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Nanomaterials on the basis of electroboosted rolling in grooves and calibres

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The process of electroboosted rolling in grooves and calibres can be utilised as an effective way of obtaining of new materials with structure and properties, close to nanosizes. The features and technological capabilities of electroboosted rolling in grooves and calibres utilised for obtaining unique constructional (structural) and functional materials and hardware products from them. The cross-sectional(transversal) size of internal layers can be at the expense of repeated reduction of a package (packet) from the ordered threads or layers as metallic, and not of metallic materials. One consist of techniques of obtaining of composite and functional materials in the following operational sequence. For the first cycle of operations the metallic shell(envelope) (usually was rolled, a handset of round or square section(cross-section)), in which the package(packet) of the ordered threads or belts(tapes) was contained. The appropriate threads and belts(tape) were obtained on the previous operations. After the first cycle, as a result of which the shell(envelope) inclusive an enclosed package(packet) of threads, was decrease up to the necessary sizes, the operation of assembly decreased of bars in a package (packet) follows which also places in the next shell (envelope) and such process repeat some times. The number of threads in a shell(envelope) usually makes 4, 9 or 16. In a limiting case this digit was equaled 25. The number of cycles of reuction by rolling can vary over a wide range, it is usual no more than 10-15. It is easy to show, that quantity S of filaments in final bar after m of cycles will make value $S = Nm+1$. If N to put equal 4, 9 or 16, number of filaments in final bar after completion 12 cycles for number, for example, 4 (that is 4 initial filaments in single package) approximately 108. If to take for initial number of filaments number 9, after 8 cycles the number of filaments in final bar will make about 109. And, at last, for initial number 16 in zero cycle, after 7 cycles of reduction the number of filaments in final bar will come nearer to digit 1010, that is this quantity of filaments will come on several square millimeters. Thus, the cross-sectional(transversal) size of a single filament will be equal approximately 10 nanometer, that is corresponds (meets) to criteria of the nanomaterials. As, there are no principled and technological limitations on increase of number of cycles, then, as it is easy to see, cross-sectional(transversal) sizes of filaments, of layers and other components will make units and less nanometer, that is it is possible to finish the cross-sectional(transversal) sizes of components down to nuclear scales. By a main and necessary condition for such obtaining of materials it is high quality also of exact

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geometry in sense of the form(shape) and structure(profile) the internal component in cross section is preventing gaps and destructions of inner shells, layers or filaments practically on all length of final bar. And length of bar can be practically unlimited. To execute this condition at a conventional processing techniques of metals by pressure, in this case, by methods of rolling in groovesручьях or calibres it is in essence impossible.

The conducted researches have allowed to make a conclusion(injection) that, apparently, only by methods of electroboosted rolling in grooves and calibres of a special structure(profile), when there is a capability to operate(control) processes of plastic deformation of metals, and also friction forces between contacting internal layers the component, is present a practical capability to implement the schemes of obtaining of the multicomponent ordered structures nanometer.

Interesting capability is one more kind(view) of materials and hardware products, which can be received by methods electroboosted rolling in grooves and calibres. In particular, the technique of obtaining of long-sized hardware products of an arbitrary structure (profile) in cross section inclusive longitudinal pinholes practically anyone as is wished(as much as) of mesh sizes in cross section, any density and character of distribution was designed. Moreover, the experimental methods detected capabilities of obtaining of longitudinal pinholes of the different form(shape) and structure(profile) in cross section. As have shown researches with the help of a submicroscopy, the pinholes can be free (empty) on all length of a hardware product or filled metallic and non-metallic components. The similar results, under the available literary data, are not known for us. Cutting obtained thus кщвы and band on cross section on thin disks(disces) and slices and collecting from it is possible to receive them flat compositions of the necessary size and forms (shape), initial unique material for membranes, microspinnerets, micromasks(microoils) and etc. The materials and hardware products can be if necessary obtained, in which wall of a matrix between channels can be reduced and are concentrated up to supersmall of the sizes, that is up to nanometer. The similar materials and hardware products can be recommended for usage as cold cathodes in electrovacuum devices.

During realization experimental and analytical investigations we detected one more technological capability of new methods of rolling. In a number(series) of devices and devices for their successful operation the thin and strong membrane materials with selective ionic and electronic conductances, for example, for electrochemical units of a new generation are required. Using a technique of joint rolling in grooves both calibres the metallic and non-metallic component, is possible, as have shown experience, to receive in a final hardware product micron and supermicron channels of the given form(shape) and sizes. Is once again underlined, that the similar results were not marked by us in the known literature and other sources.

During experiments, as by us was established, for obtaining required materials and hardware products of a non-metallic component at stage of rolling with the metallic component should be crude (unburnt) weight of an appropriate structure and properties. After chemical or electrochemical deleting the metallic components, which was intended only for derivation and fixing(fixation) on definite time of pinholes and simultaneous realization of necessary operations of heat treatment, were obtained unique membrane materials and hardware products from them.

The methods electroboosted groove of rolling utilised for implementation of processes of mechanical (cold) dilution or doping of one component (metallic or non-metallic) in the friend in any volumetric ratio and combinations. And in those combinations when in a usual terms (for example, in easy melt) the components are not admixed. As against a conventional powder metallurgy in our case mechanical dilution or the doping is reached by that doping components as thin filaments or cores by methods electroboosted groove of rolling reduce together with a matrix or shell (envelope) for rather small quantity of cycles. And

the distribution of doping components on section(cross-section) of bar can be reached with a very large degree of uniformity(homogeneity), and also if necessary, this distribution can be carried out under the given law, that in usual technologies is impracticable in essence.

Further usage of features and capabilities of a technique electroboosted groove of rolling in sense of a control of forces of friction on a demarcation between components, for example, between a metallic shell (envelope) and high-strength polymer filament has allowed to develop a technique of obtaining of a unique composite material with high unit strength. In particular, at usage of aluminum and his(its) alloys as a material for shells(envelopes) and hardening filaments (such as ceblar and etc.) samples of bands and rods with tensile strength more than 4,5—6 GP (450-600 kgs /sq. mm) were obtained.

Varying a volumetric ratio a component and selection for shells(envelopes) and and filaments in a system "the metal-polymer filament", is possible, as have shown experiments, to receive of a new constructional(structural) material with high unit strength exceeding strength of a doped steel wire in 3—5 times and higher. The similar materials combining high strength, small specific gravity and corrosion resistance, can find application in air and space engineering, for example, for manufacturing of fuel tanks, helicopter propellers(screws), designs of a wing and etc.

The technique of electroboosted rolling in grooves and calibres utilised for obtaining hardware products as membranes, microsieves and microcapillary tubes. If rods, inclusive pinholes of the necessary parameters to cut on thin disks(disces) and them to compose in membrane compositions, it is possible to receive unique filtering systems which are not having of clones in world (global) practice. Really, now there is a technology of obtaining of microstrainers on polymer materials, which subject to processing by ion beams.

Thus, the methods of electroboosted rolling in grooves and calibres open broad capabilities of obtaining of unique materials and hardware products adequate(answering) to the full criteria for nanomaterials.

From above-stated follows, that in Institute of Metallurgy and Materials Science create the scientific and technological fundamentalses for obtaining of nanomaterials of the broad class both on properties, and on application are created.