Analysis of the state of ferroalloy production in the world allows the following trends to emerge:

- Continuous increase in the volume and consumption of ferroalloys;
- Studies aimed at meeting the needs of the needs of the internal market;
- Reduction of raw material resources;
- Increasing the role of metallurgical technologies;
- Development of cooperation and integration processes;
- Creation of new production enterprises on the basis of industrial parks.

At present, a comparative analysis of various technological schemes of ferroalloy production has been carried out. This comparative analysis shows that slag and sludge produced by ferroalloys are important as raw materials in metallurgy. Therefore, of particular interest to metallurgy is ferroalloy slag. They contain a significant amount of valuable components used for purification and doping of iron-carbon alloys.

References

1. Дашевский В.Я. Ферросплавы. Теория и технология / Дашевский В.Я. – М.: Металлургия, 2014, с. 18-33.

2. Ferro Alaşımların İstihsali. Elektrometalürji (Çev. H.Erman Tulgar). Elyutin V.P., Yu.A., Pavlov, Levin B.E., Alekseev E.M., (1968) Cilt-1, İstanbul

3. International Journal of Eastern Anatolia Science Engineering and Design- 2019 s. 99-121.

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FORMATION OF MOLYBDENE COATINGS ON STEEL IN CONDITIONS OF SELF PROPAGATING HIGH TEMPERATURE SYNTHESIS

A promising way to obtain coatings with adjustable composition, structure and performance characteristics with limited or minimal time of their formation is the strengthening of steels with molybdenum coatings obtained in the conditions of self-propagating high-temperature synthesis (SHS). For the deposition of coatings, we used steels of mass purpose (st.20, st.45, U8). The treatment was carried out in open-type reactors in the thermal autoignition mode. Working temperature range 1000 ÷ 1300 ºC, duration of isothermal holding - 120 min. Powders of oxides of chromium and aluminum, titanium, chromium, aluminum, technical purity, metallic iodine with a dispersion of 200-350 microns were used as reaction agents.

Characteristically, in the temperature range of 800–1600 K, the reaction products decompose during molybdenum, which is confirmed by the production of decomposition substances and a sharp increase in the number of gas moles. With increasing temperature there is an increase in the number of aluminum halides: AlH_3, $AlCl$, $AlCl_2$, $AlCl_3$, Al_2Cl_6, AlI, AlI_2, AlI_3 chromium: $CrCl$, $CrCl_2$, $CrCl_3$, CrI, CrI_2, molybdenum: $MoCl$, $MoCl_2$, MoI, MoI_2, MoI_3.During molybdenization of iron-carbon alloys under similar conditions, the surface zone of the samples was decarburized and the diffusion layer was a solid solution of molybdenum in α-iron. At saturation of steels of mass use in powder mixtures based on molybdenum and ferromolybdenum at 1100-1150 ° C for 2 h, a diffusion layer is formed from a solid solution of molybdenum in α-iron (a-phase).

The thickness of the diffusion layer obtained at 1050 ° C is about 150 μm. An increase in temperature to 1150-1300 ° C leads (with slow cooling) to the formation of inclusions of the intermetallic Fe_7Mo_6 in the α-phase.

On U8 steel, a diffusion layer with a surface zone carbide Mo_2C with microhardness 14000-15000 MPa, under which the α-phase is located + Mo_2C, and below - a zone of an α-solid solution of molybdenum in iron with a microhardness of 21500 ... 4000 MPa.

References

1. Sereda B.P., Bannikov L.P., Nesterenko S.V., Gaidaenko O.S., Kruglyak I.V., Sereda D.B. Surface hardening of materials working in the conditions of complex influence of aggressive substances: monograph.. Kamyanske: DSTU, 2019. 173 p. ISBN 978-966-175-185-8.
2. Sereda B., Belokon Y., Belokon K., Kruglyak I., Sereda D. Modeling of the processes of obtaining porous materials under SHS conditions. *Materials Science and Technology*. Portland, 2019. P. 1331–1335.

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FORMATION OF WEAR-RESISTANT COATINGS ON CONSTRUCTION MATERIALS USING SELF PROPAGATING HIGH-TEMPERATURE SYNTHESIS

Among the methods of surface hardening are widely used protective coatings based on titanium, obtained by various methods of surface modification. A promising way to obtain coatings with adjustable composition, structure and performance characteristics with limited or minimal time of their formation is the alloying of structural materials in the conditions of self-propagating high-temperature synthesis. The paper considers the production of multicomponent titanium coatings obtained under the conditions of self-propagating high-temperature synthesis. As a result of combustion of powder mixtures with the transport agent may form a gas phase containing compounds I, I_2, I_3, F_2, F_3, H, H_2, H_3, F, F_2, F_3, HF, H_2F with chemical elements. With increasing temperature there is an increase in the number of halides Gaseous products that interact with the elements of the powder system Ti, Cr and are converted into the gas phase AlI, AlI_2, AlI_3, CrF, CrF_2, CrF_3, Crl, Crl_2, Crl_3, TiF, TiF_2, TiF_3, TiI, TiI_2, TiI_3, At temperatures above 750 K, the proportion of condensed phase does not change. This fact indicates that in the temperature range 750–1600 K reactions occur with the release of the condensed phase, but without changing the number of moles, which is characteristic of the reactions of decomposition, exchange with material, ie essentially chemical transport of elements.

High surface hardness is a necessary condition for wear resistance in most types of wear. In the case of abrasive, oxidative, fatigue wear, the most wear-resistant are steels with a high initial surface hardness, the structure of which consists of particles of the solid phase of carbide and the high-strength matrix holding them. Tests for microhardness are carried out using desktop devices PMT-3. The obtained data comparing the wear resistance of steel 45 with alloyed titanium coatings correlate with the values of microhardness, which is for coatings obtained under SHS conditions during chromium doping H_{100} = 16000 – 19000 MPa. The test results showed that when tested under friction-sliding conditions, the best wear resistance among the considered alloyed titanium coatings have coatings doped with chromium. Their wear resistance is 1.7 - 1.9 times higher than that of coatings obtained under isothermal conditions.

References

1. Sereda B.P., Kruglyak I.V., Baskevich O.S., Belokon Y.O., Kruglyak D.O., Sereda D.B. Surface strengthening of structural materials using composite saturating media: monograph. Kamyanske: DSTU, 2019. 242 p. ISBN 978-966-175-187-2
2. Sereda B., Sereda D., Kryglyak I. Selection of materials for use in corrosive environments using SHS technology for automobile parts. *Materials Science and Technology* 2018, MS and T 2018. P. 1414–1418.