most dangerous local types of corrosion.

To obtain wear-resistant molybdenum coatings for parts which operating in aggressive environments with high temperatures and in conditions of self-propagating high-temperature synthesis (SHS) [1,2]. SHS is a high-intensity exothermic interaction of chemical elements in the condensed phase, capable of involuntary propagation in the form of a combustion wave.

**The aim of this work** The main purpose of the work is to obtain legovapnyh molybdenum coatings in the SHS.

**Research materials.**

For the application of molybdenum coatings used samples of iron of technical purity and steel for mass use (steel 20, steel 45, U8).

Chemical-thermal treatment of carbon steels was carried out in an open type reactor in the operating temperature range of 1100 – 1200 ºC with an isothermal exposure time of 30 – 60 minutes.

The thickness of the hardened layers was studied using a Neophot – 21 and Neophot – 32 light microscope with an increase of ×150 – ×500. The microstructure was detected by etching in a 3 % alcoholic solution of picric acid (TU 6-09-08-317-80). To identify the grain boundaries of ferrite, a 4% alcohol solution of nitric acid was used.

The elemental composition was studied by X-ray microanalysis using a JEOL Superprob-733 microanalyzer. To calculate the equilibrium composition of the system products, the applied software packages “ASTRA 4” and “TERRA” were used [3].