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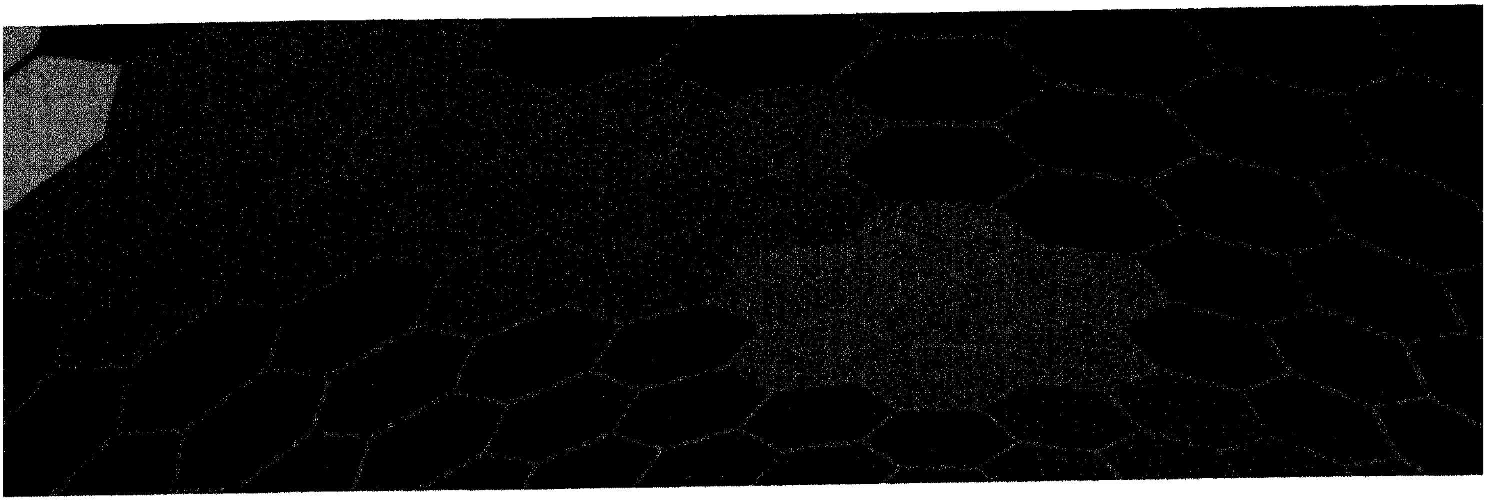

Abstracts.
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Hence, the conducted test has shown that the produced coatings completely sequestered Pu(V). Of importance is that all humic derivatives synthesized did not acquire toxicity as a result of modification that allows for considering them and derived materials as «green» chemicals and biomaterials.

Directed modification was shown to be a promising tool for producing biocompatible humic nanocoatings and nanomaterials. This opens broad opportunities for commercial applications of humic materials in environmental and biomedical technologies.

References

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OBTAINING COMPOSITE α-Fe AND TRANSITION METAL CARBIDES NANOMATERIALS AND THEIR CORROSION-ELECTROCHEMICAL PROPERTIES

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Nanocrystalline a-Fe and transition metal carbides materials have high mechanical properties, increased noncorrodibility and electrocatalytic properties. The objective of the present work is the investigation of the electrochemical properties of nanocrystalline composites (NC) based on a-Fe + Fe_3C (TiC) in the mediums of various compositions and pH.

NC composites a-Fe + Fe_3C (TiC) are obtained by mechanical activation of carbonyl Fe with graphite in the ratio of Fe(100-x)Cx (x=5, 10, 15, 20, 25 at.%) and in organic-silicon mediums — 0.3 and 3 mass.% solutions of vinyltriethoxysilane in heptane (VTES/H) and in toluol (VTES/T), respectively. Separate carbide Fe_5SiC and NC composite Fe70Ti15C15 are obtained by grinding elementary mixtures of powders; the composite Fe(70)TiC(30) is obtained by mechanical activation α-Fe with TiC. Finely dispersed powders are pressed in a dynamic way at 500^{0}C.

X-ray phase analysis of NC composites shows the formation of two-phase α-Fe+Fe_3C (Fe_3C: 9-92mass.%) and three-phase α-Fe+Fe_3C+TiC (TiC~15 mass.%) systems. To reveal the role of NC states as reference specimens the coarse-crystalline specimens of cast steel U13 with hydrogen content close to NC Fe95C5, armco iron, and composites after one hour annealing at 800^{0}C have been used.

The effect of carbide phases on the release of hydrogen can be estimated by the cathode current magnitude with one and the same potential (fig. 2). The increase of cathode current depending on cementite content for NC composites obtained in graphite containing cementite inclusions with spherical shape (fig. 3a) has an exponential character. In the case of NC composites VTES/H and VTES/T with reticulous structure of cementite (fig. 3b, c) the release of hydrogen is much more intensive. The likely course of it is the more developed surface of inclusions Fe_3C being formed under selective dissolution of ferritic phase and resembling a skeleton catalyst. The similar result is obtained in в 0,5 M H_2SO_4 and in hydrochloric acid solutions.

According to catalytic activity in the release of hydrogen reaction the phases can be ranged in the following way: α-Fe(1)<TiC(4)<<Fe_3C~Fe_5SiC(50). Carbides with the low overtension of the release of hydrogen and the composites with reticulose nano-carbides in conducting matrixes are perspective catalysts for electrochemical obtaining of hydrogen. In alkaline mediums (0,01-0,5M NaOH) the rate of the release of hydrogen increases by a factor of 1.5 — 3 from iron to cementite; the lower catalytic activity of carbides in alkaline mediums is connected with the formation of hydrogen at the discharge of water moleculars rather than H_3O^+ ions.

Thus, carbides Fe_3C, Fe_5SiC, TiC and their composites with α-Fe are characterized by the increased resistance to isolated corrosion. The given materials are perspective for electrochemical technology whereas they have high catalytic activity in the process of hydrogen release in acid environments.

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CALS-TECHNOLOGY OF PLASMACHEMICAL SYNTHESIS OF HIGH PURITY NANOMATERIALS

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In the last years, a special interest was generated by some nano-powders which are used in production of ceramic products, such as: tungsten carbide, tantalum, niobium, hafnium, molybdenum, silicon; silicon nitride, titanium nitride, aluminum nitride; silicon oxide, ferric oxide, aluminum oxide, zirconium oxide, titanium oxide and tin oxide. In our works special attention has been given to producing of oxide nanopowders of high purity.

To obtain a nanodisperse oxide of high purity an universal plasmachemical apparatus [1] was developed, which allows to apply not only initial hardphase product by means of powder feeder, but liquid-phase reagents with the help of special sprayer. Universality of the plant allows to obtain nanodisperse oxide of metals of 2nd, 3rd and 4th group of the periodic system. Depending on amount of the parent material, plasma-formation gas flow and power insertion it is possible to obtain nanopowders of different dimension series.

Development of the plasmachemical process was carried out in the context of the most current and perspective system of computer support – CALS-technology (Continuous Acquisition and Life cycle Support). Within design CALS-project a typical scheme was created (protocol of application) – «Initial data for designing» (Fig. 1).

Design electronic description according to STEP standard (fig. 1) contains the structure and variants of item configuration, geometrical models and drawings, properties and features of components. At the element of this scheme universal plasmachemical apparatus is shown allows to transfer to reactor (Fig. 1-a) not only the initial solid product by means of powder feeder, but the liquid reagents (chlorides and alchoxides) with a special sprayer (Fig. 1-b). For this CALS-project of apparatus (Fig. 1) includes metering device for the transfer of initial materials powders, pulverizer for transfer of plasma-creating gas, filter for the product recovery (Fig. 1-c) and plasma torch. Apparatus universality allows obtaining nanodisperse compounds of tin, iron, silicon, titan, tungsten, etc. on it.

To the work and CALS-project researches, dealinfg with influence for nanodispersity of two parametrical complexes: aggregate condition of initial substance; ratio of speed pressures of plasma stream (PS) and stream of input gas (SIG) were included. Research of influence of aggregate condition was carried out for plasmachemical synthesis of nanopowders of silicon oxide (required granulated content: d = 10 nm). To the proper subcategory of information CALS-project the table of obtained results (Fig. 2-a) was included. It is shown that for obtatining of required granulated content when using of initial substance (tetraethoxysilane – TEOS) ratio of SIG/PS is enough to 1. When input through sprayer of liquid TEOS ratio of SIG/PS equal to 12 is required. When input through feeder of quartz powder (d_0 = 10 mcm) for obtaining of nanodisperse silicon oxide (10 nm) high ratio of SIG/PS equal to 50 is required.

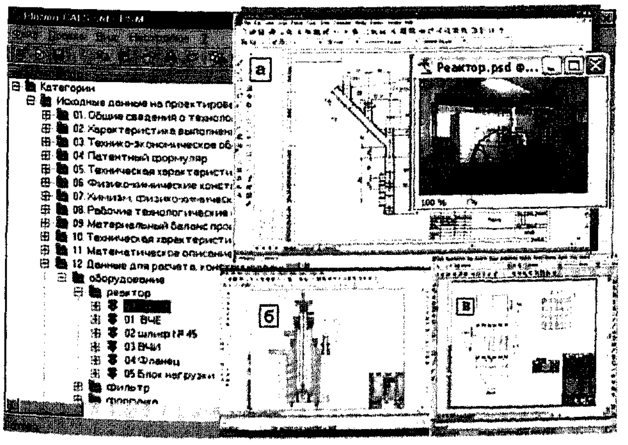

Fig. 1. Element of design CALS-project of plasmachemical apparatus for synthesis of nanomaterials (a – reactor, b – sprayer, c – filter).

In CALS-project researches of influence for dispersity of final product of ratio of SIG/PS (Fig. 2-b) are shown. Quartz powder was used as initial product (d_0= 10 mcm). Ratio of SIG/PS (β) varied from 20 till 50. As the result there were nanopowders with the diameter form 60 till 10 nm. This relation is approximated by the next exponential relation: $\ln(d) = a_0 + a_1 \beta$. Linear equation of correlation of ratio of SIG/PS and input power (W) also included to the model: $W = W_0 + b_1 \beta$. Application in the CALS-project of methods of computer modeling and forecasting allow to create optimum flexible structure of high technology plasmachemical production and to provide full post sell support, including the documentation in electronic form.