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QUANTUM DOTS FORMATION IN THIN NANOSTRUCTURED AMORPHOUS FILMS

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ABSTRACT

In the last years an interest in field of quantum dots devices creating has been increased. In this work the nanocrystallite with Frank-Kasper structure was examined as the quantum dot in amorphous film. An ability to create all-inorganic Quantum Dots Light Emission Device may be considered for $Tb_{30}Fe_{70}$, $Co_{80}C_{20}$, $Fe_{86}Mn_{13}C$ and $Co_{50}Pd_{50}$ films. The self-organisation of atomic structure in $Tb_{30}Fe_{70}$, $Co_{80}C_{20}$, $Fe_{86}Mn_{13}C$ and $Co_{50}Pd_{50}$ films, which possess large values of perpendicular magnetic anisotropy (PMA) constant ($K_{\perp} \sim 10^6$ erg/cm^3), were investigated by methods of electron diffraction and transmission electron microscopy, including the method of bend contours [1]. The crystallization of the films proceeds in an explosive way forming different dissipative structures from initial nanocrystalline state. In previous works [2, 3] it was shown that after crystallization ($T_{ann} \sim$ 260-330°C) the atomic structures of $Tb_{30}Fe_{70}$, $Co_{80}C_{20}$, $Fe_{86}Mn_{13}C$ and $Co_{50}Pd_{50}$ films are tetrahedrally close-packed Frank-Kasper structures. In this work the structural model of thin film at mesoscale and its correlation with magnetic and optical properties is proposed.

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QUANTUM ANOMALIES IN NANOCOMPOSITE MATERIAL

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ABSTRACT

On the basis of the theory fiber bundle spaces (the concept is stated in [26]) the model of nanocomposite material is created. The model takes into account influence of distortion fields on kinetic characteristic nanocomposite. The anomalies of nanocomposite properties determined by features of a mass - resonance sold in these materials are considered**.**

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THEORETHICAL ESTIMATION OF TOPOLOGICAL FACTOR IN INTERACTION OF THE NANOPARTICLES WITH ELECTROMAGNETIC WAVES.

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ABSTRACT

Theoretical study of interaction between dielectric nanoparticles of various topology with electromagnetic and electrostatic fields was conducted. For this purpose the classical electromagnetic Maxwell's theory was used. It was shown, that the values of resulting electric field on the surface of spherical, cylindrical and tor nanoparticles are considerably different. In first two cases the results obtained correspond to the known information for the corresponding metal nanoparticles. Tor nanoparticle had giant (by several digits) amplifications of intensity of both variable and static fields on the surface of such particle. This phenomenon can explain numerous effects of nanomodification of various materials, received by the authors before, but also to foresee new directions in development of applied nanotechnologies.

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HIGH PERFORMANCE CONCRETES PRODUCING: OPPORTUNITIES AND PRACTICAL APPLICATION OF NANOTECHNOLOGY METHODS

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ABSTRACT

The submitted work by the example of cement concretes is concern with opportunities of the directed formation inorganic composites properties by application of various nanomaterials and nanotechnological methods :

- combinations of nanosized fractions of basic concrete components,
- introduction of nanosizes initiators of directed crystallization,
- application of nanosized thixotropy regulators of heterogeneous mixes,
- introduction the nanocomposite reinforcing elements into the concrete structures ,
- application of photodynamic self-sterilization methods, etc.

Synergic effects of these new tools have helped to create the high performance light concretes with high parameters. The application of this possibilities provides now an opportunity to change the point of view to designing of various objects, including transport (road bridges), high-rise structures (high-rise buildings from monolithic reinforced concrete, concrete cooling towers) and buildings with high level of seismic resistance, etc. These applications are possible to provide for building industry the significant economic benefit.

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FEMTOTECHNOLOGY: THE STRONGEST AB-MATTER FOR AEROSPACE

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ABSTRACT

Aerospace, aviation particularly need, in any era, the strongest and most thermostable materials available, often at nearly any price. The Space Elevator, space ships (especially during atmospheric reentry), rocket combustion chambers, thermally challenged engine surfaces, hypersonic aircraft materials better than any now available, with undreamed of performance as the reward if obtained. As it is shown in this research, the offered new material allows greatly to improve the all characteristics of space ships, rockets, engines and aircraft and design new types space, propulsion, aviation systems. At present the term 'nanotechnology' is well known – in its' ideal form, the flawless and completely controlled design of conventional molecular matter from molecules or atoms. But even this yet unachieved goal is not the end of material science possibilities. The author herein offers the idea of design of new forms of nuclear matter from nucleons (neutrons, protons), electrons, and other nuclear particles. He shows this new 'AB-Matter' has extraordinary properties (for example, tensile strength, stiffness, hardness, critical temperature, superconductivity, supertransparency, zero friction, etc.), which are up to millions of times better than corresponding properties of conventional molecular matter. He shows concepts of design for space ships, rockets, aircraft, sea ships, transportation, thermonuclear reactors, constructions, and so on from nuclear matter. These vehicles will have unbelievable possibilities (e.g., invisibility, ghost-like penetration through any walls and armour, protection from nuclear bomb explosions and any radiation flux, etc.). Nanotechnology, in near term prospect, operates with objects (molecules and atoms) having the size in nanometer (10^{-9} m). The author here outlines perhaps more distant operations with objects (nuclei) having size in the femtometer range, (10^{-15} m, millions of times less smaller than the nanometer scale). The name of this new technology is femtotechnology.

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NANOCOMPOSITES PREPARED BY SDP METHOD: THE PHYSICS OF SUPERDEEP PENETRATION PHENOMENON

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ABSTRACT

"Superdeep penetration" phenomenon is the perfect physical instrument for creating massive composite materials. The massive metal material can be transformed into a composite material for split second without using the difficult equipment. It was shown that all possibilities of explanation of decrease in resistance to a striker at its movement in a solid body due to the mechanism of economical use of the kinetic energy, are considered (so-called dead end was stated). Estimations of a minimum energy necessary for superdeep penetration have been performed. The obtained results have proved that the kinetic energy of a collision of a clot of discrete (separate) strikers with a barrier makes only 5÷10% of the total amount of the energy loss. It was shown that the process of cavitation of microbubbles in dense plasma is the source of additional energy, providing implementation of superdeep penetration.

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REVEALING, TYPIFYING AND ASSESSMENT OF CRACKS MODE I AND II BY QUANTITATIVE ACOUSTIC EMISSION NON-DESTRUCTIVE INSPECTION AND PHOTO-ELASTIC METHODS

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ABSTRACT

QAE NDI technology has been adapted to revealing, identifying and assessing a type of previously non-predictable failure of high energy equipment and piping, known as crack type IV. These cracks are classified according to their position in weld joints by welders and NDI specialists. However, until now, they were not typified in terms of fracture mechanics.
To establish the reasons behind the significant number of high energy piping failures as a result of crack IV development, to minimize social damage and economical losses, we have investigated crack IV peculiarities using a fracture mechanics approach. This was carried out using the Quantitative Acoustic Emission Non-Destructive Inspection and photo–elastic methods, optical and electron fractography investigations, and other methods. The research established the following:

1. Cracks of type IV correspond to transverse shear crack mode II, according to the classification used in fracture mechanics and solid-state physics.
2. The earliest quantitative statistical AE indications and peculiarities necessary and sufficient to reveal, typify and assess individual and interacting flaw danger level according to fracture mechanics criteria in specimens loaded by tension or transfer shear loads.
3. The zone of plastic deformation around crack mode II is approximately 2-5 times larger than in the case of mode I crack under similar loads; the configuration zone of plastic deformation around mode I and II crack types significantly differ each from other.
4. The length of crack jumps under mode II loading are significantly higher than in mode I crack under the same loads.
5. The velocity of mode II crack propagation is much higher than mode I cracks in similar steel and under similar loads.
6. The mechanical energy required for mode II crack propagation is much smaller (about 30-50% for P91 steel) than for mode I crack.
7. Based on the findings described in 1-6 above, we have:
   - Created a statistical database that enables recognition and assessment of the danger level of interacting flaws, according to the fracture mechanics approach.
   - Formulated requirements and technological solutions for revealing systems of interacting and individual flaws.
   - Proposed criteria for equipment acceptance and rejection from operation. These give increased reliability and accuracy of the assessment lifetime of pipes with flaws and can be successfully used for the inspection of high-energy piping of fossil and nuclear power plants, chemical and refinery industries, etc.,

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STRUCTURALLY-SUPERFINE SILUMINS FOR MODIFYING OF ALLOYS

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ABSTRACT

Environmentally safe way of obtaining of castings from silumins with nanostructural eutectic silicon by the method of quenching solidification casting is developed. The way of casting of silumins in jet crystallizer with the device of jet secondary cooling is developed. Their application allows to obtain ingots from silumins with ultra disperse microstructure where crystals of eutectic silicon have globular form. Thus use of environmentally unsafe admixture modifiers is not required. These methods were used for working out of high-performance technological process of casting of structurally-superfine silumin modifiers. They are environmentally safe substances and essentially raise effectiveness of modification process. Structurally-superfine silumins can be used as charge additives for realization of the process of hereditary modifying. It allows to 2… 5 times crush microstructure of billets from silumins and considerably reduce gas- shrinkage porosity in. Structurally-superfine silumins can be used as universal modifiers microstructure of billets from silumins, steels, cast irons, bronzes.

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PHASE TRANSITIONS IN SOLUTIONS OF STIMULI-SENSITIVE POLYMERS CAUSED BY DIRECT HEATING BY ALTERNATING ELECTRIC CURRENT

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ABSTRACT

Phase transitions in solutions of liquid crystal polymers already are widely used in different devices. Phase transitions in solutions of other stimuli-sensitive polymers may be used in image reproductions systems too. Particularly, thermosensitive polymers may be used for this purpose. Direct heating of solution by alternating electric current may cause phase transition in this case. The main factor, which determines applicability of such polymers in mentioned above devices, is duration of phase transition. The velocity of phase transition in solution of widely investigated polymer (poly N-isopropylacrylamide) with additives of low molecular salt already gives possibility to reach standard frequency of frame (24 Hz) as it is shown in present report. Consequently, new systems of image reproduction actually may be designed on the base of stimuli-sensitive polymers.