PATENTS FOR INVENTIONS

UDC 608; 69.001.5

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NANOTECHNOLOGICAL INVENTIONS AND NANOMATERIALS PRODUCE A PROFOUND EFFECT IN DIFFERENT AREAS OF ECONOMY

The inventions in the area of nanotechnologies and nanomaterials produce a profound effect in construction, housing and communal services and adjacent economic fields as they allow us: to increase mechanical strength, coefficient of elasticity, alkali resistance and temperature of products vitrification; to obtain nanostructured coatings with the property of shape memory on the steel; to raise the dynamics of coal burning and its full burnout in the boilers of thermoelectric power station; to produce metal nanopowders with increased stored energy 10–15% etc. For example, the invention «Epoxy composition for high strength, alkali resistant structures» refers to epoxy composition used as a binder for production of high strength, thermal- and alkali-resistant glass-fiber material which can be applied in the manufacture process of construction reinforcement to strengthen concrete structures. The invention «The method to produce nanostructured reaction foil» can be used to join different materials including metal alloys, ceramics, amorphous materials and elements of microelectronic devices that are sensible to the heating. This process provides decreased labour-output ratio and energy consumption as well as the condition to manufacture foil with specified stored energy and high mechanical properties. The invention «The method of intensification of burning low-reactionary coal in the boilers of thermoelectric power station» refers to the thermal energy and can be implemented at the thermal plants. The increased dynamics of inflaming and burning leads to full burnout of powdered-coal low-reactionary fuel and decreased mechanical underfiring.

The specialists may be also interested in the following inventions: fine dispersed organic suspension of carbon metal-containing nanostructures and the method to produce it; the dispersion of carbon nanotubes; the composition for reinforcement of building structures; the reinforced plate element made of natural or conglomerate stone and its multilayer protective coating; the production method for sensible element of gas detectors with carbon nanotubes; the method to strengthen metal products with obtaining nanostructured surface layers; the production method for microballs and microspheres; the method to apply nanodiamond material by means of combined electromechanical treatment; the production method for stable suspensions of metal nanoparticles and stable colloid suspensions, etc.

Key words: nanotechnologies, nanostructures, nanomaterials, nanopowders, nanocomposites, nanoparticles, nanotubes.

DOI: dx.doi.org/10.15828/2075-8545-2015-7-1-82-104

Epoxy composition for high strength, alkali resistant structures (RU 2536141)

The invention refers to epoxy composition used as a binder for production of high strength, thermal- and alkali-resistant glass-fiber materials which can be applied in the manufacture process of construction reinforcement to strengthen concrete structures. There is a description of polymer composition which contains epoxy diane oligomer ЭД-20, isomethyltotrahydrophthalic anhydride (iso-MTHPA), catalyst of polymerization-2,4,6,-tris(dimethylaminomethyl)phenol and nanomaterials of carbon type [1].

The development of polymer matrix of composite material is an important technological task as many properties of polymer composition materials are determined by it. By means of selection of the composition and properties of the filler and the binder, their ratio, it is possible to obtain materials with required combination of performance and technological characteristics.

The technical result is the increased mechanical strength, coefficient of elasticity, alkali resistance and temperature of vitrification for the products based on the proposed composition. This is possible because the

epoxy composition of hot hardening as a binder for production of glass-fiber materials comprises epoxy diane oligomer ЭД-20, isomethyltotrahydrophthalic anhydride (iso-MTHPA) and catalyst of polymerization. According to the invention it contains nanomaterials of carbon type as a modifying additive: carbon nanotubes (CNT) or carbon nanofibers (CNF), or a mixture of carbon nanomaterials (fullerenes, nanotubes, nanofibers, smut carbon).

The method to produce nanostructured reaction foil (RU 2536019)

The invention refers to powder metallurgy, in particular to the technology of production of multilayer reactionary foils. It can be used to join different materials including metal alloys, ceramics, amorphous materials and elements of microelectronic devices that are sensible to the heating [2]. The initial mixture of components is treated with cold rolling to make it band-shape. The band is subjected to clad rolling between the layers of plate metal (for example, aluminium) with crimping of reaction mixture from 30 to 60%. The obtained foil contains clad exterior layers of plate metal and interior reaction layers with reagents which size is 10–100 nm. This process provides decreased labour-output ratio and energy consumption as well as the possibility to manufacture foil with specified stored energy and high mechanical properties.

These are technical results of the proposed invention:

- obtaining of reactionary foils within a wide range of compositions;
- obtaining of reactionary foils with specified stored energy;
- obtaining of reactionary foils with high mechanical characteristics;
- decreased labour-output ratio and energy consumption.

The method to produce nanostructured reaction foil consists of three operations which can be considered on the example of the system Ni–Al.

At first the initial mixture of nickel and aluminium powders, molar reagent ration can be for example 1:1, is subjected to high power mechanical treatment in high-speed planetary-ball mill for 4–5 minutes in the atmosphere of inert gas under the pressure 1-5 at. In this case the ratio of balls mass to the mass of the initial mixture is (5–40):1, diameter of the balls is 2–8 mm, the frequency of cylinders rotation in mill is 1800–2500 rotations per minute.

Then the obtained composition nanostructured particles Ni/Al are subjected to cold rolling. This process allows reactionary powder to have shape of the band.

At the second stage the molded environment of reagents is subjected to clad rolling between the layers of plate metal (for example, aluminium) with crimping of reaction mixture from 30 to 60%.

Thus the produced nanostructured foil contains clad outer layers of plate metal and inner – without pores nickel/aluminium reaction layers with reagents which size is 10–100 nm.

The method to obtain nanostructured coatings with the property of shape memory on the steel (RU 2535432)

The invention refers to metallurgy, in particular to application of coatings with the property of shape memory. The method to obtain nanostructured coatings with the property of shape memory on the steel surface includes application of powder based on Ni with the effect of shape memory on the steel surface, heat hardening with the temperature up to 100°C and further cooling in liquid nitrogen, plastic deformation of the produced surface in three stages under the heating [3]. After each stage of plastic deformation baking is performed. The powder used in this process possesses the effect of shape memory and contains the components, mas%: Ni – 41–44, Cu – 5–10, Ti – the rest. Before application of coating the mechanical activation of the powder TiNiCu in vacuum is performed. The powder is applied by means of high-speed gas flame sputtering. The obtained TiNiCu coating with the effect of shape memory is characterized by increased mechanical properties due to raised adhesion, decreased surface porosity and the plastic properties of the structure are improved owing to formation of nanostructure.

The method of intensification of burning low-reactionary coal in the boilers of thermoelectric power station (RU 2535425)

The invention refers to heat-power engineering and can be used at the thermoelectric power stations (TPS). The method of intensification of burning low-reactionary coal in the boilers of TPS includes inflammation

and burning of powdered-coal low-reactionary fuel along with introduction of aqueous emulsion with nanoadditive in the form of soluble taunit. The technical result is the increased dynamics of inflaming and burning and full burnout of coal in the boilers of TPS [4]. It is possible to achieve the technical result if aqueous emulsion with nanoadditives in the form of soluble taunit gets into furnace through drawdown burners. Through thermal radiation and light impact of flame body in furnace soluble taunit as a photosensitizer generates singlet fed oxygen. Oxygen in high-stable singlet state possesses energy by 94,2 kJ/mole (0,98 eV per molecule) more than in stable state, that results in decrease of activation energy of chemical reaction of burning and increase of the rate of the oxidation of organic part of coal and raise of the inflammation and burning rate in general. The increased dynamics of inflaming and burning leads to full burnout of powdered-coal low-reactionary fuel and decreased mechanical underfiring. Thus introduction of aqueous emulsion with nanoadditive in the form of soluble taunit makes it possible to increase dynamics of burning and fullness of burnout of powdered-coal low-reactionary fuel in the boilers of TPS and there is no need to use mixing, low-efficient in these conditions, equipment which worsens aerodynamics of powder flow and negatively affects on efficiency of burning in general. The method of intensification of burning of low-reactionary coal in boilers of TPS includes inflammation and burning of powdered-coal low-reactionary fuel and is characterized by introduction of aqueous emulsion with nanoadditive in the form of soluble taunit.

The method to produce metal nanopowders with increased stored energy (RU 2535109)

The invention refers to powder metallurgy, in particular to obtaining of nanopowders of metals with increased stored energy [5]. It can be used to raise reaction ability of nanopowders in the processes of baking, burning and in energy saving technologies. The sample of the nanopowder is exposed to rays of accelerated electrons which energy is not more than 6 MeV in vacuum and the positive charge of inner part of metal particle is provided. The thickness of the sample doesn't exceed the length of electron track. That results in increase of stored energy by 10–15%.

Dispersed composition material (RU 2534479)

The invention refers to welding, in particular to production of powders used for plasma-powder welding deposition of antifriction reinforcing coatings when wear-resistant details are manufactured. The dispersed composition material for welding deposition of antifriction coatings based on aluminium bronze contains, mas.%: 0,5–2,5 nanopowder of aluminium oxide with particles which size is 20–140 nm; powder of aluminium bronze – the rest. The use of composition material allows increasing hardness and wear-resistant of the coatings or welds [6].

The method to produce nanopowders (RU 2534477)

The invention refers to powder metallurgy, in particular to production of nanopowder. Powder basic material in the form of micrograins which size is 20–60 μm and which consists of particles with the size 0,1–3 μm and binder which evaporation temperature is not more 300°C, taken in the quantity 5–25 mas.%, is introduced into the flow of thermal plasma. That leads to production of nanopowders without admixtures of raw stuff [7].

The method for production of nonwoven nanocomposite material based on polyamide-6 (RU 2533553)

The invention refers to the method for production of nonwoven nanocomposite material which can be used in the area of medicine and filtration. The principle of the method for production of nonwoven nanocomposite material is that basic components are mixed in extrusion machine and catalytic synthesis of polyamide-6 is performed in the reaction part of extrusion machine. Then by means of the method of electric extrusion fibers are obtained from the melt of polyamide-6. The initial mixture contains montmorillonite and ε-caprolactam as the initial monomer. Due to the invention it is possible to decrease energy consumption for production of nanocomposite material and decrease the quantity of technological stages and regulate the structure of the ready material.

The device of sample orientation for nanotechnological complex (RU 2533075)

The invention refers to nanotechnology and can be used in automated transport systems of moving and positioning of the sample in vacuum and controlled gas environment. The device contains the tool to capture the sample and mechanism for its transportation, the ring-shape carrier of the sample profiled by the outer circle. The tool for capture contains a platform, two pairs of rollers disposed on the opposite edges of the platform and performed with elements of interaction with the sample carrier and transmission which displaces rollers along horizontal axis. The transportation mechanism of capture tool includes U-type frame connected with transmission along horizontal axis fixed at the base of device. The device allows performance of independent functions of orientation and flipping of surface sample up or down, function of in-process transportation of the sample from one chamber in cluster to another one without flipping and orientation [9].

The method to produce nanodispersed powders and device to perform it (RU 2533580)

The group of inventions refers to production of nanodispersed powder of aluminium oxide. The method includes supply of powder aluminium and initial active gas into prechamber, their mixing, inflammation of metal-gas mixture in the prechamber along with conversion of aluminium in gas phase due to self-sustaining exothermal reaction, supply of the obtained mixture into main combustion chamber, afterburning of metal in gas phase along with supply of the second active gas, air, and formation of condense combustion products. The walls of the chamber are cooled and protected from pickup of condense phase by means of supply of chemically neutral (respect to aluminium) gas into prechamber. To cool the main chamber distilled water is supplied. The obtained condense combustion products with distilled water are supplied together into takeoff device, then the formed suspension of condense combustion products is cooled with extraction of nanodispersed powder of aluminium oxide from it. Some part of the suspension after being additionally cooled is returned to the takeoff device. The device to perform this method has been also

proposed. The result is increase of performance of the method and operational reliability of device [10].

The method to produce ultradispersed powders of alloys (RU 2533622)

The invention refers to metallurgy and can be used for production of ultradispersed powders and alloys. The method of production of ultradispersed powders of alloys with the particle size 5–200 nm and specific surface 80–170 m^2/g includes supply of powder of initial mixture of the basic and additional metals with average particle size 100–150 μm in the form of inert plasma-forming gas into reactor of gas-discharge plasma, evaporation of the initial mixture of the basic and additional metals, cooling of thermal decomposition products with inert gas and condensation of obtained ultradispersed powder of alloys in water-cooled inlet chamber. When thermal decomposition products are cooled, one provides their mixing in the zone of flame cooling with electromagnetic field created by electromagnetic mixer which is on the outer side of reactor cooling zone. The result is ultradispersed powders of alloys with even distribution of elements in them [11].

The specialists may be also interested in the following inventions:

- Fine dispersed organic suspension of carbon metal-containing nanostructures and the method to produce it (RU 2515858) [12].
- The dispersion of carbon nanotubes (RU 2494961) [13].
- The composition for reinforcement of building structures (RU 2493337) [14].
- The reinforced plate element made of natural or conglomerate stone and its multilayer protective coating (RU 2520193) [15].
- The production method for sensible element of gas detectors with carbon nanotubes (RU 2528032) [16].
- The method to strengthen metal products with obtaining nanostructured surface layers (RU 2527511) [17].
- The production method for microballs and microspheres (RU 2527427) [18].

- The production method for solar element and the module of solar elements (RU 2532137) [19].
- The method to apply nanodiamond material by means of combined electromechanical treatment (RU 2530432) [20].
- Tandem solar phototransducer (RU 2531767) [21].
- The production method for ceramic slurry (RU 2531960) [22].
- The method of ultrasound final polishing of the details made of construction and tool steel and the equipment to perform it (RU 2530678) [23].
- The production method for stable suspensions of metal nanoparticles and stable colloid suspensions (RU 2536144) [24].

Dear colleagues!
The reference to this paper has the following citation format:

Vlasov V.A. Nanotechnological inventions and nanomaterials produce a profound effect in different areas of economy. Nanotehnologii v stroitel'stve = Nanotechnologies in Construction. 2015, Vol. 7, no. 1, pp. 82–104. DOI: dx.doi.org/10.15828/2075-8545-2015-7-1-82-104.

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