Theme 4 – NMP – Nanosciences, Materials and new Production Technologies
FP7–NMP–2008–SMALL–2
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NANOMODIFIED MATERIALS WITH CONTROLLABLE PROPERTIES

acronym **NAMCOP**

The project deals with obtaining new micro-, nanostructural modified and composite materials with determined mechanical, physical, and chemical properties. Production of these materials is based on the effect of **super deep penetration** of a clot of discrete microparticles in a solid (SDP effect).

The purpose of the project - to carry out the basic research on a new idea of phase changes in solid materials, to develop scientific bases of new technological processes of micro- and nano-structures in matrix systems (metal, polymer, semiconductor), and to create a pilot line for manufacturing new generation composite materials with controllable physicochemical parameters.

***Idea of the project*:** activation of physical and chemical transmutations in solids is caused by simultaneous influence of a set of physical factors on material, i.e., high and ultrahigh fields of pressure, intensive local strains, pulsing electromagnetic fields, flows of penetrable microparticles (additional doping), flows of high-energy ("galactic") ions, etc.

In conformity with the project tasks, the following basic scientific and practical results will be obtained:

1. New methods of interaction on materials, including overlapping in uniform process of formation nanostructures and nanocomposites with parallel oriented threadlike inclusions of new phases; methods of a composite material formation with the activated zones and growth of new phase inclusions will be developed.
2. Size effects in formation of nanomaterials properties, which can be accompanied by quantum effects, will be established.
3. Technologies of metal nanocomposites reception on the basis of carbides, oxides, borides, nitrides will be developed.

Value of the project

Scientific value. Development of the theory of microparticles penetration in solid structure on super big depths consists in the fact that it will concern the whole class of new physical phenomena for which theoretical interpretation is not given yet. The important direction of application of fundamental results is development of a general concept of production of new micro- and nanomaterials in technological processes.

Practical value. Production of new materials in conditions of SDP at mass production does not demand significant power and industrial expenditures. Therefore manufacturing products on the basis of the offered method will be accessible for small and medium enterprises and it will provide them high competitiveness.

Offered in the project, essentially new technological process of nanocomposites deriving in a uniform production cycle (synthesis and consolidation) will not influence on ecological situation as a whole.

Economic aspects of the project consider necessities of the European market of ecologically pure cutting instrument, which price is lower in comparison with hard alloy tools. Potential consumers of this production are Germany, France, Poland, Ukraine, Belarus, Russia, and other countries.

Future applications of the obtained results

Deepening on fundamental representations of micro- and nano-structure in materials, the mechanisms of reception of new structural elements at zonal refinement and synthesis of metastable materials, manufacturing, on this basis, new composite materials by means of SDP method will promote development and advance not only in the area of essentially new manufacturing nano- and micromodified metals, polymers and semiconductors, but also in application of these materials in other areas of the industry.

Applications of the project results

1. Instrument for mining industry (cutting tool, milling cutters, heads for coal crushing), instrument for metal cutting (drill, mill), and stamping instrument.
2. Materials for electrical industry (e.g., aluminium or copper composite materials for electrical connectors).
3. Composite materials for electronic industry (e.g., anisotropic metal, ceramic, and semi-conductor materials).
4. Composite materials for macro- and micro-sensors with anisotropic physical and chemical properties.
5. Synthesis of new metastable materials with special electrical, semi-conductor, and insulation properties.

The industry: mining, metalworking industry, electronics, electrical engineering.

Term of realization – 36 months from the begining of financing

Appendix. Superdeep penetration - SDP is the unusual physical phenomenon. Singularity of this phenomenon consists in the fact that at impact of a clot of dust particles, unlike impact of a macrobody of the same mass, a depth of penetration increases in tens - thousand times. This phenomenon is naturally realized at impact of a clot of a space dust in a protective shell of a space vehicle. Dust particles move in a material of a barrier on depths to tens and hundreds millimeters. At this motion of a particle, it does not meet resistance in a material of the barrier. Additional high-energy physical effects are realized: synthesis of new chemical compounds; synthesis of new chemical elements and inconvertible isotopes; intensive electromagnetic radiation; flows of "galactic" ions; crushing of initial structural elements, local melting of materials and so on.

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