Science Opportunities in Ukraine

Institute Profiles and Technology Profiles of Some Technical Universities and Scientific Institutes in Ukraine

The information in this booklet is prepared as a starting point to learn about universities, institutes and the scientific expertise and technology developments. Interested parties should contact the inventors and the institutes directly for collaboration and partnering opportunities.

This document has been produced with the financial assistance of the governments of Canada, the European Union, and the United States of America, as Parties to the Agreement Establishing the Science and Technology Center in Ukraine (STCU).

Preface

The Science and Technology Center in Ukraine (STCU) has developed this booklet as a reference guide for opportunities in this country. Similar booklets are being developed for universities, scientific institutes and technology opportunities in the five countries that STCU works in, namely, Azerbaijan, Georgia, Moldova, Ukraine, Uzbekistan.

Over the last few years it has become apparent to us that such scientific organizations need to promote their scientific skills and opportunities in order to seek partnering opportunities with western investors and western organizations, both public and private. This booklet contains one-page capability descriptions of Ukrainian universities and scientific institutes (Institute Profile Forms- IPFs). After each IPF one can find a number of one-page technology profile forms (TPFs). More information can be obtained directly from the scientific contacts provided at the universities and institutes.

As these countries move toward a market-driven economic structure, their scientific institutes and universities will become increasingly important as technology drivers that promote the scientific research and technologies that are being developed and produced by their scientists. In order to establish business relations with western investors and business people, the various scientific communities will need new tools that will enable them to demonstrate their intellectual capital in the most productive manner.

To meet the competitive challenges of integrating into the largely knowledge-based economies of the western world, the countries of the former Soviet Union will need to change and adapt. They will need to utilize the forms by which scientific communities get their products to the marketplace and through sales acquire wealth and promote healthy economies. Licensing, technology transfer and new high technology start-up companies will be some of the necessary steps leading to global economic integration.

An integral and valuable resource for universities, scientists, researchers, and scientific organizations in the West is the development of Technology Transfer Offices within their various organizations. The scientific communities in the countries of the former Soviet Union are now aware that the kind of services that these Technology Transfer Offices provide is very much needed by them also. This booklet of Science Opportunities in Ukraine is a way to address this need.

We want to thank the scientific organizations that have prepared the original profiles of their scientific expertise and their technology opportunities. It must be noted that in translating from one language into another exact correlations are not always possible; stylistic, cultural, business and legal discrepancies do occur.

Good luck with your scientific developments, and may this booklet help to promote the scientific opportunities that exist in Ukraine, as it moves toward a global, market-driven knowledge economy.

Editor

Please note:

STCU is not responsible for the contents of any of the institute and technology profiles in this booklet. The material should be used as a guide only in order to interest others to collaborate and partner with the scientific organizations of Ukraine.

Science and Technology Center in Ukraine – STCU

STCU is a intergovernmental organization whose mission is the non-proliferation of knowledge and expertise in weapons of mass destruction. STCU is headquartered in Ukraine and works in 5 countries, namely, Azerbaijan, Georgia, Moldova, Ukraine and Uzbekistan. We support the scientists of the Former Soviet Union in their transition from building weaponry to redirecting their scientific skills to peaceful research in the civilian, government and private sectors. We encourage their participation, interaction and collaboration with western scientific and business communities. We have many scientific projects which were sponsored with the financial support of STCU's Governing Parties from the US, EU and Canada.

For more information about STCU's activities please visit our website at http://www.stcu.int.

STCU is an established, western style organization having over 14 years of operational experience. STCU helps you search and set up tailored development projects. Key benefits of working with STCU are moderate R&D costs, project monitoring and customs clearance assistance provided.

The STCU project related activities are supported and augmented by other initiatives: Training Programs, Patent and Licensing Support, Sustainability Promotion, Travel Grant Program, Targeted R&D Initiative, and others.

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Frantsevich Institute of Problems of Materials Science

Technical Area Keywords: material science and advanced technology of metal, ceramic and composite materials

General Information

The Institute for Problems in Materials Science (IPMS) is a leading Ukrainian center of advanced scientific and engineering services, technical consulting, and contract research and development in the field of material science and advanced technology of metal, ceramic and composite materials.

The Institute was founded in 1955 on the base of the laboratory for special alloys of the Ukrainian Academy of Sciences. Since then it has progressively widened its fields of application and customer base. IPMS has no analogs among academic institutions in Ukraine due a great variety of technological processes, materials and products. IPMS employs about 1500 people, including 78 Dr.Sc. and around 300 Ph.D. IPMS is a large scientific and research complex, including over 40 R&D departments, two pilot production centers, pilot plant, computer center and branch in Chernovtsy city.

Institute's Focus

One of the major focus points of the Institute in basic research – physical chemistry and physics of condensed systems – involves extensive research into electronic and crystal structures of matter, effect of pressure and temperature on phase transitions in metals, alloys, intermetallides, and high melting compounds of oxides, carbides, borides, nitrides etc. A significant role in the Institute's applied activity is played by research and development of metallic, ceramic and composite materials with a high level of structural and functional properties.

Valuable Technology Offerings

The Institute's core competencies allow engaging in research related to:

- Basic research in materials science and technology development with a focus on chemical thermodynamics, phase equilibria in the systems of metals, high melting compounds, inorganic compounds, condensed systems, nanostructures;

Technologies of powder metallurgy parts, protective coatings, composite materials, basalt- and carbon-based

- materials, porous materials, wear-resistive components, electric contacts;

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- materials, porous materials, wear-resistive components, electric contacts.

Scientific Cooperation and Technology Transfer

All achievements in the development of new materials with their further commercial application are supported by basic researches. The Technology commercialization Office has been organized to improve protection of intellectual properties and facilitate technology transfer to industry.

IPMS' scientists are collaborating with many companies worldwide from the USA, United Kingdom, France, Germany, Yugoslavia, Poland, Hungary, Bulgaria, Austria, Switzerland, Mexico, India, Cuba, South Korea, Israel, Japan, China etc. The Institute has set up service centers operating on the basis of its detonation coating technology in Japan, China, India and Vietnam. IPMS has carried out around 100 international projects and contracts for last 7 years.

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Al Base Alloys by New Economically Efficient, Environmentally Benign Technology of Rapid Solidification

Description

A new rapid technology based on the use of modified water atomization (see Fig. 1) followed by direct powder extrusion has been developed. The atomisation stage is innovative and realised as a pilot plant. The pilot plan built provides: (a) cooling rates between 5x104 and 106 K/s, (b) 2 to 10 kg of powder per atomisation run, (c) minus 40μ size fraction amounts to 70% at water pressure of 150 atm, (d) low surface oxidation, and (e) powders being highly irregular in shape are easy to press.

New high-strength, corrosion resistant weldable Al based alloy compositions have been developed, produced by the proposed technology in the form of strips (Fig. 2) and tested (Table below).

Properties	High strength 7xxx alloys
Room temperature strength, MPa	500-550
Elongation, %	8-12
Weldability	Weldable
Strength of weldments, MPa	300-350
Stress corrosion cracking, MPa	270-350
Low frequency fatigue strength, cy cles/Load	8x104-6x105/ 160 MPa
Fracture toughness, K1c, MPa m1/2	40-65

Ultra-high strength 7xxx alloys	Developed alloys
550-650	620-670
7-9	8-12
Welded by resistance welding	Very easy to weld
270-310	530-570
100-150	00-350
8x104/160 MPa	8x104-6x105/ 160 MPa
25-30	60-65

Innovative Aspects and Main Advantages

The main advantages of the proposed technology over the existing prototypes (gas atomisation and centrifugal atomisation): (1) explosion and fire-proof, (2) environmental safety (dust-free process), (3) higher productivity in powder production, (4) higher economical efficiency, and (5) recycling of wastes of packaging aluminium.

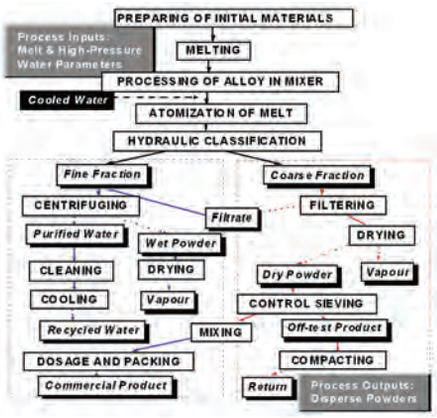

Fig. 1) Prossesing line for Powder Manufacture

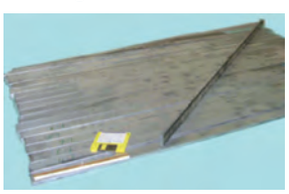

Fig. 2) Al strips (10x40 mm section)

The principal advantage of the developed alloys over the existing commercial materials consists in a unique combination of different properties. The tensile and yield strength of new alloys are similar to those of high strength commercial 7075 alloy while their stress corrosion cracking and fracture toughness are similar to the characteristics of less strength materials, such as 1973, 1949 etc alloys.

Areas of Application

Production of alloys for transport (aircraft and shipbuilding industry) and consumer goods (wheelchairs and sportive goods).

Stage of Development

- Patented in Russia and Ukraine;
- Ukrainian and 2 Russian patents;
- Pilot plant is operative;
- New Al alloys are produced, tested and available for demonstration.

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Ceramic Nanocomposites for New Generation of Cutting Tools and Heavy Loaded Wear Resistive Components

Description

We are developing the technologies of ceramic nanocomposites based on SiCC and Si3N4TiNTiB2 systems for novel generation of ceramic cutting tools, wear resistive components, radiation resistive ceramic components and otherpotential applications, where high melting temperatures, hardness, chemical and thermal stability and other properties are successfully married. The formulaton SiCC means nanocrystalline (40120 nm) betasilicon carbide reinforced with diamond planar clusters builtinto the lattice of SiC. This unique structural property provides hardness round 40 GPa in pure poreless ceramics. We found hardness of 24 GPa in nanocompostes with alumina, which also show fracture toughness around 9 MPa m1/2. As a result of NATO SfP project we have built the pilot unit for production of 20 kg of SiCC nanopowder a day. Here we propose the technology development of the nanocomposites based on SiCC nanopowders. Another group of nanocomposites based on nanoTiN reinforced with nano TiB2 and Si3N4 particles was obtained by sintering, highpressure sintering and sparkplasma sintering. Prototypes of cutting tools (unresharpable tools) were tested at room and elevated temperatures. These composites are promising tools for extrafine finishing of metallic parts. Hardness around 20 GPs, fracture toughness up to 8.5 MPa m1/2, keeping high stability (grain size around 80 nm) up to 800 C look attractive. The best combination of properties: hardness 24 GPa, bend strength >500 MPa, and fracture toughness of 7 MPa m1/2 was revealed for the TiN25%Si3N4 nanocomposite. The sintering process without pressure is available to get near fully dense (98.5%) ceramics and there fore, is promising for massive production of tools. At present we propose the technology development of ceramic cutting tools based on TiNSi3N4 ceramic nanocomposites.

Innovative Aspects and Main Advantages

Very good combination of hardness and fracture toughness at room and elevated temperatures looks attractive for cutting tool application. The technological operations are not expensive: for in stance, synthesis of SiCC is comparable with analogs by costs, pressure less sintering at moderate temperatures is used instead of hot pressing etc. The refinement of grains is desirable property for finishing treatment of alloyed steels and viscous metals and alloys. Stability of properties at high temperatures is promising for dry cutting operations.

We have a patent of Russian Federation concerning technology of SiCC nanopowder synthesis, pending patents of Ukraine and know how in technologies of TiNTiB2 and TiNSi3N4 nanocomposites.

Areas of Application

- Cutting tools, ceramic bearings, wear resistive components;
- Cutting tools made from Si3N4TiN nanoceramics were tested in ALCON (Kiev, Ukraine) - Wear resistive components based on SiCC ceramics were examined in Baker Hughes INTEQ GmbH.

Fig. 1 SiCC nanopowders

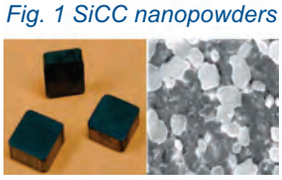

Fig.2 TiNSi3N4 multilayer cutting plates (50% Si3N4 50%TiN)

Stage of Development

- The pilot unit for SiCC nanopowder synthesis is under operation;
- The pilot batch of cutting tools made from Si3N4TiN nanoceramics has been prepared. Technical documentation is under preparation. - We have a patent of Russian Federation concerning technology of SiCC nanopowder synthesis, pending patents of Ukraine and knowhow in technologies of TiNTiB2 and TiNSi3N4 nanocomposites;
- We would prefer joint development of ceramic nanocomposite products with foreign partner. Licensing of technologies or development of startup company or joint venture is also appropriate.

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Development of High Efficiency Long Wavelength Infrared Radiators for Medical Application in Area

Description

The main task of this development is choice material, investigate its properties and create technology for production of high efficiency infrared sources of thermal energy. The idea to se layered gradient ceramics was developed by V. Petrovsky and gives possibility to solve next problems:

- Increase the wavelength range up to 7 12 μm at the same or higher surface temperature;
- Decrease the power consumption of one heater up to 25-30%. Such distribution of energy sufficiently increased physio therapy efficiency and reduce power consumption above 450W per physiotherapy chamber;
- Create essentially new system for sterilizing treatment equipment: the two heaters with sizes 100 x 8 x 8mm3 can radiate 825 Watt for heating the air blast (under pressure 8 atm. the speed is about 20 km/h at the temperature 300°C).This heated air blast can obliterate all bacteria and microbes on any surface during parts of second.

Innovative Aspects and Main Advantages

Decrease the power consumption at some thermal efficiency. Follow on the concept of layered composite there are offered the three type of IR radiators: (i) low temperature IR radiator based on layered structure of composite based on heat source from flexible ribbon heater (Fig.1) and IR radiated surface based on glass ceramic (temperature range before 150°C), (fig.2); (ii) middle temperature IR radiator based on heat source from flexible ribbon and IR radiated surface based on heater silicon nitride (temperature range 300550°C); (iii) high temperature all ceramic IR radiator (temperature range 5001100°C) for utilization at condition of intense heat exchange (Fig.3).

Areas of Application

- Energy sawing electrical heating of industrials and living rooms;
- medical application in area of human physiotherapy;
- system for sterilizing treatment equipment of rooms or medical equipment.

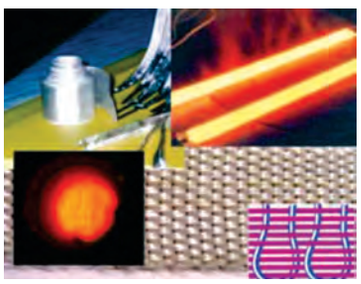

Fig.1. Flexible ribbon as heat sources.

Fig.2. Low temperature IR radiator as electrical heater for industrial and living rooms (The efficiency is 2 times more as compared with oil heater)

Fig.3. All ceramic IR radiator and their utilization as heater to extra high heat emission in new system for sterilizing treatment equipment

Stage of Development

(i) Low temperature IR radiator for industrial and living rooms – commercialized

(ii) Middle temperature IR radiator for of human physiotherapy and

(iii) high temperature all ceramic IR radiator for sterilizing treatment prototype available for testing.

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Efficient Sooty Filters and Neutralizers for Diesel and Carburetor Engines

Description

Neutralization and clearing of EICs exhausts is one of the most actual and enough complex problems of the environ ment protection from pollutions. According to specialists vehicles are suppliers of carbon monoxide about 6080 % from total in an aerosphere of the big cities. Introduction of hard restrictions on the toxic substances contents in the vehicles gas exhausts in the USA (ULEVstandards) and the states of Europe (EUROIII) causes necessity of development existing and creation of new materials and production engineering on manufacturing more efficient means of clearing of internal combustion engines exhausts. The problem of increase in reliability and efficiency of clearing of EICs exhausts from nitrogenoxides and soot particles for what at present the optimal solution is not found yet in the world is rather actual. Existing means of neutralization and clearing of EICs exhausts are functionly imperfect on the technical data and require certain development, including: raise of thermal stability of a honey comb structure of ceramic catalysts carryiers (initial and the secondary); efficiency of catalytic clearing at lower (200_220 oC) temperatures that is especially important.

Innovative Aspects and Main Advantages

It is developed:

- New methods of synthesis of oxide compounds cordierite and aluminium titanate with low TKLE in solid phase and by melt crystallization;
- Manufacturing methods of new ceramic materials with the increased thermal resistance and mechanical strength: porous for catalysts carryiers (porosity is 22_29 %), porous and permeable (porosity is 45_50 %) for sooty filters;
- An original design and the newest manufacturing methods of the sooty filter which is distinguished high efficiency;
- Methods of modification of the secondary carrying agent ђ Al2O3 which provide thermal stability of a covering, expansion of catalysts ≪bifunctionality window≫ which has allowed to reach high clearing efficiency, including from NOx, even at deficient oxygen concentration;
- Economy of the platinum metals contents at saving of high production characteristics and reliability.

Areas of Application

The developed catalysts will be used in catalytic neutralizers of the exhaust gases of automobile engines, both diesel, and carburettor.

Other perspective ranges of application of honeycombed block catalysts is clearing of gas exhausts of the enterprises from carbon monoxide, organic compounds of different classes, nitrogen oxides, and also clearing of gas exhausts of stationary engines – Diesel electric units (self_contained reserve sources of supply of electric energy) which are characterized by considerable volumes of exhausts.

Block catalysts of honeycombed structure can efficiently be used also in the high temperature processes of producing catalysis which run in outwardly diffusion area, for example, catalytic conversion of methane in production of synthetic ammonia. Now in IPC NAS Ukraine investigation tests of the developed block catalysts during catalytic conversion of methane in apparatuses of the secondary reforming on Open Society " Nitrogen " (Cherkassy) are carried out.

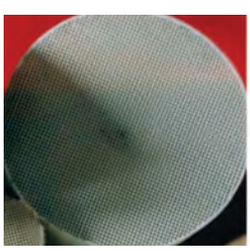

Fig.1 Honeycomb catalyst carier

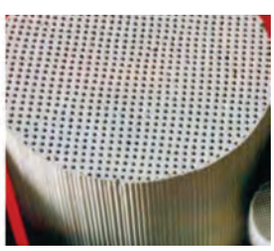

Fig.2 Sooty filter

Stage of Development

The patent of Ukraine is in a stage of development. The organization of production of catalysts and sooty filters with use of valuable mineral raw material kaolins of Ukraine makes possible their lower price at saving of high function characteristics (thermal stability, high catalytic activity), reliability and the long work resource.

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Production of Highly Disper-Sed Extra Pure Powders and Extremum Mechano-Chemical Treatment of their Mixtures

Description

Milling materials with various properties is expedient to carry out in the jet disintegrators (Fig.1). Principle of their operation consists in the following.

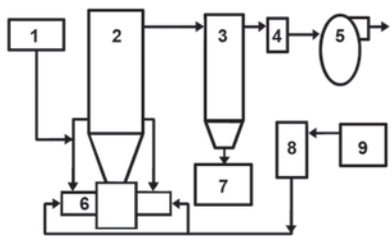
Two counter-current gaseous flows carry off the starting bulk material owing to ejection. In the accelerating tubes the particles are mixed and speeded. In the zone, where the flows meet, intensive milling of the starting material occurs due to collisions and intensive friction of particles. The rising flows carry off material to the zone of preliminary separation of rough fractions and then to the separator where the fine fraction is separated. At first it is caught in the cyclone and finally in the filter. The rough fractions are continuously returned from the separator to the milling chamber for further milling.

Advantages of the milling method using counter-current flows are:

- the absence of friction elements eliminates the entry of impurities into the milled material and lowers specific energy consumption;
- grinding dry vegetables and fruit occurs without destruction cellulose what favors the maximum preservation of their biologically natural structure;
- possibility for milling both superhard materials (diamond, boron nitride) and viscous easily fusible plastics (caprone, fluoroplastic etc.);
- mechano-chemical activation of material and milling occur simultaneously. Strenght of the cement produced in this disintegrator is increased; abrasive materials are abraded to powder without particles in the form of needles and plates; sintering temperature for ceramics is decreased.

Earlier authors have performed investigations on optimization of a milling unit in the existing jet disintegrator. This unit was used for the fine milling (particle dispersity of 5-200 μm) fruit and vegetable products.

To solve materials science problems, it is expedient to design a new jet disintegrator in with an inert gas is used as a carrier what makes it possible to eliminate oxidation of the material milled.



Structural scheme of the jet air disintegrator:
1 – loading unit; 2 – separator; 3 – cyclon; 4 – filter;
5 – ventilator; 6 – milling unit; 7 – container for ready product;
8 – system for air preparation; 9 – compressor.

Innovative Aspects and Main Advantages

- to product of highly dispersed extra pure powders owing to the elimination of the “milling” effect. The use of an inert gas as a carrier instead of air in the jet disintegrator will make it also possible to eliminate oxidation of material in milling;
- to give new useful properties to the materials milled as a result of mechanochemical treatment and activation. Free-flowing ingredients are in the zone where the flows meet under extremum conditions (near-sonic speeds at collisions and strong friction conditions).

Areas of Application

The new jet disintegrator will find wide applications in several industrials sectors, in particular:

- in powder metallurgy for production of extra pure highly dispersed powders and activated homogeneous powder mixtures;
- in hydride technologies: it is supposed that the compositions, which are produced by joint mechano-chemical treatment and activation of hydride-forming alloys and nanostructural carbon in the extremum conditions of the counter-current flows, would have improwed hydrogen-sorption properties.

Stage of Development

Technical feasibility of technology is studied. Also cooperations for further development are sought.

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A New Class of Composite Materials Highquality Welding Machines and Equipment Working in Controlled Automated Lines

Description

The physico-chemical substantiation is conducted and the production processes of composite materials by powder metallurgical techniques and electron-beam high-velocity vaporization- condensation are designed. The basis (fundamentals) of powder metallurgical techniques is: analysis of morphological compatibility of powders; the adhesive characteristics in systems refractory metal- melt; research of features of formation in solid, at the presence of a liquid phase and at capillary impregnation. The analysis of influencing on physical, mechanical and chemical properties, of main (basic), alloying agents and functional components contents, and also influencing thermo-mechanical working at usage of a commercially pure feed stock were the basis for optimization of technological conditions. The complex of powder metallurgical techniques provided obtaining composites and articles from them with carcass structure or matrix structure with different filling components. At usage of methods of electron-beam high velocity evaporation-condensation the optimization of technology was connected to selection of a structure of boshes evaporators on the basis of cuprum and refractory metal, roughness of a substrate, speed of its (her) rotation, separating material (matter), spacing intervals between boshes evaporators and substrate, electrical parameters of a system. The properties of condensate composite materials were provided with their stratified structure with micro-disperse layers.

Innovative Aspects and Main Advantages

The powder metallurgical techniques were used for obtaining new composite materials, which one provide in 1,53 times a large durability of electrodes for resistance welding of materials with different thermal properties, items with different thick nesses and diameters in comparison with bronze welding rods. These composites promoted increase at 810 of time of stability of electrodes (current conveyance) at arc welding by a melting in comparison with bronze. The powder metallurgical techniques appear effective at regulation of high current vacuum chromium-copper contacts durability by change of a dispersivity of an initial composite and effect on secondary structure arising in a working layer under influencing of an arc discharge. The technol ogy, founded on usage of a method of electron beam high-velocity vaporization- condensation, make available to receive of composite materials without silver and intended for of electrical contacts of switches, exploited in the ground and underground electro transport, lifts, turret cranes (valves) etc.

Areas of Application

Welding electrodes for the electro-technological installations and contacts for switches of various types and assignment (fig.2).

Stage of Development

Is tested, is accessible to demonstrating - the full-scale tests are conducted. The broad full-scale tests of welding rods and contacts made by powder metallurgical techniques and electron-beam high-velocity vaporization-condensation are conducted. Electrical contacts made or reduced with usage of condensate composite materials are already in the market of Ukraine.

Fig.1 Installation for evaporation – condensation.

Fig.2 Contacts for switches of various types

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Institute of Organic Chemistry

Technical Area Keywords: fine organic synthesis, organophosphorus, fluoroorganic and sulfurorganic chemistry, organic dyes, supramolecular chemistry

General Information

The Institute of Organic Chemistry of the NAS of Ukraine is one of the best known among the Institutes of chemical profile in the National Academy of Sciences of Ukraine. It was founded in 1939 and has become the base establishment of the National Academy of Sciences of Ukraine, where the most important directions of the modern chemistry have been generated.

The Institute of Organic Chemistry of the NAS of Ukraine conducts very important theoretical and experimental investigations on the structure, chromaticity and reactivity of the organic compounds, elaborates new directions of the fine organic synthesis and first of all, in the field of the organo-element compounds chemistry, heteroatom and heterocyclic compounds chemistry and supramolecular chemistry of the macrocyclic compounds. Under elaboration are the scientific synthesis methods for the compounds showing practically useful properties, including physiologically active compounds, cyanine dyes, organic catalysts and complex-forming agents.

The scientists of the Institute execute important fundamental and applied research in the modern fields of organic chemistry, organo-element chemistry and chemistry of heteroatom compounds.

The staff of the Institute of Organic Chemistry of the NAS of Ukraine consists of 274 officers, 117 of them are researchers, including 22 Doctors of Chemistry and 86 PhDs.

The structure of the Institute includes 10 scientific departments, analytical laboratory and the Pilot Plant.

Institute's focus

Institute's areas of core competencies include the following:

- Development of physiologically active compounds for medical and veterinary applications;
- Predominantly basic research in the field of organic and heteroatom chemistry;
- Chemistry of heterocyclic compounds.

Valuable Technology Offerings

- Development of physiologically active substances and drugs for medicine and veterinary;
- Development of pesticides and plant growth regulators;
- Development of cyanine dyes for laser techniques;
- Development of complexing agents for hydrometallurgy (extraction of heavy, non-ferrous and rare metals) and complexones for the extraction of radionucleides;
- Development of chemical additives (light- and thermal-stabilizers) to polymers based on PVC;
- Development of spectral and infrachromatic sensitizers for light-sensitive materials.

Scientific Cooperation and Technology Transfer

IOC's Pilot Plant has the necessary basic equipment and supply lines to develop technologies and manufacture various types of organic and elemento-organic compounds, including those for medicine and veterinary.

The Institute has a building devoted to a Pilot Plant. An additional building is being planned. Current staffing level at the Pilot Plant remains to be about 120 engineers and technicians.

The Pilot Plant's past projects and developments include manufacturing of complexing agents for hydrometallurgy, complex light- and thermal stabilizers, lubricants and additives to polymers, inhibitors of scale formation, various medical and veterinary preparations, amino acids, herbicides, regulators of plant growth, etc.

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Calixarene Nanoextractants for Radiowaste Partition

Description

We propose a new class of perspective extractants of long-lived radionuclides on the base of nano-sized calixarenes functionalized with phosphine oxide groups. In such compounds the binding groups may be best located around a metal cation, increasing the extraction efficiency and selectivity to a great extent.

Innovative Aspects and Main Advantages

The nano-sized calix[4]arene phosphine oxides, developed jointly by the Institute of Organic Chemistry NASU (Kiev) and Khlopin Radium Institute (St. Petersburg) extract simultaneously actinides, lanthanides, technetium and palladium from real HLW hundred times more efficient than the industrial extractants. In three contacts ~ 99,9 % of gross a-activity, more than 98 % of Tc and Pd were recovered from real HLW on the "MAYAK" plant (Chelyabinsk).

Areas of Application

High level wastes partitioning technology. Radiowastes management.

Stage of Development

The Institute of Organic Chemistry of the National Academy of Sciences of Ukraine produces different calixarene extractants.

Speciaists of the Khlopin Radium Institute, St.-Petersburg possess experience in development of radiowastes partition technologies.

J. Supramol. Chem. 2002. 2. 421-427

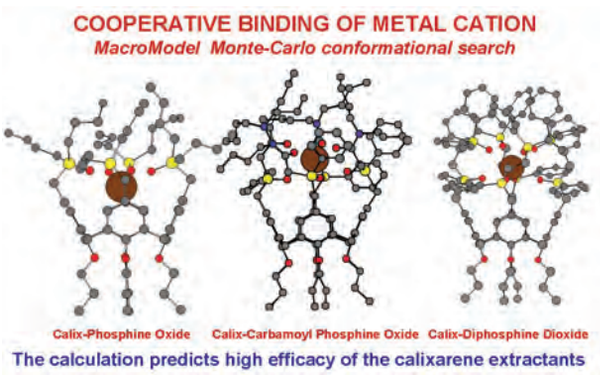
J. Inclusion Phenomena. 2004. 49. 47–56

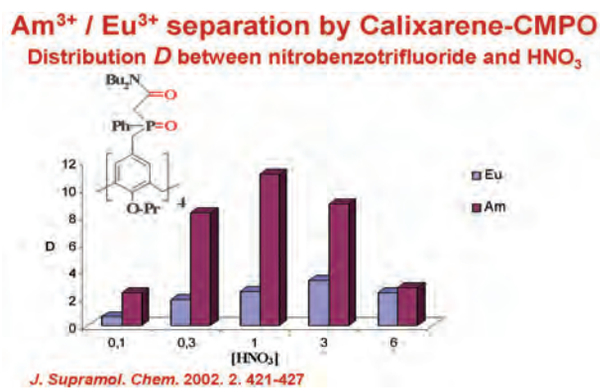
Radiochimica Acta. 2007. 95. 97-102

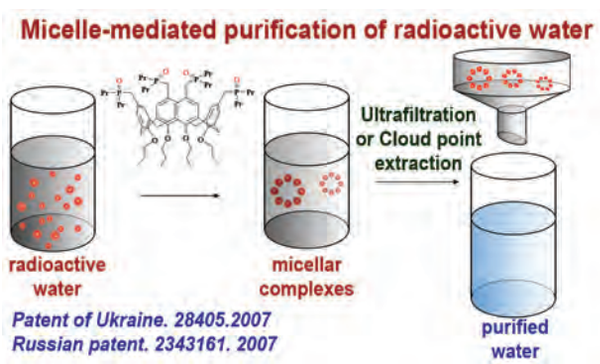
Reports of Natl. Acad. Sci. of Ukraine 2009. 164-167

Patent of Ukraine. 28405. 2007

Russian patent. 2343161. 2007.







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Catalyst for Preparing Vinylidene Chloride

Description

Vinylidene chloride is a valuable monomer for preparation of polymers, which have an extremely high barrier resistance to the transmission of oxygen and water vapors. Copolymers produced from vinylidene chloride show excellent resistance to solvents and corrosive chemicals and have a high degree of abrasion resistance, toughness and dimensional stability.

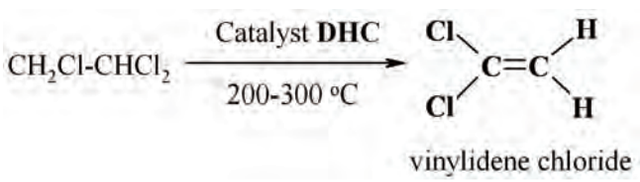
Vinylidene chloride is commonly produced by dehydrochlorination 1,1,2-trichloroethane using inorganic bases such as calcium hydroxide or sodium hydroxide, but this reaction produce large quantities of the corresponding salts (CaCl2 or NaCl) and the waste water.

Much more economically and ecologically attractive is a catalytic preparing vinylidene chloride. However the modern catalytic processes suffer from deactivation of the catalysts due to the formation of coke on their surface and chlorination of the carriers, such as SiO2 and Al2O3.

We propose a novel selective catalyst for preparing of vinylidene chloride.

Innovative Aspects and Main Advantages

Reaction with catalyst DHC proceeds with selectivity of 85 % and conversion of 75 %.



Proposed catalyst DHC for preparing vinylidene chloride exceeds of a best world patent analogs by prolonged work (250 h and more) without loss of activity and selectivity in the absence of promoters and inductors. Catalyst DHC was developed jointly by the Institute of Organic Chemistry NASU (Kiev) and PPG Industries Inc. (USA).

Areas of Application

Chlorine and Polymer Industries, Medicine and Agrocheistry.

Stage of Development

This is intellectual property which is defended by Pat. Ukraine N77876 (2007) and Intern. Appl. WO 2006/132625.

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Catalysts for Para-Selective Preparing Para-Dichlorobenzene and Para-Chlorotoluene

Description

Chlorinated aromatic compounds are widely used in different fields. Chlorotoluene derivatives are used as intermediates in medicine and agrochemistry.

p-Dichlorobenzene is a useful intermediate product for the synthesis of dyestuff, drug precursors, deodorant blocks and moth control. A growing use in the production of the high performance polymer of poly(phenylene sulfide). Para isomers of dichlorobenzene (DCB) and monochlorotoluene (CT) are usually more valuable than ortho-isomers. Hence of great importance is the processes with high para-selectivity.

Conventional commercial processes for chlorinated toluene and benzene or chlorobenzene has been carried out, most commonly, in the presence of Lewis acid catalyst such as SbCl5, FeCl3 or AlCl3 which produce about 2/1 para/ortho isomer ratio of chlorotoluenes and 3/2 ratio of para/ortho-dichlorobenzenes.

The high selectivity to the para isomers was achieved in the field of zeolite based catalysis and in the Lewis Acid technology with the use of substituted phenothiazines as cocatalysts, but these technologies are very expensive.

We propose a novel para-selective catalyst for chlorobenzene and toluene chlorination.

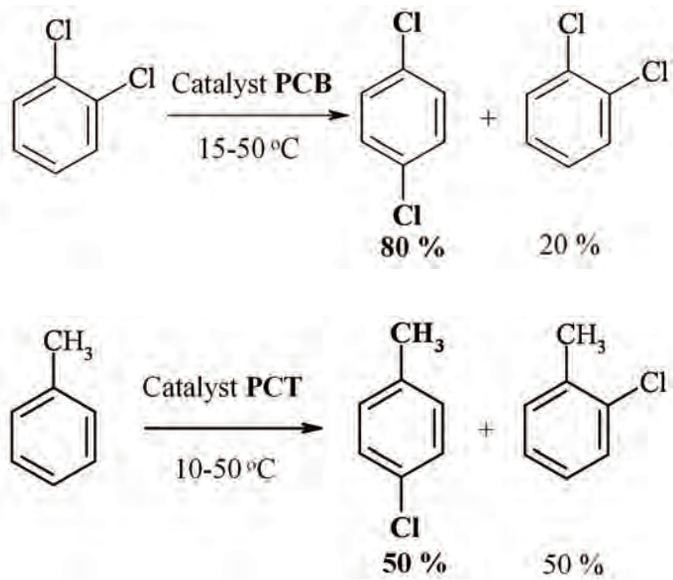
Innovative aspect and main advantages:

Catalyst PCB was developed jointly by the Institute of Organic Chemistry NASU (Kiev) and PPG Industries Inc. (USA). Catalyst PCB consists of the ferric chloride and cheap cocatalyst.

Innovative Aspects and Main Advantages

Catalyst PCB was developed jointly by the Institute of Organic Chemistry NASU (Kiev) and PPG Industries Inc. (USA). Catalyst PCB consists of the ferric chloride and cheap cocatalyst.

This cheap composition displays high para-selectivity, up to 80 %. The catalytic composition PCT for more high yield of p-chlorotoluene was developed.



Stage of Development

The catalysts PCB and PCT are defended by „know how“.

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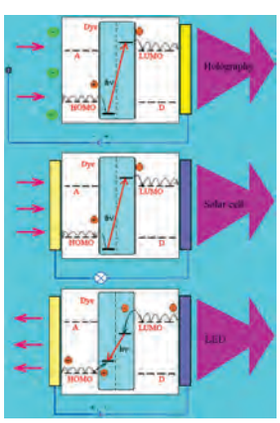
Polymethine-Dye-Based Molecular Photosemiconductors for Data-Recording Media, Photovoltaic, and Optoelectronic Devices

Description

Polymethine dyes (PDs) are unique centres of photogeneration and emission recombination of charge carriers in photoconducting polymer matrices. Depending on the donor-acceptor properties (ionization potential and electron affinity) of the PD and the polymer, these centres provide intermolecular electron transfer from the former to the latter or vice versa. As a result, cation and anion radicals are formed which are bound into electron-hole pairs by the electrostatic attraction forces of opposite charges. In an external electric field, the pairs dissociate due to field-induced electron transitions which give rise to directed electron transport, i.e., photocurrent, in a coloured medium. PDs of various ionic states afford the hole (p), electron (n), and mixed-type photo-conductivity. Purposefully selected PDs and polymers provide an appropriate conductivity type to obtain a photovoltaic effect in solar batteries, polymer surface-charge modulation and surface-relief deformation in photothermoplastic holographic media used for optical data recording as well as charge carrier capture by PD molecules causing their excitation to a luminescent state in electroluminescent devices.

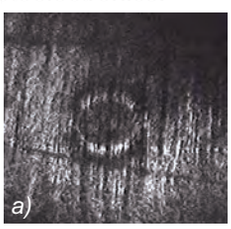


Innovative Aspects and Main Advantages

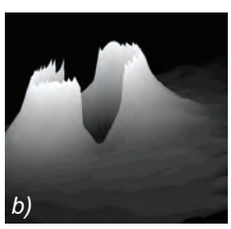
Polymer photosemiconductors, as compared to their inorganic counterparts with the same output technical parameters, are distinguished by lower energy inputs, smaller dimensions, reduced costs, and the possibility of preparing thin-film flexible nanocomposites. PD composites have advantages over individual photoconducting polymers in that they operate throughout the visible and near IR spectral region, and also exhibit the maximum absorption selectivity and light energy conversion efficiency. These properties are helpful in the design of holographic data-recording media with high-level information characteristics which require no protection from outside light during latent image formation, electroluminescent diodes with a narrow emission band, and photovoltaic solar energy converters with high sensitivity at the maximum of the solar emission spectrum.

Areas of Application

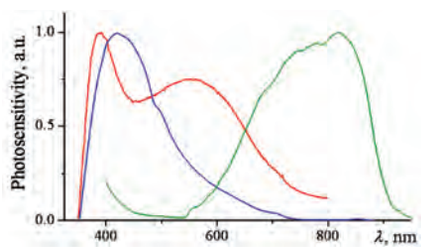
Solar power engineering, optical data recording and imaging, optoelectronics.



The interferogram of a site on an aluminium plate after boring a hole (with 1 mm diameter and 0.5 mm depth). The hologram was recorded on polymethine dye doped polymer.



The interferogram of a site on an aluminium plate after boring a hole (with 1 mm diameter and 0.5 mm depth). 3D-processing was made.



Spectral dependences of photosensitivity of Cyanine Green composite sample and recent developed layers for plastic solar cells PCBM+PTPTB and CIS+PCPM

Stage of Development

Methods to synthesize organic dyes have been developed at the Institute of Organic Chemistry NAS of Ukraine. The scientists of Taras Shevchenko Kiev National University have elaborated the procedure for preparing PD-based photoconducting polymer media.

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Institute of Physics

Technical Area Keywords: physics, solid state physics, physical and quantum electronics, nonlinear optics and holography, plasma physics, physics of semiconductors, liquid crystals and nuclear physics.

General Information

The Institute of Physics (IOP) of the National Academy of Science of Ukraine was established in 1929 and is the oldest institution of physical science within the Academy. IOP boasts a broad spectrum of areas of scientific study including solid state physics, physical and quantum electronics, nonlinear optics and holography, plasma physics, physics of semiconductors, liquid crystals and nuclear physics. The IOP organizational structure includes 16 scientific departments, 7 specialized labs and a National Academy of Sciences of Ukraine center for "collective use", the Femtosecond Laser Complex, collectively staffed with about 200 scientists (PhD and DSc).

The IOP has a track record of manufacturing various devices, instruments, and systems including liquid-helium and liquid-nitrogen cryostats, radiation detectors and sensors, laser systems, bolometers and electric topographs, cryosurgery instruments, pyro-receivers, highly sensitive photo elements, devices for remote temperature measurement, etc. Most of these devices are specialized, science-intensive, niche units used in scientific laboratory experiments at research institutions

Institute's focus

The core competencies of the Institute could be summarized as follows:

- Physics of non-metal and liquid crystals;
- Physics of surface, emission and plasma electronics, electronic and atomic processes on solid surfaces;
- Biophysics;
- Laser and non-linear optics physics;
- Physics of radiation processes.

Although predominantly basic science-oriented, IOP undertakes a certain amount of applied R&D mostly concentrated in such areas as:

- laser systems and laser technologies;
- radiation and plasma technologies;
- precision control systems for low-temperature/cryogenic studies;
- sensors and measurement devices.

Valuable Technology Offerings

The Institute has a track record of manufacturing various devices, instruments, and systems including liquid-helium and liquid-nitrogen cryostats, radiation detectors and sensors, laser systems, bolometers and electric topographs, cryosurgery instruments, pyro-receivers, highly sensitive photo elements, devices for remote temperature measurement, etc. IOP's Department of gas electronics developed a new type of sterilizer for processing medical instruments and materials at a temperature less than 60°C using ultraviolet radiation and active electrically neutral particles of low-temperature gas discharge plasma. The Department of radiation sensors was credited for the development of pyro-electric IR radiation sensors and measuring devices for space applications. For example, IR radiation sensors and high-sensitivity 32- and 64-element linear arrays of pyro-electric radiation sensors were engineered for use in on-board IR spectrometers on Meteor and Ocean satellites and Venus and Mars interplanetary stations.

Scientific Cooperation and Technology Transfer

IOP's designing and prototyping capability is housed within several units and labs. First, there is a special design and technological bureau (SKTB) of physical electronics with experimental production. The SKTB is tasked with implementation of applied R&D results into practice. The product line includes: a) pyrometers with advanced performance characteristics used at nuclear power plants and metallurgical plants, b) radiometers based on pyro-receivers used for the generation of thermal maps of the Earth and ocean surface, c) devices for remote temperature measurement used, for example, in railroad transportation.

Second, promising potential for commercialization exists within the IOP's Cyrogenic Technologies Laboratory (CTL), the design, research and production structure with an experience in manufacturing of cryogenic devices dating back to 1947. CTL is the developer of UTRECS systems (Unified ThermoREgulated Cryogenic Systems) intended for manual and/or automated smart control and high-precision stabilization of temperature of an object under study or cryotechnical instrument within the range of 1,4-4,2-350 K or 77-80-350 K in the flow of cryogen. UTRECS allows for the measurement of a broad spectrum of parameters, such as optical and photoelectric measurements in visible, UV and IR ranges, electro physical and X-ray measurements, radiation resistance of materials, mechanical strength of materials and microwave spectroscopy measurements.

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Novel Plasma Technique for Functional Coating of Anilox Rollers

Description

Anilox roller -heart of flexo printing - is a hard cylinder, usually constructed of a steel or aluminum core which is coated by an industrial ceramic which surface contains millions of very fine dimples (cells). Modern anilox rollers are laser engraved.

Typical products printed with the use of flexography include flexible packaging with retail and shopping bags, food and hygiene bags and sacks, flexible plastics, self adhesive labels, wallpaper etc. Growing market needs faster printing with the highest quality. The market demand for faster printing requires that rollers with enhanced anilox-core adhesion must be developed to keep up with it. In turn, enhanced adhesion requires a special cleaning of anilox core surface.

The Institute of Physics of the National Academy of Sciences of Ukraine, in collaboration with Institute of New Materials and Technologies, developed a novel plasma-based functional coating laboratory facility for the ion-plasma treatment of anilox rollers. Available equipment performs pre-heating, ion cleaning, and polishing of the cylindrical-type substrates, followed by magnetron assisted sputtering with a subsequent deposition of a variety of functional coatings onto the anilox surface.

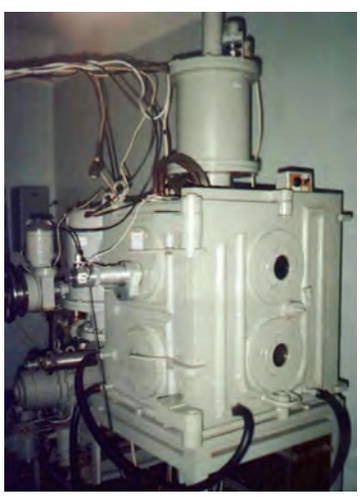
Technique developed is particularly suitable for deposition of high-quality metallic (e.g. Cu, Ti, Zr) and ceramic (TiN, TiC, ZrN) coatings onto the working surfaces of the anilox core. The purpose of the treatment is to increase the wear and corrosion resistance of the rollers and to increase the wetting when used with the printing inks.

Innovative Aspects and Main Advantages

- Deposition of binary chemical compounds (e.g., nitrides, oxides, carbides) to make ware-resistant and corrosion–resistant anilox layers and increase their wettability;
- Integration of plasma based ion cleaning, polishing and deposition techniques into the single technological process to increase anilox-core adhesion and prevent pollution of the environment;
- Special design of interior of vacuum chamber that allows to transfer anilox core from the heating zone into the ion-plasma cleaning zone and finally into the deposition zone where rotating cylindrical magnetron performs coating.

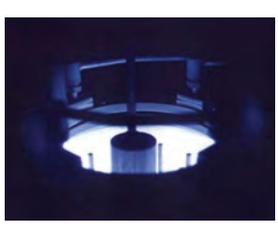
Areas of Application

Equipment developed can be used in industry for manufacturing of advanced anilox rollers.

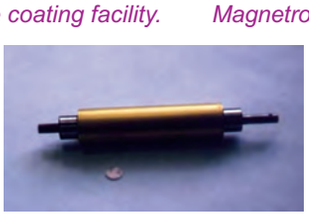


Prototype of the coating facility.

Ion cleaning device.



Magnetron sputtering unit.



Anilox roller with TiN coating.

Stage of Development

Our advanced technique is an outcome of hard R&D work that resulted in creation of the working prototype. The last one was tested for deposition of TiN coating on the steel rollers. The coating has revealed the fine grain structure and hardness of the stoichiometric TiN layer. A deep patent search has shown patenting potential of the technique developed. We can design, fabricate, test and deliver an industrial prototype that meets the customer's needs.

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Pyroelectric Power Meter VP-1

Description

Pyroelectric power meter VP-1 measures the mean power of continuous and pulse-periodic electromagnetic radiation of coherent and non-coherent sources. The power meter is designed as a portable system that is ideally suited for direct data readings. It works efficiently in a wide dynamic range with radiation from 0.25 μm to 14 μm electromagnetic waves (continuous and pulse-periodic). Pyroelectric Sensor makes it perfect for fast measurements. Solid-state construction of both Head and Indication Units assures long-term stability and reliability

To ensure high accuracy of measurements, the device operates in the two modes of 0-200 mW and 0-2000 mW.

Head Type:	Pyroelectric
Watt Range:	0.002 – 2 W
Response time:	0.5 s
Accuracy, %	7
Weight:	0.7 kg
Specific Dimensions:	90 x 200 x 60 mm 40 x 60 x 60 mm

Innovative Aspects and Main Advantages

- Short time interval between consecutive measurements;
- Cost effective;
- Easy to use.

Areas of Application

- Operational monitoring of industrial lasers and other sources of radiation, both coherent and non-coherent;
- Certification of coherent and non-coherent laser sources;
- Measurements of laser beam power characteristics in scientific and medical applications.

Stage of Development

Ready for application.

Pyroelectric power meter VP-1

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Pyroelectric Transmission-Type Sensor

Description

Pyroelectric transmission-type sensor is a portable system designed to operate simultaneously as a measuring device and a laser window. The sensor is developed to read both temporal and energy characteristics of radiation beams from the high-power industrial lasers operating in a frequency-pulsed mode. The sensor's response is generated by tertiary pyroelectric effect as a result of inhomogeneous heating of the crystal used. As the laser beam passes through the sensor's sensitive element with the set of electrically-discontinuous electrodes atop, the polarization produced by the tertiary pyroelectric effect is captured. Then the captured signal is accepted by the processing system that transforms it into a readable form.

General specification

Material of the sensitive element	ZnSe
Sensitivity, V/W	10^{-5}:10^{-2}
Spectral Range, μm	2:12
Diameter of the active area, mm	10:20
Transmission factor	>0.95
Output resistance, kΩ	1
Upper limit of the dynamic range, kW/cm2	2

Innovative Aspects and Main Advantages

The distinguishing feature of our transmission-type sensor is the possibility to read out desirable data at any point of the optical system without placement of any extra optical elements. Specific features of the tertiary pyroelectric effect gives advantage to offered sensor by setting the upper limit of the dynamic range up to several kW/cm2, which is determined by the crystal's resistance to laser radiation in the vicinity of the transparency maximum.

Areas of Application

Transmission–type sensor can be used as:

- Sensitive element of the control-measuring instruments for industrial lasers;
- Transmitting optical element for feedback systems;
- Multifunctional element for laser beam focusing and simultaneous measuring of beam's intensity;
- Laser exit window capable of measuring laser beam intensity.

Pyroelectric transmission-type receiver

Pyroelectric transmission-type receiver in use

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Universal Variable Temperature Cryostats

Description

Our cryostats are designed to secure excellent temperature stability in the range of either 1.4 -350 K or 77-350 K and used with liquid He and liquid N2 as needed. Equipped with various types of optical windows (options: FusedSilica/Leucosapphire/ZnSe/CdTe etc.), they are suitable for optical, microoptical, magnetooptical and electrical measurements.

Range of products available includes:

- Autonomous type cryostats (CRYOPT series) are capable of controlling the chamber temperature via feedback system that runs both the supply of either He or N2 and heat exchange between cryostat's chamber and the flow of relevant gaseous cryogen;
- Universal cryostats (CRYOPT/vac series) are capable of controlling the chamber temperature via two-level feedback system and feature the high temperature accuracy and low cryogen consumption;
- CRYOMAG series is designed to control the temperature of samples placed in magnetic fields up to 4 T;
- Continuous-flow cryostats are compact products deliberately designed for research in the field of Micro-Optics. They cover extremely wide temperature range of 40 – 1000K with the smallest temperature sampling of 1K.

Innovative Aspects and Main Advantages

High accuracy of the chamber temperature (for some series less than 0.1K); low consumption of liquid cryogents; combined system of gas-flow regulation and heat exchange controller, smart temperature controller that is ready to work with various types of standard temperature sensors; easy-to-use manipulators and sample-holders;; helium pressure stabilizer.

Areas of Application

Measurements in the field of:

- optics;
- electro-optics;
- Raman-spectroscopy;
- spectroscopy;
- polarization optics;
- magneto-optics and spectroscopy;
- magneto-electrical measurements.

Stage of Development

Low-volume manufacturing of serial products and custom applications development.

International customers include institutions from CIS countries, France, Germany, Israel, Switzerland and other countries.

Autonomous cryostat "UTRECS" A-287 especially designed to fitOlympus BX41 optical microscope and capable of controlling chamber temperature in the range of 5–350K. Patented in Ukraine and Russia.

Continuous-flow He-N2 cryogenic system "UTRECS" C-40 used with optical microscopes for microoptical measurements in the temperature range of 40–1000K. Patent pending in Ukraine.

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Water-Jet-Assisted Laser Cutting Head

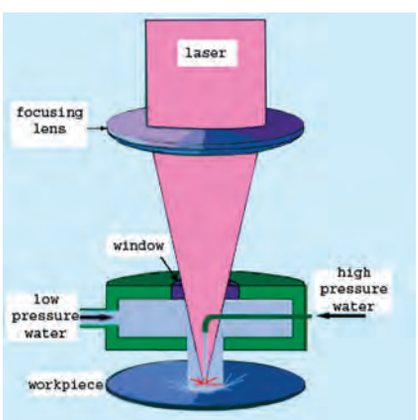
Description

The wafer cutting in microelectronics is most commonly accomplished with diamond wafering blades. However, the cutting techniques involved have reached their limit in both speed and quality, and are applicable to only straight contours. Besides, they are highly expensive due to the high cost and consumption of the saws used. Other cutting tools such as lasers or water-jets have their own limits when used separately.

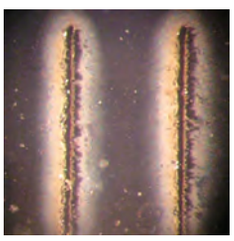
Laser-Microjet system by SYNOVA SA is the first approach that has combined advantages of each individual process: “low-force” cutting of the laser and “cold” cutting of the water microjet.

We offer unique Water-Jet-Assisted Laser Cutting Head (WJALCH) that keeps the advantages of Laser-Microjet and provides extra quality in cooling and cleaning owing to the surplus of low-pressure water used.

WJALCH employs fully PC-controlled water-to-laser switching, combines low pressure water and high pressure water-microjet supplied to the cutting point, secures effective cooling and ablation product removal. The laser beam passes through the low pressure water cell and is focused on the workpiece in the center of high pressure water micro-jet (up to 200 Bar). Laser beam is not guided by water microjet. This secures more precise focusing compared with the similar devices available on the market.



Case study: Silicon scribing



Air-Flow-Assisted laser beam 100 μm groove width

WJALCH, 33 μm groove width

Innovative Aspects and Main Advantages

- High quality of cutting:
  1) precise focusing;
  2) cutting width is reduced;
  3) heat affected zone is reduced;
  4) deposition of the ablation products on the
  5) samplesurface is minmized;
- No atmosphere contamination.

Areas of Application

Manufacturing parts of discrete minute components as well as micro-drilling, micro-cutting, micro-milling and micro-etching of various materials for application in diverse fields such as medical, bio-medical, microelectronics, opto-electronics, space and others.

State of development

WJALCH is ready for industrial application.

Laser cutting head with the high pressure water microjet.

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Institute of Technical Mechanics

Technical Area Keywords: industrial technologies, rocket and space technology.

General Information

The history of the Institute of Technical Mechanics (ITM) dates back to 1966, when a Sector of Mechanical Engineering Problems was set up within the Dnipropetrovsk branch of the Institute of Mechanics. The sector was later transformed into a division, which became the basis of establishing the Institute under its current name in 1980. Traditionally, the Institute's structure included a Special Design and Technology Bureau (SKTB) together with the Pilot Production facility for experimental production and prototyping of applied R&D results.

Since 1993, ITM has been a lead institute of Ukraine's aerospace industry involved in solving of a wide range of scientific and engineering problems in the field of rocket and space technology. As a leading Institute of Ukraine's rocket and space industry Institute resolve problems on the development of concepts of government policy in the field of space research and exploration, contributes significantly to the development of projects of Ukraine's National Space Programs, and provides its comprehensive analytical and information support.

The Institute performs a wide range of basic and applied research on scientific and methodic support to develop and operate railway and motor vehicles.

Institute's Focus

ITM has unique capabilities in experimental and test equipment (e.g.,high-pressure bench for studying various hydrodynamic processes, plasma electrodynamic research facility, vacuum aerodynamic plant), as well as in the development of software and physical and mathematical models of processes associated with rocket and space equipment en route to launch sites, functioning in orbit, and during the atmospheric re-entry to Earth. More specifically, ITM's core competencies stem from basic and applied investigations in the following fields:

- Dynamics of mechanical and hydro-mechanical systems, launch vehicle systems, railway and motor transport;
- Aero-thermal gas dynamics of power plants, spacecraft, and their subsystems;
- Strength, reliability and optimization of mechanical systems, launchers, and spacecraft;
- Mechanics of interaction of a rigid body with ionized media and electromagnetic radiation;
- Modeling and simulation of various operating conditions, such as electric and magnetic fields, solar and radar electromagnetic radiation, etc.;
- Systems analysis of rocket and space technology development trends.

Valuable Technology Offerings

- New pneumatic systems protecting drivers of various transportation facilities against vibration;
- New effective and environment-friendly technologies and devices for de-scaling carbon stainless-steel parts;
- Technique and device for improving the efficiency of mining by using the method of underground melting (in particular, sulfur melting);
- Environment-friendly high-efficiency burners for gas and liquid fuel, as well as coal furnaces using a new method of burning;
- Technology for manufacturing antenna and wave-guide devices and concentrating systems;
- Methodology and device for evaluating and monitoring parameters of ionosphere plasma;
- Software for determining projects parameters of products of rocket and space technology in the engine dynamics, aerodynamics, dynamic load and structural strength.

Scientific Cooperation and Technology Transfer

The Institute has established scientific collaborative links with its counterparts in the areas of :

- rocket and space technology development;
- railway transport;
- machine-building and heat power engineering.

Research in these areas was conducted in collaboration with leading organizations of Russia and Ukraine:

- Yuzhnoye State Design Bureau;
- “Lutch” Research and Production Association;
- Antonov ANTK;
- Zhukovsky TsAGI;
- the Central Research Machine-Building Institute (TsNIIMash);
- Baranov Central Institute of Aircraft Engine-Building (CIAM);
- the Institute of Theoretical and Applied Mechanics of the Siberian Branch of the Russian Academy of Sciences, etc.

Foreign partners and collaborators include Technical University of Vienna (Austria), University of Bremen (Germany), Medical Records Institute, Newton, MA (USA).

Industrial cooperation plays an important role in ITM’s applied R&D activity.

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Cavitational-Pulse Technology of Fine-Dispersion Water-Coal Fuel Preparation

Description

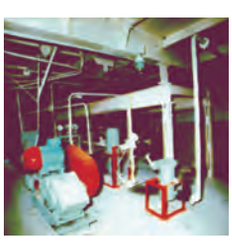
Use of the phenomena of periodically stalling cavitation in slurry flow for dispersion and homogenizing of water-coal slurry to obtain fine-dispersed water-coal fuel which can be used for the direct burning in boiler heat furnace, and the use of cavitational-pulse generator to realization of the technology.

Innovative Aspects and Main Advantages

- use of direct burning in heat boilers without preliminary drying and dehydration;
- considerably less energy consumption to obtain product unit (4-6 times);
- absence of moving parts and automation elements in cavitational-pulse dispergator design and the facility design simplicity;
- high productivity;
- wide range of cavitational-cumulative action control;
- after one pass through the dispergator the acquisition of stable fine-dispersed water-coal mixture is provided. It has 65% of coal.

Areas of Application

Power machine building, heat stations, municipal engineering boiler plants. Besides of power machine building plants, manufacturers of chemical, metallurgical, pulp and paper production can use the technology.



General view of the facility to prepare water-coal mixture

Experimental sample of the cavitational-pulse dispergator to work out the operational regimes with different types of coal.

Stage of Development

The technology of fine-dispersion water-coal fuel preparation was worked out at the institute hydrolaboratory with slurry of different types of coal. It was shown that the cavitational-pulse dispergator characteristics practically do not depend on slurry viscosity and density.

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Descaling of Hot Rolling Billets with Pulsating Water Jets

Description

One way to descale hot rolling billets is to use high-pressure steady water jets. In the hot-billet descaling technology proposed at the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the National Space Agency of Ukraine, the steady flow at the inlet of the water descaling header is transformed into a pulsating high-frequency, high-amplitude flow at its outlet. To do this, the cavitation generator of hydraulic pressure oscillations developed at the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the National Space Agency of Ukraine is used. In hot rolling (Fig. 1), the pulsating high-frequency, high-amplitude flow at the header outlet is fed onto the surface of the moving hot billet. For certain operating conditions of the cavitation generator, the dynamic action of the pulsating jet (Fig.2) provides high-efficiency descaling.

Fig.1

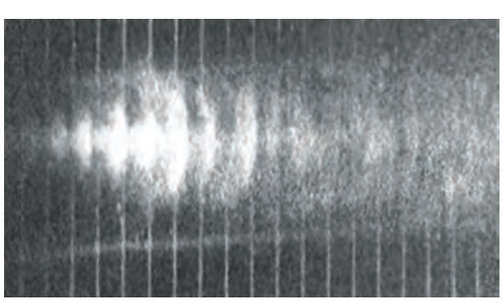

Fig.2

Innovative Aspects and Main Advantages

The use of the cavitation generator of pressure oscillations, which has no moving or rotating parts. The water pulsation frequency can be controlled in the range between 100 and several hundreds of hertzs. The pulse pressure is 2 to 4 times as high as the steady pressure at the cavitation generator inlet.

Pulsating-jet descalers reduce the rolled-in scale rejection rate by a factor of 2 to 5 in comparison with steady-jet ones.

Areas of Application

Rolling.

Stage of Development

Design documentation has been prepared, and water descales have been made and introduced at the Vyskunsky Metallurgical Works (Russian Federation), the Orsko-Khalilovsky Integrated Iron-and-Steel Works (Russian Federation), the Zaporozhstal Works (Ukraine), and the Kommunarovsky Integrated Iron-and-Steel Works (Ukraine).

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Development of Principally New Pneumatic Vibroprotective Systems

Description

Pneumatic vibroprotective module for the seat suspension of various purpose transport means drivers (tractors, trolleybuses, lorries etc.), which allows to reduce vibrations perceived by a driver 3 times in comparison with the best world sam-ples.

Innovative Aspects and Main Advantages

According to the results of dynamic tests of a trolleybus, tractor and bus with the driver seats with pneumatic vibroprotective module, the maximal eigenfrequency of the seat vibrations is not higher then 1.0 Hz, and the maximal amplifying factor at the resonance frequency is not higher then 1.2, which is sufficiently lower then the permissible values.

Areas of Application

Different transport means like cars and lorries, buses, agricultural machinery, locomotives and helicopters.

Stage of Development

Experimental samples of autonomous vibropro-tective pneumatic modules are used in driver seat designs by Cherkassy bus enterprise at the as-sembly of city buses of “Bogdan” type, by pro-duction enterprise “Yuzhny machine-building plant” at production of YuMZ-6AKM type trac-tors, by “UkrAvtoZapchast” company at the as-sembly of “Belarus” tractors in Ukraine, by “UkrAgroSelMash” company at production of “Yarilo” tractors.

General view of the transport mean driver seat suspension with the autonomous pneumatic vibroprotective.

Variants of driver seat designs with autonomous pneumatic vibroprotective modules

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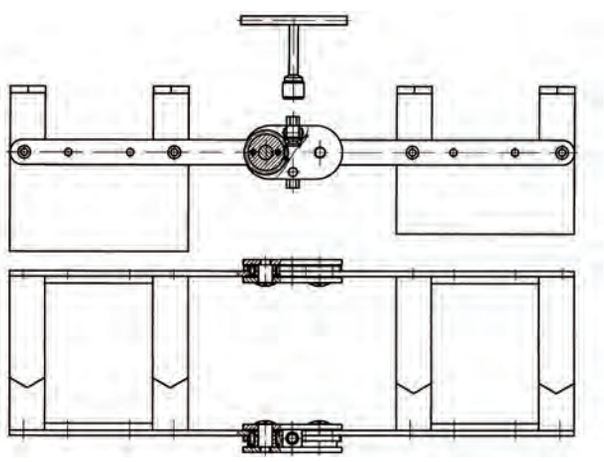
Elbow Fixator

Description

The elbow fixator falls into the class of upper-extremity orthopedic apparatuses. It is intended for the treatment and rehabilitation of patients after elbow joint injuries and surgeries, in the case of dislocations, subluxations, ligamentous injuries, inflammatory, destructive and degenerative diseases of the elbow joint, and for contracture treatment. The fixator is secured directly on the body or on the clothes. The shoulder and the forearm are fixed with four belts in locating blocks, which are connected to one another with two pairs of hinged splints. During rehabilitation, the elbow joint angle is changed from time to time to prevent contractures and other side effects. The figure shows the fixator embodiment where the splints are fixed with a worm-and-worm pair. Embodiments where the splints are fixed with friction discs, a flat tooth clutch, a spring-loaded flat tooth clutch, and a ratchet-and-pawl have been developed too. The developmental work is conducted in cooperation with the Ukrainian State Research Institute for Medical and Social Problems of Disability (Dnepropetrovsk, Ukraine).



Innovative Aspects and Main Advantages

In comparison with similar orthopedic apparatuses, this fixator allows one to extend the range of motions in rehabilitation by changing the elbow flexion/extension angle smoothly (for hinges fixed with friction discs or a worm-and-worm pair) or in small (60) steps (for hinges fixed with a tooth clutch, a spring-loaded tooth clutch, or a ratchet-and-pawl), thus enhancing its therapeutic capabilities.

Areas of Application

Practical and research medicine.

Stage of Development

Four prototype embodiments with different hinges are being made to be tested at the Ukrainian State Research Institute for Medical and Social Problems of Disability.

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Grinding of Loose Materials

Description

Gas jet grinding of loose materials with process parameters acoustic monitoring.

Innovative Aspects and Main Advantages

Technological process efficiency increases as the process control monitoring is realized. Disclosing valuable minerals without their superfluous re-grinding is reached, concentrate quality is im-proved, fine and hyperfine pure grinding is done

Areas of Application

Fine and superfine grinding of materials with dif-ferent physical properties (ore and fire-resistant raw material, kaolin, quartz sand, rare-metal con-centrates, abrasive and diamond powders, techni-cal alumina, mullite-corundum chamot, cement, slag, forming plaster).

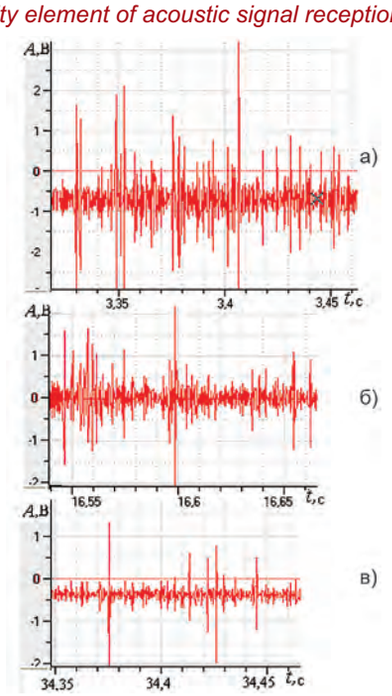
Stage of Development

A gas jet mill with productivity of 20kg/h is made on the experimental base. Researches on realiza-tion of grinding monitoring on the acoustic emis-sion method basis are carried out. The technique of process control system is being developed.

Experimental gas jet plant

The mill with an acoustic detector

The facility element of acoustic signal reception system



Kinetics of signal amplitude at different grinding regime

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Information Technology for Engineering Data and Cost Determination Form the Cost Efficiency Criterion

Description

The information technology a decision-making support system to be used in the substantiation of space program projects in the market economy environment, and it includes: software for the substantiation of space program projects with consideration for uncertainties in engineering and economic data and time parameters; software for the substantiation of the technical-and-economical performance of a launch vehicle (the masses of its systems, the reliability, the launch cost, etc.) with consideration for its multicriterion competitive ability, which is evaluated on the ba-sis of the decision-maker's preference pattern.

When formalizing the launch vehicle and spacecraft parameter substantiation problem, ac-count is taken of the fact that the quantitative measure of operability from which the system parameters are chosen is the reliability. Besides, the reliability affects both the economic indices (competitive ability, share of the market, manu-facturing cost) and the engineering ones (bearing structure mass, redundancy level and type, etc.). Because of this, to reduce the dimension of the problem, it is suggested that first the optimum reliability rates should be found and then the pa-rameters that maximize the profit.

Mathematical models have been developed to study relationships of the manufacturing cost – mass – reliability type.

Innovative Aspects and Main Advantages

To quantify the reliability and safety to the ac-curacy required in engineering design, methods that are free from a priori assumptions on the dis-tribution law types and allow for mathematical model errors, the effect of manufacturing and the known information on the factors have been proposed.

To find guaranteed estimates of the probabilis-tic measures, algorithms have been developed for a directed search of the marginal values of the operability function with consideration for factors that characterize the system operability.

Numerical substantiation has been performed for the polynomial degrees and the number of terms in the series expansion of the operability density function which are called for the con-struction of relationships between the quality indices to the accuracy required in engineering practice.

Areas of Application

Space engineering and mechanical engineering.

Stage of Development

The use of the technology calls for a consider-able body of organizational work on the collec-tion and analysis of basic data on the labor ex-penditures, the reliability, and the existing and prospective world market of space products and services.

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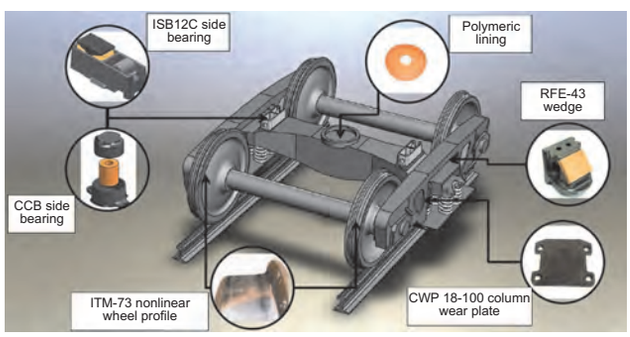
Modernization of Freight Car Bogies

Description

Freight car bogies modernization supposes the replacement of bogies standard friction units by the new ones with better life performances, and also the use of new devices improving car dynamic characteristics. Operation and dynamic tests and cars observation in service have proved the estimation of such modernization efficiency.



The mill with an acoustic detector

Innovative Aspects and Main Advantages

For the first time the freight car bogies modernization technology, which may be used both by car repairing enterprises and car sheds, is proposed. The technology does not need considerable capital investments and allow to improve freight car performance sufficiently. The wear-resistant wheel profile ITM-73, which allow to reduce wheel wear more than twice, is developed.

The main advantage of the technology is the possibility to modernize bogies both of exploited and new cars. The car price increase only for 3-4%, and the more wearing parts service life increases some times, sometimes ten times.

Areas of Application

- At the modernization of freight cars three piece bogies;
- At the development of new freight cars bogies.

Stage of Development

The project C03.04 of freight car bogies complex modernization is developed and applied in Ukraine. It allows to modernize gondola car bogies, which are widely distributed in our country. The modernization in accordance with this project is going on at all the car repairing enterprises and ten car sheds of Ukraine. Suggestions are made for hopper-cars and container platforms modernization. There are patents for the wear resistant wheel profile ITM-73 reducing the wheel flange wear; elastic-roller side bearings increasing car critical speed; frictional wedges more than ten times increasing wedge system service life for the car oscillations damping.

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Radically New Bioenergoinformational Medical Technology with the Use of Electromagnetic Waves

Description

The technology includes

- instant diagnosis (including the early, preclinical stage of disease) by measuring the biophysical characteristics of biologically active points (BAPs), which in its turn allows one to assess the energoinformational status of twenty organs and tissue systems and determine their resistance;
- millimeter-wave puncture therapy (therapeutic action on BAPs with low-intensity millimeter-wave radiation to normalize the energoinformational status and remedy abnormalities).

The functional condition of all organs and tissue systems is assessed on the same scale by measuring the admittance of the bioenergy channels of the human body. Comparison of the measured energoinformational matrix with nosode-type reference ones. Making liquid-based and solid-based matrices (an energoinformational "disease imprint") for diagnosis and therapy. Making electronic authonosodes with the use of GaAs crystals for informotherapy.

Sublow-energy targeted actions on organs (systems) of the human body via its bioenergy channels (up to 12 at a time) with millimeter-wave electromagnetic radiation with consideration for its resonance interaction with cell membranes. The energoinformational spectrum of the radiated signal is formed by modulating it with a specially formed signal or a signal from a nosode-type reference pharmaceutical matrix or an autonosode.

Innovative Aspects and Main Advantages

Diagnosis: noninvasivity, informativity (preclinical disease detection), high sensitivity (disease prediction), the accuracy and reproducibility of results.

Therapy: noninvasivity, harmlessness, a sublow-energy intensity and a high accuracy of action on organs (systems) of the human body with millimeter-wave signals, the possibility of acting on the vegetative nervous system to restore the innervation of organs and tissue systems.

Stage of Development

The clinical testing of the medical technology was conducted at:

- Institute of Pediatrics, Obstetrics and Gynecology, Academy of Medical Sciences of Ukraine (Kyiv);
- Institute of Nephrology, Academy of Medical Sciences of Ukraine (Kyiv);
- Institute of Gerontology, Academy of Medical Sciences of Ukraine (Kyiv);
- State Medical Academy (Dnepropetrovsk).

Based on the results of the clinical testing, State Registration Certificate No 8501/2009 was issued by Order No 141 of the Ukrainian Ministry of Public Health dated February 5, 2009.

Punctural electrographic instant diagnosis system

Apparatus for bioresonant information-punctural therapy

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Service in the Area of Rocket and Space Engineering

Purpose

- Scientific and technological assistance of launchers and spacecraft development;
- Theoretical and experimental research of processes in rocket and space objects elements;
- Development of software for research and design work;
- Development and investigations of sam-ples of rocket and space objects components;
- Scientific and technological assistance of requirement specifications, projects, production and operation for rocket and space objects.

Services

- Development of mainly new means to en sure liquefied launchers longitudinal stability;
- Prediction of dynamic response (longitu-dinal accelerations) of spacecraft during injection and flight of the liquefied launcher;
- Use of plasma electrodynamic facility to simulate operational conditions, motion and flow regimes, spacecraft and Solar system planets interaction with interplane-tary medium (solar wind), cold and hot plasma;
- Vacuum-arch techniques for plasma condensate coating high-heat surfaces of liq-uid propellant rocket engine combustion chambers;
- Calculation of motion parameters and optimization of programs for spacecraft mo-tion control;
- Strength and carrying capacity of shell and rod structure of scpacecraft under extremal conditions;
- Aerogasdynamics of rocket and space technology objects – computational aero-thermogasdynamics of launch vehicles, re-entry spacecraft, passages of hyper-sonic ramjet engines and control jet thrusters;
- Determination of parameters of launch vehicles trajectories and spacecraft orbits by measuring data of navigation satellites and earth stations;
- Laboratory flight simulation, experimental investigations of features of the rarefied gas supersonic neutral flow/streamlined surface interaction.

Areas of Application

Rocket and space objects.

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Services for the Railways

Description

Mathematical simulations of dynamic response, stability of motion and stress-strain-state of railway vehicles elements at service and accidents.

Services

- Estimation of dynamic response of vehicles in freight (passenger) train at transitional regimes (acceleration, braking, motion along gradients);
- Investigations of nonuniform train dynamics at accidents caused by trains collision or train riding into an obstacle;
- Investigations of railway train dynamic performances (freight and passenger trains with different type gears) at the motion along the track with arbitrary shape;
- Wheelset derailment simulation;
- Nonlinear dynamic analysis of elastic-plastic deformations of tank-car tank heads equipped with the protection devices at superstandard loading.

Areas of Application

Transport machine building.

Innovative Aspects and Main Advantages

- Possibility to choose rational parameters of passive protection devices for railway vehicles (including those with honeycomb energy absorbing elements);
- Possibility to reduce considerably the number of tests and the term of testing for new developed designs of railway vehicles and absorbing devices;
- Reduction of expenses for the railway accidents consequences liquidation, especially ones connected with vehicles derailment, trains collision and train riding into an obstacle.

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Technological Ion-Plasma Devices and Vapor Deposition Technique for Hard-to-Reach Surfaces

Description

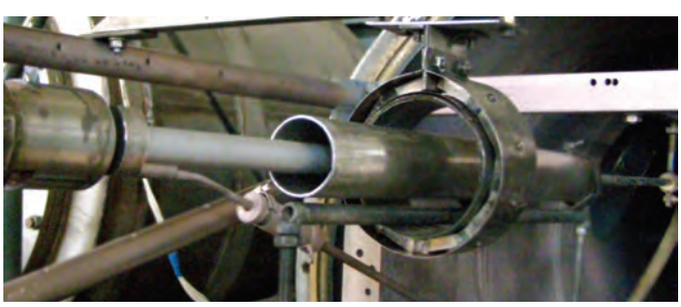
Technological ion-plasma devices for vapor deposition technique for hard-to-reach surfaces of tubular items are developed. With this “dry” technology use it is possible to deposit wide range of coatings, and the technology is ecologi-cally appropriate. Developed ion-plasma devises allow ion beam matching of the surface and deposition of internal hard-to-reach surfaces with 25 mm diameter. There are no limits for the treated item length. Causing by multi-layer nano-composite and superlattice type coverages from any metals, alloys and chemical compounds is also possi-ble. The thickness of one-layer deposi-tion is up to 0.1 mm. Coating condensation tem-perature is 250-400°C. Surface roughness corre-sponds to the padding roughness. Spe-cific deposi-tion rate is about 1 mcg/J.

Innovative Aspects and Main Advantages

The technology is ecologically appropriate and is alterna-tive to chemical galvanic and thermal overcoating tech-nologies, it possesses universal possibilities of causing by different composition and usage functional coverage to the internal and external surfaces of axisymmetrical details. It gives the advantageous distinction from other electro-physics ways of surface modification and also from me-chanical technologies of surface plastic deformation type.

Areas of Application

Friction elements working in the responsible devise units in increased corrosion and mechani-cal wear conditions. The technology can be used by enterprises of aviation, transport, mining ma-chine building.



Stage of Development

Samples of the plasma technological de-vices and a pro-totype of the industrial plant are made for the treatment of working surfaces of friction pairs like “cylinder – piston” from high strength titanium alloy. There is a patent of Ukraine for the useful model. Chromic coating has been in-flicted to the internal surface of titanic hydro cylinder of AN 148 aircraft hydrosystem with 32 mm diameter, 250 mm length, 30 mcm covering thickness and 0.2 mcm rough-ness. The coated detail successfully passed stand tests dur-ing 75 400 model flights that exceeds aircraft life pe-riod.

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Technologies for the Manufacturing of Antenna/Waveguide Devices and Solar Concentrators

Description

Multipurpose use of electroforming (current-induced crystallization of a metal from a super-saturated near-cathode electrolyte layer). The sur-face of the electrodeposit is a precise replica of that of the matrix cathode, and a large number of identical products with a high-quality reflective surface can be made.

Innovative Aspects and Main Advantages

High manufacturing accuracy, small mass, con-trolled uniformity of the material distribution in the electrodeposit (structural homogeneity of the material). Possibility of making complex-structure antenna/waveguide deices and solar concentrating systems, which cannot be made by other technologies. Assurance of the required strength, stiffness and longevity. The technolo-gies fall into wasteless and energy-saving ones. Solar concentrator (made at the Institute of Tech-nical Mechanics of the National Academy of Sciences of Ukraine and the National Space Agency of Ukraine) at the Heliocenter of the Institute for Problems in Materials Science of the National Academy of Sciences of Ukraine (Katsiveli, the Crimea, Ukraine).

Areas of Application

In the development of space antenna/waveguide devices, radio astronomy devices and solar plants.

Parabolic mirror antennas and solar concentrators

Diameter 0.5÷1.6 m, variable thickness 0.2÷0.5 mm.

Parabolic solar concentrator or mirror antenna (variable thickness (2.5÷4)·10-4 m, diameter 1.6 m, mass 8 kg) and the apparatus to make them.

Services

Transfer of documentation for methods of manu-facturing of antenna/waveguide devices and solar concentrating systems including (a) flowcharts specifying the operation sequence and operating conditions (temperature, electrolyte composition, etc.); (b) design and production documentation for products and equipment. Development of processes for the manufacturing of new complex products (seamless pipes, diaphragms, bellows, floats for oil storage metering systems).

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Technology for Increasing the Durability of Structural Materials by Combined Energy Action Using Synergetic Effects

Purpose

Treatment of structural materials by combined energy action using physical fields of different nature to increase the longevity and reliability of units in different industries.

Description

Combined energy loading with the use of high-intensity sources triggers self-organizing processes in the structural materials being treated, thus greatly increasing their durability.

Innovative Aspects and Main Advantages

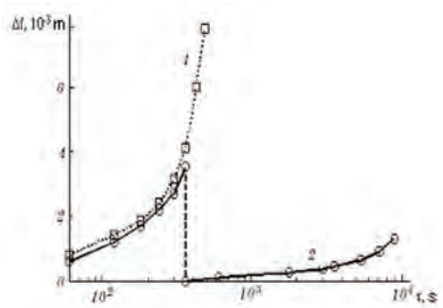
The high energy efficiency of the self-organizing processes and the reduced level of energy and matter outflow reduce, in comparison with traditional technologies, the energy intensity of the process, thus providing the resource saving and environmental appropriateness of the technology.

Stage of Development

Laboratory research.

A technology of combined energy loading of AMg6M aluminium-magnesium alloy specimens has been developed. The technology offers a significant (35-fold) increase in the average creep-rupture life.

Combine d energy treatment setup



Average creep-rupture life of an untreated (1) and a treated (2) AMg6M alloy specimen

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Technology of Computational Substantiation of the Design Parameters of Complex Hydraulic Systems

Description

Computer simulation of fast hydro- and gas-dynamic processes in complex hydraulic systems, which include manifolds, pilot-controlled valves, tanks, throttle valves, dead legs, etc., for the choice and substantiation of the design and operating parameters of engineering systems.

Innovative Aspects and Main Advantages

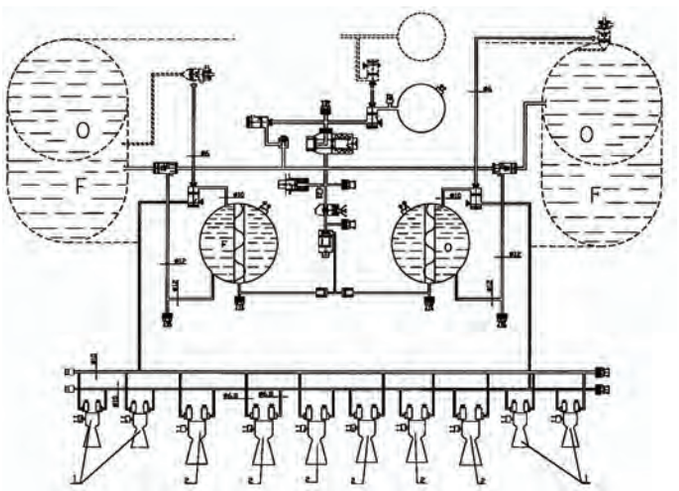
Accounting for: the design features of hydraulic lines (pipe diameters, wall thickness, material), the physical and chemical liquid/gas properties, the hydraulic resistance of feed pipelines and control valves, the degree of gas saturation, gas release and discontinuity, the propagation of wave processes in the system elements, and the dynamics of electrically or pneumatically controlled valves.

Areas of Application

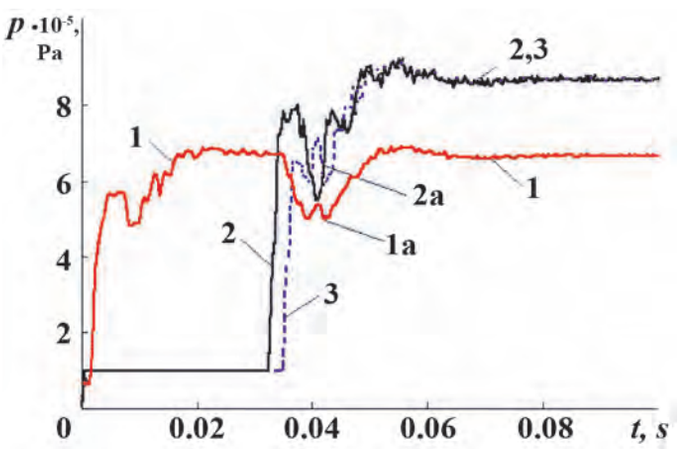
Design organizations that develop complex branched hydraulic systems of airborne and space vehicles, rocket and internal-combustion engine fuel supply systems, urban water distribution systems, etc. operating in transient conditions (start-up and shut-down transients, hydraulic shock).

Stage of Development

The technology has been tied out as applied to the feed system of two-component liquid-propellant spacecraft flight control thrusters.



Hydraulic schematic of the feed system of liquid-propellant thrusters
O – oxidizer tank; F – fuel tank; 1, 2 – thrusters



Effect of the sequential start-up of thrusters 1, 2, 3 on the combustor pressure

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Technology of Development of Industrial Apparatus Flow Systems

Description

Combined use of computational methods and ex-perimental modeling of gas-dynamic processes using model plants of different scale (including full-scale ones).

Innovative Aspects and Main Advantages

The technology is implemented using inexpen-sive model equipment and shortens (or fully eliminates) the stage of flow system tryout using pilot and industrial apparatuses

Area of Application

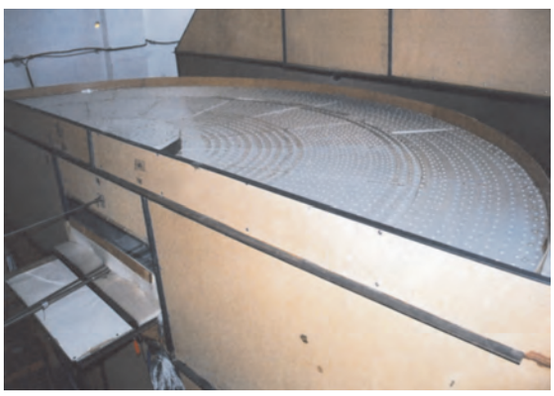
Design organizations that develop various in-dustrial apparatuses for the chemical, the pharma-ceutical, the food and the power industry and for ventilation, conditioning and temperature control systems.

Stage of Development

The technology has been tried out in the devel-opment of ground temperature control systems for the head fairing of the Zenit launch vehicle, a gas distributor for an industrial ammonia conver-sion apparatus and the flow system of an indus-trial spouted-bed apparatus.

Full-scale model apparatus for the spouted bed coat-ing of granulated materials

Spouted bed structure (semicircular version, 1:6 scale)



Gas distributor (4,000 mm in diameter) of an in-dustrial ammonia conversion apparatus

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Technology of Dust Vortex Separation from a Gas Flow

Description

The use of the energy of coaxial vortex counter flows for the separation of dust particles from dust-laden flows and the development of efficient fine-dust-trapping plants on this basis. Depending on the dust type, different methods are used to control the aerodynamic activity of the vortex flows.

Innovative Aspects and Main Advantages

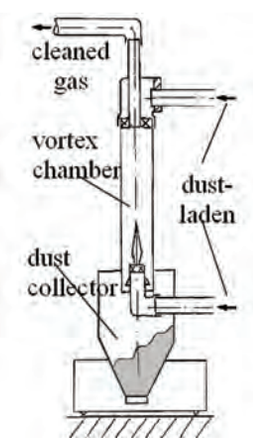
Enhanced dust separation efficiency for small-fraction micron particles: separation of dusts smaller than 5 micrometers with an efficiency up to 97 to 98 percent for some dust classes, lower power consumption in comparison with filters and scrubbers, higher recovery of dust materials, and lower environmental impact.

Areas of Application

The chemical industry, the woodworking indus-try, the iron-and-steel and the nonferrous-metals industry, the building materials industry, and the power industry.

Stage of Development

A laboratory vortex dust-trapping plant, on which a technique of choice of the design and op-erating parameters that maximize the efficiency of fine dust separation has been tried out.



Schematic and overall view of laboratory dust-trapping plant

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Vibratory-Rotary Drilling with the Use of a Cavitation Hydrovibrator to Impart High-Frequency Longitudinal Vibration Accelerations to the Rock-Cutting Tool

Description

In vibratory-rotary drilling through hard rocks, high-frequency and high-intensity longitudinal vibration accelerations are imparted to the rock-cutting tool, which combines the advantages of vibratory drilling and rotary drilling. In the technology developed at the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the National Space Agency of Ukraine, vibratory-rotary drilling is implemented by mounting a cavitation hydrovibrator (see the figure) in the drilling string. The hydrovibrator can be mounted both some distance from the rock-cutting tool (e.g. over the core barrel) and just ahead of it. The hydrovibrator serves to transform the steady drilling mud flow into a pulsating one. Depending on the hydrovibrator inlet pressure and drilling depth, the pulsation frequency ranges from 100 to several thousands of hertzs. The pulse pressure is 2 to 4 times as high as the steady pressure at the hydrovibrator inlet. The cavitation hydrovibrator sets up the longitudinal vibrations of the rock-cutting tool.

Cavitation hydrovibrator

Innovative Aspects and Main Advantages

The proposed high-frequency hydrovibrator differs from conventional ones in that it doesn't have any rotating or moving parts and doesn't use any energy sources other than the stream energy of the drilling mud pumped to the borehole for bottomhole cleaning. This simplifies its design and servicing, offers a far higher reliability and reduces its mass and dimensions. The use of cavitation hydrovibrators will result in a far higher drilling rate and rock-cutting tool durability.

Area of Application

Exploratory drilling, oil- and gas-well drilling.

Stage of Development

Design documentation has been prepared, hydrovibrators have been made, and drilling-depth simulation tests have been conducted to determine the dynamic performance of the hydrovibrators as a part of drilling assemblies. The drilling rate obtained in test drilling has confirmed the efficiency of the hydrovibrators developed.

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Kurdyumov Institute for Metal Physics

Technical Area Keywords: material sciences, metal physics

General Information

Since 1945 the Institute for Metal Physics (IMP), one of the major European centers of excellence in the field of physics of metals and related materials, has 22 scientific departments and 10 laboratories staffed with nearly 290 scientists.

Specific projects that highlight the Institute's capabilities are phase transformations in high nitrogen steels, solidification in microgravity conditions, growth of single crystal shape memory Cu-Al alloys, production of metallic Co by hydrometallurgical processing of Ni and Co raw materials, development of Zr-based shape memory alloys (Zr-Cu-Ni, Zr-Cu-Co), and localized rapid heat treatment of Al and Ti alloys for improved wear and fatigue resistance, development of high hardened engineering Al-based alloys with nanocomposite structure, alloying of Invar Fe-Ni-based alloys for varying of hardness and thermal expansion, transformation of solar energy into power one by nanostructured electrodes,methods of dynamical diffraction, superelasticity and magneto-elasticity in Ni-Mn-Ga-based alloys.

The Institute is responsible for fulfillment of the State Program "Nanostructural systems, nanomaterials, nanotechnologies". The Institute has unique capabilities for producing powder metallurgy Ti-alloys, Ni-based eutectic supertype alloys and shape memory materials, amorphous and nano-crystalline metallic alloys, as well as super-elastic and high-damping materials and metal-fullerene films.

IMP has a unique technological base, which includes vacuum laboratory induction ovens and melting furnaces with copper water-cooled crystallizers for induction and induction-arch melting. The equipment allows to meet the Institute's units' research demands, as well as to produce small (10-100 kg) quantities of precision alloys for industrial use in Ukraine and Russia. The Nuclear Magnetic Resonance (NMR), Magnetometer, Mechanical Testing centers for "collective use" are equipped with Avance 400 multifunctional spectrometer (Bruker, Germany), VSM 7404 vibrating magnetometer (Lake Shore Cryotonics Inc., USA), axial testing 20 t machine INSTRON 8802 (USA) respectively for the analysis of physical, chemical and mechanical properties of metals and alloys. The Institute also houses a cryogenic facility for scientific studies in low-temperature physics and superconductivity and production of liquid helium (installed capacity 100 L/hour).

Institute's Focus

IMP has evolved to establish core competencies in the following areas:

- Theoretical foundations of metal physics;
- Electronic structure and properties of metals and alloys;
- Physics of strength and plasticity;
- Phase transformations and phase equilibriums;
- Surface science.

Valuable Technology Offerings

Currently, the Institute proposes a number of R&D results, with noticeable emphasis on new materials, for further joint development and commercialization, such as:

- Amorphous and nano-crystalline metallic alloys;
- Shape-memory alloys, super-elastic and high-damping materials;
- General-purpose 'Avialay'-brand aluminum structural alloy;
- Cost-effective production of titanium alloys for automotive industry;
- Methods for computational modeling of atomic and electronic nano structures and spectral diagnostics of nano-materials;
- Apatite-like nanosystems and nanomaterials;
- Metal-fullerene films and nanoparticles of refractory metals;
- Hardened Invar Fe-Ni-based alloys.

Scientific Cooperation and Technology Transfer

- IMP maintains extensive research collaboration with other institutes of the National Academy (Institute for Electric Welding, Institute of Electrodynamics), industrial research institutions in Ukraine and the CIS and international research centers (USA, Canada, China, EU). Noteworthy is cooperation with US Air Force Research laboratory, Edison Welding Institute in Columbus, National Center for Physical Acoustics and PNNL. In Europe, IMP has conducted collaborative research with
- Ruhr University, Germany;
- Helsinki Technological University, Finland;
- Lille University, France;
- Krakow University, Poland and many others.

The Institute participated in a number of international projects funded by INTAS, STCU, European Office of Aerospace Research & Development, as well as in inter-governmental programs of scientific cooperation (Czech Republic, Slovakia, China, Germany).

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Cost-Effective Production of Powder Metallurgy Titanium Components

Description

The technology was based on the blended elemental PM method in its simplest press-and-sinter approach without application of any pressure or deformation during or after sintering (contributing to the cost-effectiveness of the approach). The distinctive feature of technology is employment of hydrogenated titanium powder instead of traditional titanium powder. Hydrogen has a major effect on synthesis improvement, providing production of alloys having 98.5-99.5% density, the desired phase composition, microstructure and chemical homogeneity and relatively low impurity content to meet automotive application demands in the most cost-effective manner. It was shown that compacting pressures within a wide range of 400-900 Mpa doesn't influence the final porosity of material produced using hydrogenated titanium. Thus, the density in various locations of a compact, exposed to different pressures, will be the same. Significant decrease in cost simultaneously with retaining of unique properties of titanium alloys provides expansion of sphere of titanium employment. Application of proposed technology for production of titanium automotive components and aerospace components for non critical application lead to decrease in weight and improvement of fuel consumption characteristics.

Innovative Aspects and Main Advantages

- Employment of cost-effective hydrogenated titanium powder as starting material
- Employment of blended elemental powder metallurgy approach in its simplest press-and-sinter option without hot deformation.
- Attainment of high balance of mechanical properties of synthesized alloys, which rival those for corresponding compositions produced with ingot approach.

As an example, Ti-6Al-4V alloy (the "work horse" of the titanium industry) was synthesized using an approach based on hydrogenated titanium. The high density (99%) and fine microstructure (beta-grain size around 100 mμ) achieved is a result of selection of the correct blend of hydrogenated titanium and alloying element powders both in proper particle sizes and correct sintering regime. With this approach, material with tensile and fatigue properties equivalent to those of ingot metallurgy (I/M) processing can be produced without any additional thermal or thermomechanical treatments: YS=840-860 MPa; US=940-990 MPa; El.=10-14%; RA=11-27%, fatigue endurance limit 500 MPa. Contrary, earlier work with 99% dense Ti-6Al-4V was reported only in research programs where post-sintering HIP was employed and/or much cleaner (low chlorine) starting materials were used making this P/M processing much more expensive.

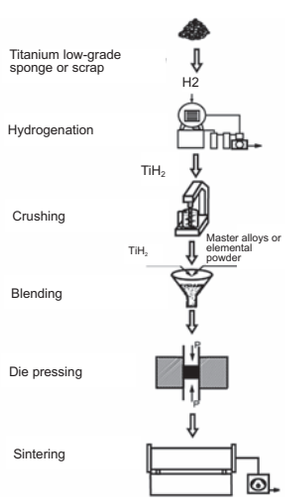
Areas of Application

Automotive, aerospace and other industries.

Stage of Development

- Patented;
- Prototypes available for testing;
- STCU – IPP partner project (P-143) aimed on development of large-scale industrial technology for titanium components manufacturing is successfully performed;

To commercialize developed approach, optimization of the technology for cost effective production of titanium components for various industries (for example, automotive) and its testing under industrial conditions is necessary.



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Equipment for Ultrasonic Impact Treatment of Metals (UIT)

Description

The surface state plays an important role during operation of constructions and especially such ones, which work in the conditions of vibrations. Such terms lead to formation of cracks in surface layers, which result in fatigue destruction of a construction as a whole under following operation. The different kinds of welded joints are the most dangerous sites of constructions. There are a plenty of methods for surface hardening of metals, which can improve the fatigue life and durability of responsible elements and parts of different machines, mechanisms and constructions. Employment of such methods allows considerably increase the operation life of machines and constructions. A number of them are based on the severe plastic deformation of surface due to multiple impact loads. The deformation leads to hardening of a surface and formation of compressive residual stresses in surface layers.

Among the traditional technologies in this direction the following methods are widely well-known: hammer peening, shot peening, etc. Currently the Ultrasonic Impact Treatment (UIT) becomes more widely used as a method for local hardening of the metal surfaces. Especially successful experience of application of the UP is related to hardening of welded joints. Long-term researches of mechanisms of structural and phase transformations in metals and alloys caused by UIT, conducted in Kurdyumov Institute for Metal Physics NAS of Ukraine became scientific basis to creation of this technology.

Innovative Aspects and Main Advantages

New modification of portable ultrasonic apparar hardening and relaxation treatment of welded joints with the output power of 300 W is developed at the G.V. Kurdyumov Institute for Metal Physics of the N.A.S. of Ukraine. The developed ultrasonic equipment is supplied with piezoceramic transducer and has low dimensions and weight. Application of piezoceramic transducers instead of magnetostrictive ones as the ultrasound source is the key difference of our development in comparison with the one, which is proposed by Applied Ultrasonic Inc. (USA). The latter one is much heavier (by 3-4 times), both considerable energy consumption and water-cooling are needed. Therefore, it is difficult to use the equipment in-the-field conditions. Similar equipment with piezoceramic transducers is made also in China. However, its technical characteristics are worse in comparison to our one (table).

Application of piezoceramic transducers substantially reduces the energy consumption, cost of equipment, and also expands technological possibilities as a result of comfort of the use in various branches of industry due to small dimensions and weight. The use of this method allows improving fatigue strength of welded joints by 20 – 30 % and permits substantially increasing their durability.

Areas of Application

Application of technology of UIT prolongs the operation life of responsible constructions in a bridge- and ship-building, on a transport, in production of Goliath cranes and in other branches of industry

The portable ultrasonic apparatus for hardening and relaxation treatment of welded joints with the power output till 650 W.

Table – Competitive matrix

Important key technology characteristics	Our equipment	Applied Ultrasonics USA	Ultrasonic Ltd China
Weight:	5.5 kg	8 kg	13 kg
Transducer and cooling system	Piezo- ceramic Air cooling	Magneto-strictive Water cooling	Piezo-ceramic Air cooling
Power output and Energy consumption	0.65 kW Lower < 1 kW	0.5-1.0 kW Higher 1.2 kW	0.2-0.35 kW Lower < 1 kW
Price	$7,000-10,000	$30,000-40,000	$15,000-20,000

Stage of Development

UIT equipment are protected by:

- Ukrainian Patent # 8366 A;
- Ukrainian Patent # 13936 A;
- The device available for demonstration and field tested.

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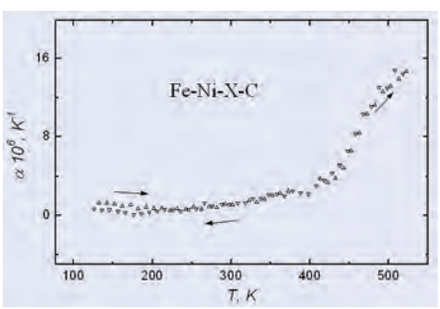
Hardened INVAR Fe-Ni-C-based Alloys

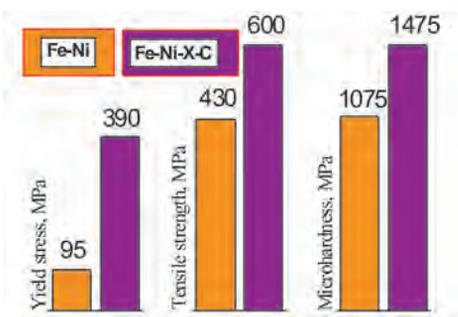
Description

The Invar Fe-Ni-X-C-based alloys have been developed on the basis of the results of studies, which for stability of thermal expansion in the temperature range of 100 – 400 K do not yield to the traditional Fe-Ni Invar and additionly demontrste edvantagous combination of the mechanical, fatigue and elinvar properties.

Innovative Aspects and Main Advantages

- low thermal expansion coefficient α (TEC)





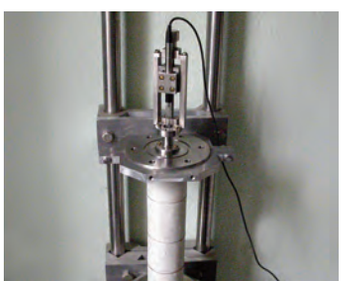
- advantage combination of strength and plasticity;
- resistance to cyclic loads;

possibility to change and renew TEC on products.

Areas of Application

- dilatometry;
- parts for ultrasonic delay line;
- laser optics;
- telescope body constructions;
- parts for tanks for transportation of liquid gases;
- clock and watches;
- radio frequency resonant cavity;
- electronics.

Stage of Development



Low temperature dilatometer. Main metallic parts of

was manufactured from developed Invar alloy.

Metallic sound guide manufactured from Invar alloy in equipment for measurements of ultrasonic velocity.

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High-Selection Integrated Filters on the Basis of HTSC-Films for Microwave Receivers of Satellite and Cellular Communication Systems, Radiolocation and Radioastronomy

Description

High-selection microwave integrated filters on the basis of high-temperature superconductors (HTSC) YBCO-films.

Performances of integrated filters on the basis of HTCS YBCO-films:

Operating temperature:	< 83K;
Center frequency f0:	1 – 4 GHz;
Bandpasswidth:	2 – 5 % f0;
Losses in the passband:	< 1 dB, < 0.5 dB;
Steepness of passband boundary:	2-8 dB/MHz;
Losses outside of the passband:	at 0.1 f_0 > 45 dB;
T_C $YBa_2Cu_3O_{7-\delta}$ -films:	89K.

Areas of Application

Microwave Receivers of Satellite and Cellular Communication Systems, Radiolocation and Radioastronomy.

Stage of Development

Functioning samples of high-selection microwave integrated filters on the basis of HTSC YBCO-films were designed and manufactured.

Innovative Aspects and Main Advantages

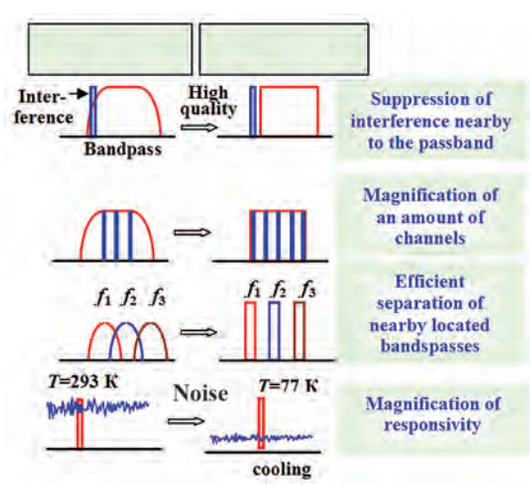

Fig. 1. Advantages of HTSC Application in Microwave Receivers

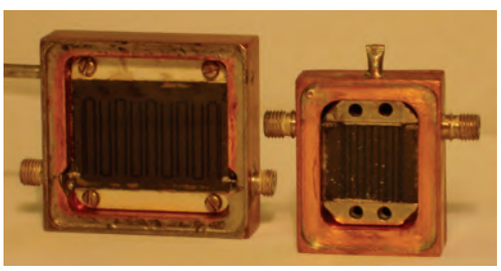

Fig. 2. HTSC high - selection microwave integrated filters for extreme operating regimes.

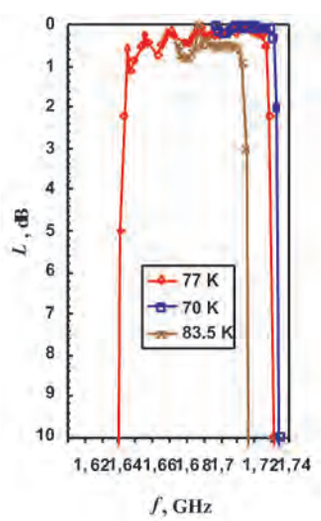

Fig. 3. Losses in the passband at 83.5, 77 and 70K

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Infra Red Transillumination Video Fundus Camera

Description

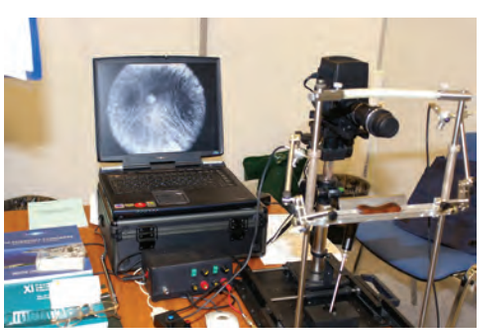
Infra red image system (IRIS) is the real time mode device of a new generation based on innovative transscleral illumination technology for spectral analysis of eye fundus.

Innovative Aspects and Main Advantages

- Innovative IR trans illumination technology;
- 100% Non-mydriatic;
- Wide spectral range (up to 1100 nm);
- Wide-Field;
- Non-invasive.

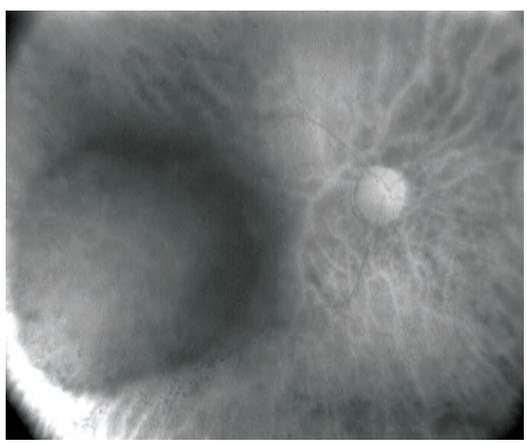
Areas of Application

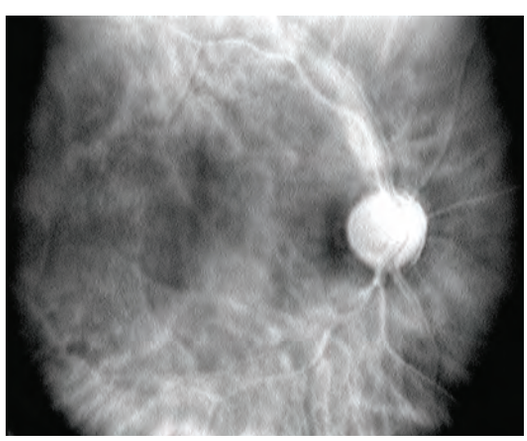
- Oncology diagnostics;
- Retinopathy diagnostics;
- Age related macular degeneration diagnostics.



Stage of Development

- Oncology diagnostics;
- Retinopathy diagnostics;
- Age related macular degeneration diagnostics.





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Mechanically Driven Method for 2d and 3d Nanofabrication of Electronic Devices by Self-Assembly

Description

Evolution to more compact electronic systems causes appearance of the novel different nanolithography techniques investigated by many research teams. As one of the novel nanofabrication method, self-assembly is intensively investigated recently.

The new self-assembly method of rectangular and rhombic grids on single crystalline Al thin plates under constrained cyclic mechanical tension is reported. The nanoextrusions and nanointrusions produced in this way evolve from initial random to regular 2D and 3D arrangements. The 2D regular continuous-solid rectangular grid ("tweed") was observed at micro and sub-micro scales with the typical grid spacing of 500 nm and extrusion height of 500 nm. After continuation of the cyclic mechanical tension, the 3D discontinuous rhombic grid of voids ("pullover") was created at micro and macro scales with the typical grid spacing distributed in the range of 1-200 μm, extrusion height of 1-100 μm, and much wider distribution of void sizes of 0,1-100 μm. This evolution could allow for the new mechanically driven method for nanofabrication of 2D and 3D electronic devices by self-assembly controlled by the chemical composition, the number of cycles, amplitude of the applied mechanical stress, initial roughness, etc.

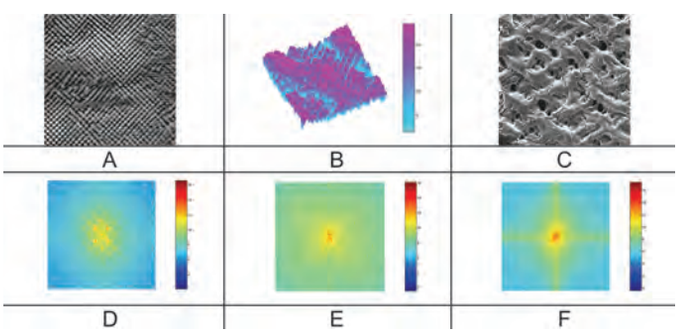
Innovative Aspects and Main Advantages

The most current fabrication methods of microelectronic devices are carried out by conventional parallel technique of photolithography (for feature sizes greater than 300 nm) and serial technique of electron beam lithography (for feature sizes between 300 and 30 nm). The novel nanolithography techniques will be necessary to create the features with sizes smaller than 30 nm. Serial scanning probe surface methods are very powerful, but have two crucial limits: high price and low rate. Despite the great advances in building devices with thousands tips at the same time, they hardly satisfy the mass production demand with commercially affordable prices.

The novel self-assembly method proposed here can provide the new paths to mass-production of cheap 2D and 3D electronic nanoscale devices.

Areas of Application

The mechanically driven self-assembly is suitable for 2D and 3D nanofabrication of electronic devices in nano and sub-micro and micro electronics, high sensitive membranes and detectors of chemical and biological agents (explosives, pollutants, warfare, etc.), other sensors and actuators.



2D continuous-solid rectangular sub-micro grid ("tweed") (A – SEM, B – AFM, D and E – their correspondent Fourier transforms); 3D discontinuous rhombic grid of voids ("pullover") (C – SEM, F – Fourier transform)

Stage of Development

Development phase - laboratory tested, feasibility study.

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Multilayer Film Sensor for Damage Diagnostics

Description

The new innovative approach to damage diagnostics within the production and maintenance/servicing procedures in industry is proposed. It is based on the real-time multiscale monitoring of the smart-designed multilayer film sensors (SMFS) of fatigue damage with the standard electrical input/output interfaces which can be connected to the embedded and on-board computers.

SMFS is a multilayer (~ 0.2-0.4 mm) structure which could be rigidly attached (glued, welded or sputtered) to the underlying engineering component with complex geometry. The first lowest layer is a highly sensitive soft single crystalline film that undergoes the permanent evolution due to external deformation influence from the underlying engineering component. The second layer is assumed to be made from different polymers with physical characteristics (electrical resistance, inductance, capacity, etc.) which are highly sensitive to form changes. The third layer is a multiscale grid of contacts for data acquisition that creates the standard interface for plugging to the embedded or on-board computer systems.

SMFS supply information about the actual unpredictable deformation damage, actual fatigue life, strain localization places, damage spreading, etc.

Innovative Aspects and Main Advantages

Current techniques can provide the measurement of a single fatigue feature only, such as crack growth or instant strain, while the technology discussed herein is designed to measure a whole range of fatigue parameters in the monitored area.

The expected benefits of SMFS could be summarized as followed:

- to reduce frequency of inspection periods of engineering constructions;
- to provide real-time data therefore giving greater safety assurance;
- to enable further reduction of conservatism in design because of ‘real-time’ safety net;
- to offer new design approaches for weight and maintenance optimization.

Areas of Application

SMFS is suitable for diagnostics of the constructive elements which failure could lead to catastrophe in the following engineering fields: aerospace, automotive industry; high-pressure reservoir and reactor materials, joints, welds to extend the integrity and lifetime of installed pipelines and their various components; bridge building, civil engineering, etc., especially under the real random spectra of loading conditions.

The immediate aerospace application is in the measurement of the actual accumulated fatigue damage of areas of high stress concentrations. Potential areas may be at the aft/centre and front/centre fuselage junctions, as well as centre-fuselage/wing junctions. Further fuselage frames and some areas on the lower wing skin may be sensitive to fatigue loading and subsequently could benefit from such tool.

Stage of Development

Development phase - laboratory tested, feasibility study.

Laboratory Virtual Reality Model: standard GSM phone with camera used for SMFS scanning, data transmitting by GPRS protocol to integral processing of the actual damage of the whole engineering construction

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Soft Magnetic Amorphous and Nanocrystalline Alloys

Description

Soft magnetic amorphous and nanocrystalline alloys in a number of applications (power pulse medium frequency transformers, current measuring transformers, electric motors, protective reactors, phase shift correctors, chokes etc.) already successfully substitute conventional crystalline rolled soft magnetic materials (transformer steel, permalloys) and ferrites. Realization of innovation developments of the G.V. Kurdyumov Institute for Metal Physics of the N.A.S. of Ukraine and the MELTA Ltd in the field of high-productivity technology of rapid (up to 106 K/s) quenching of melts (RQM) enables obtaining the materials with the unique magnetic, mechanical and chemical properties, particularly ribbons of amorphous alloys, which thickness doesn't exceed 30-50 μm. The Planar Flow Casting (PFC) method lies in the RQM technology as the well-known main component of nanotechnologies in metallurgical (micrometallurgy) and electrical industries.

Innovative Aspects and Main Advantages

In electronics, electrical engineering, aircraft and power industry.

The existing market requirements are today estimated at several hundreds of millions of small-sized (weighing from 0.1 to 3g) magnetic cores per year and demand for such products is redoubled each year in the world.

Examples of application and manufacture are as follows:

- High grade compact electromagnetic noise filters (CMC) (high magnetic permeability at frequencies >100 kHz is important);
- Matching small-size HF transformers (high values of saturation induction and initial permeability allow minimizing dimensions of transformers and added distortions of transformed or transmitted signals;
- Chokes of differential filters of small dimensions (high Bs in combination with maximum low core losses at high timing frequencies and elevated temperatures, 140oC, is important);
- Electron-optical information display and monitoring systems with minimum overall dimensions (high level of temperature stability and mechanical strength of cores are important).

Areas of Application:

In electronics, electrical engineering, aircraft and power industry.

The existing market requirements are today estimated at several hundreds of millions of small-sized (weighing from

Stage of Development

The developments of the G.V. Kurdyumov Institute for Metal Physics of the N.A.S. of Ukraine are protected by:

- UA Patent «Method of continuous ribbon casting» No. 1304;
- UA Patent «High-strength corrosion-resistant amorphous iron-based alloy» No. 5014222;

Functioning prototypes of necessary technological equipment were designed and manufactured by IMP of NAS of Ukraine and by MELTA Ltd. Design documentation has been prepared for manufacture of equipment with annual output about 20 ton amorphous ribbons. Methods have been developed and equipment has been designed for manufacture of toroidal, rod and C-shaped tape wound cores, their heat and heat-magnetic treatment, encapsulation or overall polymeric coat; functioning prototypes of this equipment were manufactured.

New six grades of amorphous and nanocrystalline alloys have been developed and are now produced. In particular, nanocrystalline (FeSiB)96,6(CuNb)3,4 - (MM-1N) and (FeSiB)96(CuNb)4 - (MM-11N) alloys showed themselves well and their small volumes are manufactured at the research-and-production company - MELTA Ltd. Beginning from 2000 the company produces annually about 1 ton of magnetic cores of various purpose and inductive components (transformers and chokes) on their base.

Amorphous ribbon production process and magnetic cores made of it

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Producer: MELTA Ltd.
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Web-site: http://www.noviteh.com, http://www.ferrite.com.ua

The Wear-Resistent and Heat-Resistent Co-Base Alloys

Description

The problems of decreasing wear abrasion protection and strengthening of bandage shelf of blades gas turbine motors at high temperature and pressure in attack of combustibles are decided in Department of Phase equilibria of G.V.Kurdyumov Institute for Metals Physic NAS of Ukraine by working the HTN-61and HTN-62 alloys. It is possible to rise of work resource for gas turbine motors up 2000 hours for VGL-2, GS6U alloys tradition application to 6000 hours, thanks to high wear resistance and heat resistance of developed alloys. The high work characteristics of HTN-61and HTN-2 alloys are determined by its eutectic structure with complex alloyed cobalt-base matrix and niobium refractory monocarbide plate-granular crystal inclusions. The high wear resistant is achieved by increasing volume part of monocarbide, and high heat-resistance – by complex alloyed of matrix.

Innovative Aspects and Main Advantages

Alloy	Intensity of wear, I_v 10^6 mm^3/cycle				Melting point,° C	Heat-resistance, Δ m g/m2hour	
	500°	850°	1000°	1100°		1000°C	1100°C
VGL-2	1,35	0,95	4,5	-	1220-1280	-	-
XTH-61	0,28	0,25	0,4	15,1	1340	0,042	3,22
XTH-62	-	-	-	15,05	1330	0,018	1,13

high, stable wear resistance at temperature up 500° C to 1100° C at high pressure in attack of combustibles, what make sure the long time work (the intensity of wear is ten times as much at 1000°C then for VGL-2);

- melting temperature is not below then 1300°C;
- availabily production – casting without heat treatment;
- structural and phase stability along working;
- heat resistance for HTN-62 alloy is best then for HTN-61 with keep another properties;

The development of cast technology and alloys properties are continued.

Areas of Application

The HTN-61 and HTN-62 alloys are produced according to developed in Institute for Metal Physics NAS of Ukraine the technically condition “Cast bars of HTN-37, HTN-61, HTN-62 alloys” and are applied for strengthening and renewal of bandage shelf of the blades gas turbine motors D18T, D-436T1, D436-148, AI222-25

for airplane AN-124, AN-225, Tu-334, Be-200, AN-148, Yak-130.The alloys are developed for aero industry but its may be used by another range of mechanical engineering.

Stage of Development

The developments of the G.V.Kurdyumov Institute for Metal Physics of the NAS of Ukraine are protected by:

- UA Patent “ The Cobalt-base Alloy” № 8240A;
- UA Patent “ The Cobalt-base Alloy” № 49450.

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Lashkaryov Institute of Semiconductor Physics

Technical Area Keywords: physics, sensors, semiconductor materials and devices science, semiconductor devices for sensing, high-temperature and microwave electronics, optoelectronics, infrared photoelectronics and solar power engineering

General Information

The Institute of Semiconductor Physics (ISP) of the National Academy of Sciences of Ukraine (NASU) was established in 1960 on the basis of several departments and laboratories of the Institute of Physics of the NASU as a leading research center specializing in semiconductor materials and devices science. ISP consists of 8 divisions, each containing of 3 to 5 departments. There is a self-financing Special Design-and-Technology Bureau (SKTB) with a Pilot Production Line at the Institute. There also are the following subdivisions develop their activity at ISP:- (i) the center “Diagnostics of Semiconductor Materials, Structures and Applied Systems”; (ii) the center “Cryogenic Sensors and Thermometry”; (iii) the testing laboratory for holographic safety elements; (iv) the central testing laboratory for semiconductor materials science; (v) the center for testing the photoconverters and photoelectric batteries. The Technology Park “Semiconductor Technologies and Materials, Optoelectronics and Sensor Technique” was also created on the premises of ISP in 1999.

ISP’s research and development results include new methods of optical and electrical characterization and certification of semiconductor materials and devices, and a variety of sensors for measurements of temperature, magnetic field and pressure, chemical and biological sensors, microwave devices, high-resolution photo resistors, high-efficiency silicon-based solar elements and optoelectronic devices, including liquid-crystal, electroluminescence displays and indicators.

Institute’s Focus

ISP is engaged in fundamental and applied research in the following areas:

- semiconductor materials science;
- interaction between electromagnetic radiation and matter;
- semiconductor optics, spectroscopy and photonics;
- physics of low-dimensional structures, micro- and nanoelectronics;
- optoelectronics and solar energetics;
- technologies and materials for sensors;
- infrared engineering and microwave electronics.

Valuable Technology Offerings

A broad-ranging of technologies and devices for transfer and commercialization, offered by ISP, include various physical, chemical and biological sensors, and diagnostic systems, microwave devices, solar elements, optoelectronic devices, electroluminescence displays, low-cost self-assembling technology for nano-electro-mechanical systems (NEMS), ultrafast light-emission sources, etc.

Scientific Cooperation and Technology Transfer

The Institute is quite active in international scientific cooperation and grant competitions. A number of projects were executed in the framework of STCU, NATO, EU INTAS and INCO-COPERNICUS programs, and Network of Excellence of the 6th Framework Program. Continuing those traditions, ISP is also involved in several international projects that are now funding by EU 7th Framework Program. As cooperative, educational and training activities of ISP, noteworthy is NIS-NEST project, which aims to contribute towards closer and mutually beneficial collaboration between the EU and the Eastern European partner countries, in the field of novel exploratory research within the 7 th Framework Program for Research and Technological Development of EU.

ISP has established a strong collaboration with a number of university, research centers and industries in Ukraine and abroad. Some of them are the SRI “ORION” and SRI “MICRODEVICES” both in Kyiv, University of Florida and Arkansas University (USA), Southampton and Nottingham Universities (UK), Institute of Solid State Physics (Sofia, Bulgaria), Institute of Microelectronics and Nanotechnology (France), Institute for Research in Metrology (Turin, Italy), Institute of Low Temperature and Structure Research (Wroclaw, Poland), Ioffe Physico-Technical Institute (Russia), Institute for Electrotechnique (Bratislava, Slovakia), Institute for Technical Physics and Materials (Budapest, Hungary), Technical University (Darmstadt, Germany).

ISP in cooperation with Ukrainian small trade and R&D enterprises supplied some materials and devices to the business customers and universities in the USA, UK, France, Italy, Switzerland, Germany, China, Poland and Russia. Some of them are the thin-film optical germanium and cryogenic temperature sensors.

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Colorimetric Detector of Gas Mixtures

Description

Chemical sensor optoelectronic system for the analysis of composition of gas mixtures on the basis of interference transducer with registration of R,G,B – components of light, reflected from the surface of the thin adsorption layer of the color-painted sensitive material and CCD camera for registration of constituents of light.

Operation of colorimetric optical instrument is based on the comparative analysis of color characteristics of signals, obtained as a result of interference of white light on the thin layer of the painted sensitive material both in absence of the analyzed gas and after its action. Recording of color parameters of sensitive layer under gas influence is provided by values of R,G,B - components of the reflected light. The library of such characteristics (chemical images) with using of statistical methods of recognition allows to identify a presence of that or other matter in the analyzed probe.

Basic technical characteristics:

- field of image 1 mkm - 2 sm;
- spatial separate ability 0.5 mkm;
- maximum number of registered colors 106;
- number of optical channels 1 – 20;
- light sensitivity 1–50 Lux;
- template size 20×20 mm;
- type / temperature of light source LED/6500 K;
- frame capture 15–30 fps;
- threshold sensitivity of gas detection 10-300 ppm;
- size 250×145×200 mm with the printing inks.

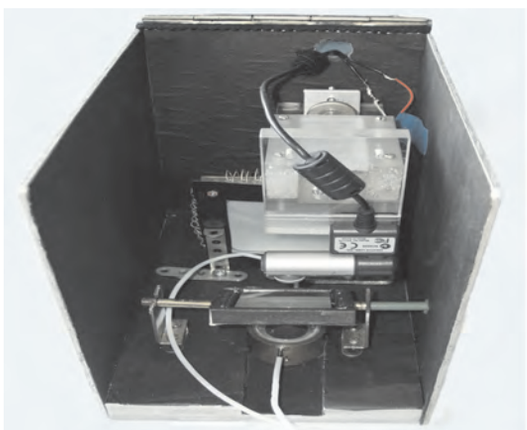
Innovative Aspects and Main Advantages

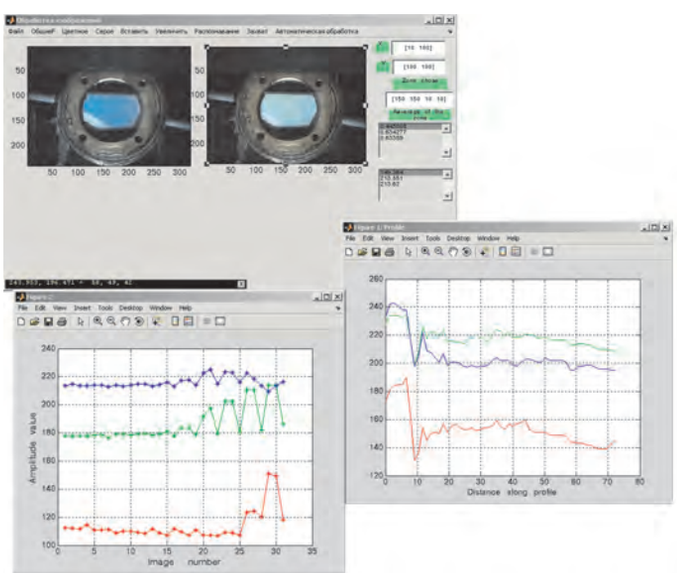
Estimation of novelty: similar developments are not present in Ukraine; original sensitive layers and methods of processing of images are used in a device.

Intellectual property: Khoruzhenko V.Yu., Shirshov Yu.M., Kostyukevych K.V., Samoylova I.A., Christosenko R.V. Patent of Ukraine “Colorimetric interference detector substances in a probe”, № 56652 A, publ. 15.05.2003.

Areas of Application

The device is intended for detection and analysis of gas mixtures in analyzed air probes and in an environment and it can be used in technological processes on a manufactory, for diagnostics of diseases in medicine, in pharmacology and perfume production, for the ecological monitoring.





Stage of Development

Pilot samples.

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Creation Sensory Diodes Structures on the Basis of Crystals CdTe for Devices of Detecting X-Ray and G-Ray Radiations

Description

The technology of fabrication of diode structures is in the formation of a p-n junction in a surface layer of high resistivity CdTe crystal by the method of laser-induced doping and vacuum deposition of electrodes.

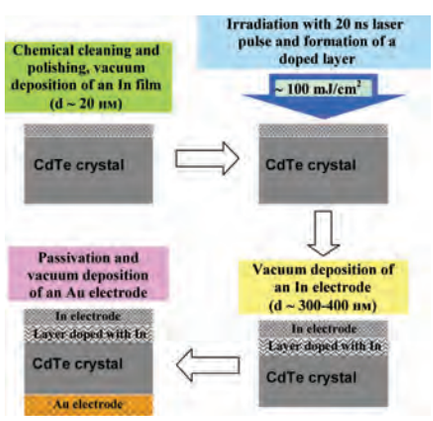
Innovative Aspects and Main Advantages

Patent UA №41216, 2009.

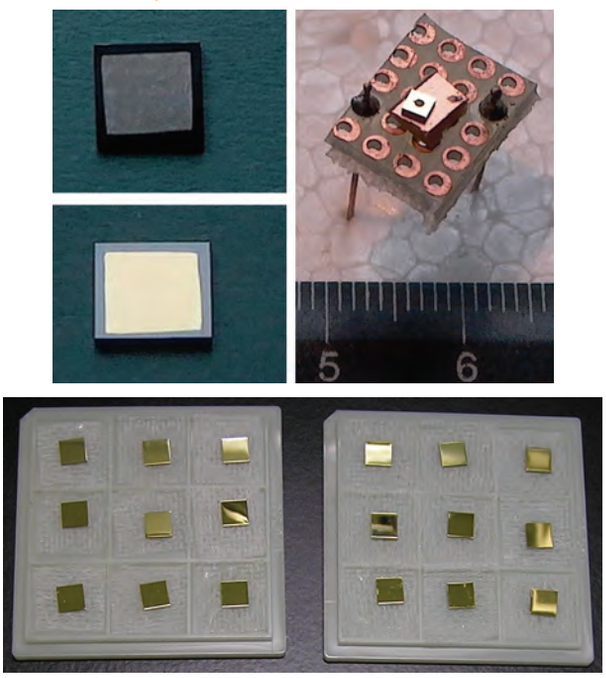
Areas of Application

The base sectors of the economy (nuclear power, industry, ecology, transport, medicine, etc.) for detection of radioisotope polluted territories, materials and subjects, in particular, for the prevention of illegal trafficking of radioactive materials, evaluation of the contamination level of mineral, soil and water, and also to control the quality of industry products, to check luggage and cargoes on transport, diagnostics in medicine, to visualize objects in space, etc.

Schematic illustgration of the procedures of laser-induced doping and formation of an In/CdTe/Au diode structure



Samples of the In/CdTe/Au detectors



Stage of Development

Pilot samples.

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Development And Manufacturing of Semiconductor Linear Sensors for Multifunction Lowdoze X-Ray Vehicles

Description

Semiconductor scanning linear sensor does not require periodic service. Due to the active elements which are in it provides the spatial resolution in the patient's plane of to 4 pairs of lines on mm. It provides to obtain a direct picture just at 0,3 mr in the plane of patient, due to transformation of x-ray photography radiation in a digital signal and high efficiency of registration. For the receipt of picture linear sensor consisting of 2560 elements and having length 550 mm is moved in horizontal direction along the area of inspection simultaneously with the fan-shaped x-ray photography bunch formed by a crack diaphragm.

Software responds to demands the international protocol OISOM-3.0, that settles if it is necessary to integrate it in any modern medical information system. The program is developed in close collaboration with roentgenologists, therefore contains not only the generally accepted protocols but also necessary forms of periodic reports. In fulfilling of the program practically unlimited possibilities of treatment of the got image by the special filters are provided for. Archiving of images is carried out on a DVD-disk by a capacity 4 700 Mb (about 3 000 pictures).

Innovative Aspects and Main Advantages

Nowadays this is one of the most reliable methods of such information saving.

Areas of Application

Product can be applied in medical establishments..

Stage of Development

The enterprise «KRAS» (Kyiv) has organized production of multifunction fluorography «ASPEKT» with semiconductor linear sensors of Special Design and Technological Bureau with Pilot Production of V.Lashkaryov Institute of Semiconductors Physics of the National Academy of Sciences of Ukraine.

The movablex-ray diagnostic cabinet with multifunctional lowdose apparatus "ASPEKT"

The semiconductor linear sensor for x-ray imaging

The functional carabilities x-ray apparatus "ASPEKT"

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Gas Sensory System «Electronic Nose» Gaz -2

Description

The gas sensory system «Electronic nose» is intended for analysis of volatile organic compounds, alcoholic and non-alcoholic beverages, perfumes and toxic pollutants in the air.

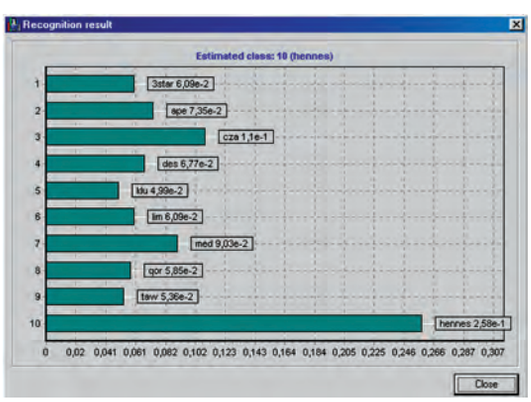
The main principles of working:- array of quartz crystal resonators (8) are covered with films of various organic sorptive materials (calixarenes, polymers) which have different sensitivity towards different volatile organic molecules analyzed. This device belongs to non-flow type, i.e. after injection of analyte vapor working cell is cut off and no flow of analyte occurs under measuring stage. Due to adsorption of analyte molecules onto sensitive surfaces of sensors frequency of quartz resonators is reducing. This frequency shift is considered as a sensor response. Obtained array of sensors responses to pulse of analyte vapor is used for "teaching" system and after that – for recognition of chemical image of analyte by means of special mathematical apparatus for statistical treatment (PCA, Neural Network, etc.). After measurements working cell and sensors are cleaned with fresh dry air.

Main technical characteristics.

- Number of channel 8;
- Working cell volume 9 cm3;
- Frequency drift 0.5 Hz / hour;
- Counter range 0–16 MHz;
- Resolution 1 Hz;
- Time single frequency counting 1s;
- Time of measuring for recognition less 5 min;
- Number of recognizing chem. images more 10;
- Range of analyte concentration 0 – 10000 ppm;
- Working temperature 20 – 30 ºC;
- Software DOS, Win9X;
- PC connecting RS-232;
- Power supply 12V/0.4A.

Areas of Application

Perfumery, food industry (estimating of freshness of meat, fish, fruits, and correspondence to etalon of coffee, vodka, brandy, beer), health services (monitoring of environment), customer service and criminalistics.



Stage of Development

Pilot samples.

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Inorganic Photoresist

Description

Proposed inorganic photoresist is based on thin films of chalcogenide glasses deposited onto substrate by thermal vacuum evaporation. It is known, that chemical properties of such layers can be changed by light or electron-beam irradiation. Using proprietary etching solutions we can obtain positive or negative resist effect: rate of irradiated resist dissolution essentially higher or lower, than non-irradiated one.

The effects of light sensitivity of chalcogenide thin films and chalcogenide-Ag structures were discovered in V.E. Lashkaryov Institute of Semiconductor Physics (ISP) NAS of Ukraine. Investigating mechanism of photostimulated transformations in such layers made it possible to elaborate thin-film photosensitive media with the number of unique characteristics.

Also worked out are some technologies of these photosensitive layers (inorganic resists) application in photolithography, for information storage, in diffractive optics (diffraction gratings, Fresnel lenses and arrays of lenses), for direct mastering of optical discs and so on. Such resists are very promising for interferential pattern registration and relief-phase holograms formation.

Main technical features of these inorganic resist:

- Resolution capability intrinsic resolution of chalcogenide layers: 1 nm;
- Spectral sensitivity: UV;
  Visible;
  IR;
  Electron;
  Ion-beam.
- Sensitivity for recording of :

1) holographic optical elements
   and contact photolithography: 5 – 50 cm2/J;
2) laser lithography: 300 cm2/J.

Areas of Application

Optical and laser lithography, holography, production of diffractive optics (diffraction gratings, Fresnel lenses and arrays of lenses, etc.), nano-optical devices (subwavelength gratings, with grating period up to 100 nm, photonic crystals), master-discs and rainbow holograms.

Stage of Development

Pilot samples. The technology is tested and available for demonstration. Prototype samples of diffraction gratings (with spatial frequency from 600 up to 6000 mm -1), masters of rainbow holograms and optical disks are made and tested.

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Instrument for Biochemical Analysis of Aqueous Solutions

Description

Instrument operation is based on simultaneous potentiometric examination of variety of ion-sensitive membranes connected to the surface of solid-state transducers and forming of multidimensional response signal toward an analyzed medium by the “electronic tongue” principle. For recognition of species in solution an array of electrochemical sensors based on ion-selective field-effect transistors with pH-sensitive layer of silicon nitride is used. Operation of multisensor consists in measurement of surface potential change at the electrolyte – sensitive membrane – transistor gate interface simultaneously for each sensor element of the array with subsequent processing of the measured data by special mathematical methods and forming of the unique chemical image of analyzed substance.

Basic technical characteristics:

Number of channels	2 (2x6);
Flow-system volume	200 µ1;
Single measurement duration	0.1 sec;
Working temperature range	0-40 °C;
Time needed for biochemical analysis	<10 min;
Automatic analyte injection at flow speed of	5..200 µ1/min;
• Serial interface	RS 232;
• Software platform	Win 9X, DOS;
• Power supply	2 V / 0.2A.

Innovative Aspects and Main Advantages

Intellectualv property: A.A.Soldatkin, E.A.Nazarenko, A.S.Pavluchenko, A.L.Kukla, V.M.Archipova, S.V.Dzyadevich, A.P.Soldatkin, A.V.El’ska. Patent of Ukraine on the useful model “Multibiosensor for determination of toxic substances concentrations in aqueous solutions”, UA № 27284 G01N33/02, submit. 08.06.2007, publ. 25.10.2007, Bull. № 17.

Areas of Application

Express analysis of aqueous solutions biochemistry and recognition of particular chemical species, including the toxic ones (heavy metal ions, chlorine and organophosphorus pesticides). The device can be used for analysis of waste and technical waters, food products (vegetables, fruit, drinks) on general toxicity and content of separate toxic matters (formaldehyde, hypochloride, cyanides, nitrates), agricultural products on content of pesticides, herbicides.

Stage of Development

Pilot samples. Exploitation of the devices in the Institutes of Biochemistry and Molecular Biology and Genetics of NAS of Ukraine for the biochemical analysis of matters.

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Pulse Microwave (MW) Bridge for a Q-Band Electron Spin-Echo (ESE) Spectrometers Equipped with Frequency Counter

Description

Spin-echo experiment is in exciting of the spin system with a high power pulse of MW energy and then measuring the emission signal that is referred to as spin echo signal - the response of the spin system on pulse excitation. Q-band Pulse MW Bridge representing a transmitter-receiver module (TRM) designed for ESE spectrometer operation. The main part of the transmitter module is the two-stage pulse amplifier which provides signal amplification in output up to 23-24 W with input power of 30-40 mW (gain factor 25-27 dB) and operates on the principle of external synchronization. The operating mode of the two-stage coherent MW generator is a serial burst of pulses. The output power of the pulse amplifier can be attenuated by a high power attenuator (0-40 dB) inserted after it.

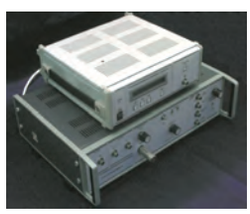
Gunn diode is used as a master oscillator. Its output power of 100 mW is split into two parts. One part of the signal is served as a driving signal for transmitter module and the second part delivers to the reference arm to balance mixer of receiver module providing the coherent detection of the ESE signal. The direct amplification scheme is selected for receiver module including balance mixer based on Shottky diode and phase-lock detector, attenuators, phase shifter, low noise amplifier (LNA) protected from pulse signals by limiter and switch. The switch is controlled by TTL pulse. LNA noise figure is no more 3dB. For the evaluation of pulse characteristics two monitor signals could be picked up through amplitude detector: one just before the pulse amplifier to observe its output pulses and a second one before the protect PIN diode to monitor the pulses reflected from the probehead. The MW bridge is optimized for standard Davies and Mims pulse ENDOR experiment and equipped with Frequency Counter to measure the operating frequency of Gunn diode.

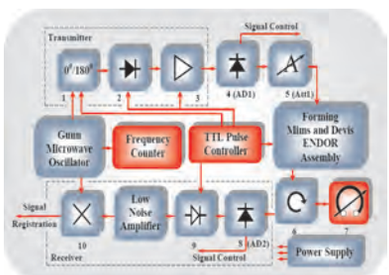
Specifications:

- Power in pulse up to 15 W;
- Burst of pulse: 1- 3;
- Duration pulse: 10-300 ns;
- Phase deviation within and between pulses: ≤ 5° for 100 ns and ≤ 15° for 300 ns;
- Frequency repetition of pulse burst: 100 Hz-1 kHz.

Innovative Aspects and Main Advantages

The advantage of the MW bridge, designed for the coherent ESE spectrometer, over available one in the world is a low cost, simple operation mode, optimal output power, minimal pulse duration. The low cost of the MW bridge, is ensured by utilization of the pulse IMPATT diodes designed for amplification of the mw pulses instead of high cost TWT amplifiers. Simple operation mode of MW bridge is ensured by selection of direct amplification scheme for receiver module. 15 W output power and minimal pulse duration ranging between 10 - 100 ns is achieved by design of two-stage pulse coherent generator. For comparison, the MW output power of MW bridge in commercially available Bruker ELEXSYS E 580 Q-band spectrometer has value of one order lower than that in suggested MW bridge (1 W).





Q-band Pulse Microwave Bridge Configuration.
1 - phase shifter, 2 - PIN modulators; 3 - two - stage pulse amplifier; 4, 8 - amplitude detectors; 5 - attenuator Att1; 6 - circulator; 7 - probehead; 9 - protective switch; 10 - balance mixer.

Areas of Application

- Relaxation Time measurements;
- Field-Swept Echo Spectroscopy;
- Spin-Echo Envelope Modulation;
- Spin-Echo ENDOR spectroscopy (optimized for Davies and Mims pulse sequences).

Stage of Development

Pilot samples.

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Silicon Pressure Sensors

Description

Two types of pressure sensors have been developed for measurement of absolute, differential and gauge pressures of liquids and gases:- (i) of the pure non aggressive; and (ii) of aggressive liquids and gases environments.

Specification for absolute differential and gauge pressure measurement of non- aggressive liquids and gases without solid contamination

- Pressure range (kPa):
  0 -1; 0 -2; 0 - 4; 0 -10; 0 - 20; 0 - 4;
  0 - 100; 0 - 200; 0 - 400; 0 - 600;
  0 -1000; 0 -1500;
- Supply voltage (V): 6;
- Full scale output (mV): 50 ± 10;
- Operating temperature (°C): - 40 ÷ + 90;
- Accuracy, less than (%): 0,1;
- Dimensions (mm): 30 x 25 x 30;

Specification for absolute, differential and gauge pressure measurement of aggressive liquids and gases.

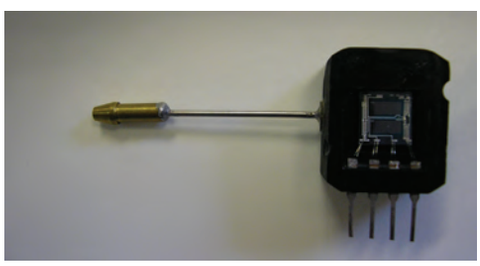
- Pressure range (kPa):
  0 -40; 0 -100; 0 -200; 0 - 400; 0 - 600;
  0 -1000; 0 -1500; 0 - 4000; 0 - 6000;
- Supply voltage (V): 6;
- Full scale output (mV): 50 ± 10;
- Operating temperature (0C): 40 ÷ + 80;
- Accuracy, less than (%): 0,2.

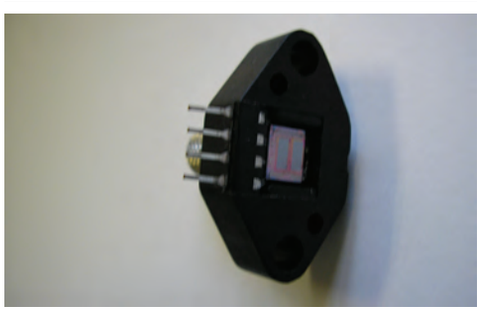
Innovative Aspects and Main Advantages

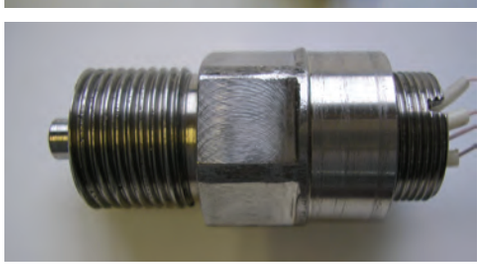
- Short time interval between consecutive measurements;
- Cost effective;
- Easy to use;

Areas of Application

- mechanical engineering;
- aircraft, in communication systems;
- control of an environment systems;
- oil refining and chemistry;
- equipment for investigation, for extraction and transportation of power resources, processing and distribution of power resources, in power mechanical engineering, in industrial power, in the measuring and control equipment.







Stage of Development

Pilot samples.

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Surface Plasmon Resonance Spectrometer Plasmon – 6

Description

The PLASMON-6 is a computer-controlled surface plasmon resonance (SPR) spectrometer that implements the Kretschmann prism arrangement. A 45 nm film of gold is deposited onto a glass slide which is brought into optical contact with the prism using refractive index matching fluid. This gold film forms the sensor surface where the surface plasmons are excited using a polarized light emitted by a semiconductor laser (l=670nm). The laser light is launched into the rotating ATR prism where it can couple with the surface mode to yield the surface plasmons. Excitation of plasmons is evidenced by a resonant dip in the reflectance of the gold film under the correct coupling conditions.

The angular dependence of this intensity (the resonance curve) reflects variation of the SPR coupling level and represents the sensor output. Its shape, especially position of the resonant dip, allows for the refractive index and the thickness of the layer coated upon the gold film to be elucidated. Surface plasmons are confined to the plane of the gold film, producing evanescent electromagnetic field. It extends over ~1 μm from the surface that makes this technique essentially surface-sensitive.

Depend on modification device has one or two optical channels. Second channel can be used as measuring or reference. Modification of the instrument destined for electrochemical applications features additional ADC input and software means for recording of voltamperograms simultaneously with the optical signal.

Innovative Aspects and Main Advantages

Surface plasmon resonance is a unique optical surface sensing technique that is responsive to refractive index changes that occur within the vicinity of a sensor surface. Thus, surface plasmon resonance can be used to monitor any physical phenomenon which alters the refractive index at the surface and has grown into a versatile technique used in variety of applications. Of special interest is its potential for biosensing techniques.

Areas of Application

- Veterinary medicine;
- Medicine;
- Biotechnology;
- Food industry;
- Ecological monitoring;
- Customs supervision.

The most used applications:

- Realization of real time biokinetic, immunosensing and biosensing techniques;
- Studies of adsorption, corrosion, electrochemical reactions;
- Thin organic and inorganic film characterization and refractive index measurements;
- Gas and liquid composition detection and chemosensor applications.

Stage of Development

Pilot samples.

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Temperature, Magnetic Field and Multifunctional Sensors for Cryogenic Application

Description

- A family of Ge-on-GaAs resistance thermometers covering the temperature range for operation from 0.03 K to 500 K.
- Si diode temperature sensor for measurement of temperature in the 1.5 K to 400 K range;
- Dual function sensors (DFSs) for simultaneous measurements of temperature (1.5 K to 400 K and 0.1 K to 400 K) and magnetic fields. The DFS consists of a Ge-on-GaAs resistance thermometer and an InSb-on-GaAs Hall-effect magnetic field sensor, which at constant current provides an output voltage proportional to magnetic field induction. These sensors are incorporated in a parallelepiped package, made from gold plated copper, sealed with epoxy. The dimensions of this package are 3.5 mm wide, 2.2 mm high and 10.1 mm long. The DFS has eight copper contact leads:- four leads for the resistance thermometer and four leads for the Hall-effect magnetic field sensor;

Nowadays three types of sensor packages are offered for resistance and diode thermometers. They are cylindrical canister package, made from gold plated copper (3 mm in diameter and 5.0 mm long), micro-package (1.2 mm in diameter and 1.0 mm long) and micro-package with plate (2 mm square by 0.15 mm thick).

Innovative Aspects and Main Advantages

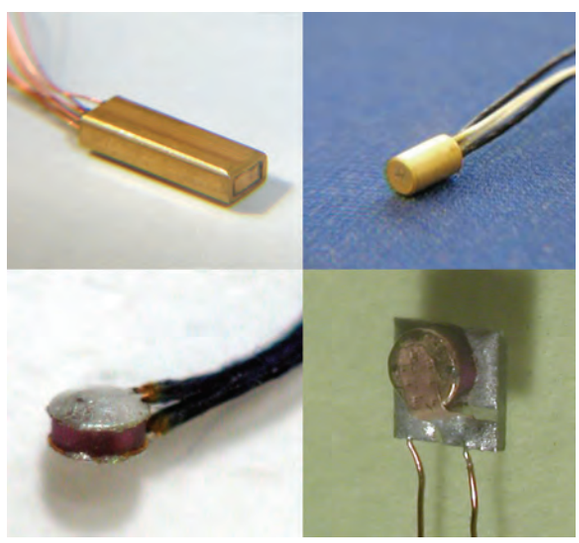
The sensors provide:

- wide temperature and magnetic field range for operation (0.03 K to 500 K and 0:30 T);
- high sensitivity;
- monotonic response over a wide temperature range;
- small temperature reading errors for operation in magnetic fields;
- small size;
- extremely fast response to temperature and magnetic field changes;
- high radiation tolerance;
- high quality and low price.

Areas of Application

Sensors for application in extreme electronics (low temperatures, strong magnetic fields and intense ionizing radiations). Static and dynamic temperature and magnetic field measurements in the 0.03 K to 500 K range and fields up to 30 T.

- Devices for diagnostics of large superconducting magnet systems such as LHC at CERN and ITER Tokamak projects;
- Devices for application in space and rocket industry;
- A number of industrial plants of cryogenic liquids;
- Research laboratories and universities;
- Cryogenic medicine.



Stage of Development

Pilot production by “MicroSensor” Company,
web-site: www.microsensor.com.ua.

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Two-Dimensional Photonic Macroporous Silicon Structures

Description

Two-dimensional macroporous silicon structures are formed by a method of photoelectrochemical etching of single crystal silicon (Fig. 2). Periodic arrangement of air cylindrical macropores has been provided with corresponding periodic accommodation of etching pits. The last have been preliminary generated as a result of photolithographic procedure and anisotropic etching. Structures with arbitrary arrangement of air cylindrical macropores have been generated without photolithographic procedure on relief and distribution of impurity to surfaces of a plate of single crystal silicon. Formation of macropores occurs in conditions of the self-organized process of photoelectrochemical etching silicon n-type conductivity in a solution of a hydrofluoric acid. According to the circuit etchings (Fig. 2) the holes being minority carriers in silicon n-type conductivity, are generated by light on the back side of a sample and transferred by an electric field to border "silicon-electrolyte " where there passes reaction. The increased intensity of an electric field on the ends of pores results that holes transport occurs mainly in these places that determine a direction of cylindrical macropores formation.

Silicon oxide nanocoatings have been formed on a structures surface by methods of anodic oxidation, dry and damp oxidation; the nanocoating of a silicon carbide has been formed by a method of low temperature gas transport reactions.

Two-dimensional macroporous silicon structures have been made with a periodic and arbitrary arrangement of macropores in diameter Dp = 1 10 microns, depth up to H = 250 microns and concentration Np = (1.5 6)×106 cm 2. Nanocoatings of silicon oxide up to 10 nanometers, 50 800 nanometers thickness have been generated on a surface of macropores; the nanocoatings of a silicon carbide had thickness up to 200 nanometers.

For formation of silicon macroporous structures on the basis of a silicon plate with any resistivity process of photoelectrochemical etching is advanced in view of influence volume recombination on holes transport for formation of in parallel located macropores. The three-component structure is developed on the basis of macroporous silicon with a nanocoating that allows realizing the maximal width of the photonic forbidden zone in the field of optical communication lengths of waves (1.55 microns) at preservation of durability of a photonic crystal.

Innovative Aspects and Main Advantages

Ukrainian patent № 83123: «Two-dimensional photonic crystal».

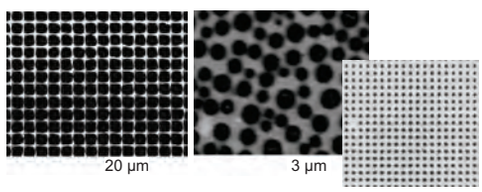

Fig.1 Two-dimensional photonic macroporous silicon structures with periodic (a, b) and arbitrary (c) arrangement of cylindrical macropores respectively in 6, 2, 3 microns diameter and up to 250 microns depth.

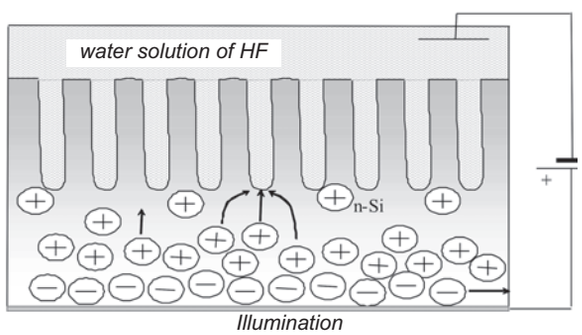

Fig.2. The scheme of macroporous silicon structures etching at presence of holes which generated by illumination of the back side of a silicon plate.

Areas of Application

Two-dimensional photonic macroporous silicon structures (Fig. 1) - a perspective material for development of radiating, photo- and thermodetecting devices. It is connected to an opportunity of manufacturing of structures with necessary geometry due to crystal anisotropy which allows to use methods of plasmochemical etching, low temperature gas transport reactions and inexpensive process of photoelectrochemical etching. Devices based on two-dimensional photonic macroporous silicon structures can be used for needs of ecological environment monitoring, control in medicine and industry.

Stage of Development

Pilot samples.

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Wideband and Selective UV Sensors

Description

Firs time developed new generation semiconductor wideband and selective UV sensors based on wideband gap compounds A2B6 for usage as initial UV radiation converters in industrial and domestic radiometers-dosimeters. Without special filters sensor sensitivity concentrated only in UV-A, UV-A+B and UV-A+B+C spectral ranges and operational parameters correspond modern world achievements.

Innovative Aspects and Main Advantages

- insensitivity to visible and infrared ligth (unlike conventional semiconductor photosensors);
- absence of special optical filters for UV sensitivity correction;
- large active areas, high parameters and reasonable cost.

Areas of Application

Environment monitoring (to control „ozone holes" and pollution analysis), implementation of obstacles-resistant UV-location (observing objects on the blue sky background), industry (fire security devices, automatizations systems of steam and water heating boilers on TPP), medicine, biotechnology, domestic techniques, detection, power measurement and dosimetry of UV radiation and its separate biologically active regions. Medical, biological and ecological instrument engineering, spectrophotometry, calorimetry, flame detection, etc.

Stage of Development

Pilot samples.

Comparison of characteristics of UV sensors and photodiodes developed by foreign companies:

№	Sensor type	Semicondactor	Photosen-sitive area, mm2	Spectral range, nm	Sensitivity maximum at, nm	Photo response at maximum, A/W
1	Developed sensor ФПД-1	CdS	25	200 ÷ 520	480	0.20
2	Photodiode G 1963 (Hamamatsu, Japan)	GaP	21	200 ÷ 550	440	0.12
3	Developed sensor ФПД-1А	CdS + filter	25	310 ÷ 395	370	0.10
4	Photodiode JEC 1 A (Electro-Optic.Com.Inc, USA)	SiC+ filter	1	335 ÷ 395	340	0.04
5	Developed sensor ФПД-1В	CdS + filter	25	270 ÷ 320	293	0.035
6	Photodiode GUVB-S10ED (Genikom Co., Ltd., Korea)	AlGaN	0,076	240 ÷ 320	300	0.01
7	Developed sensor ФПД-1С	CdS + filter	25	245÷280	266	0.025
8	Photodiode JEC 1 (Electro-Optic.Com.Inc, USA)	SiC+ filter	1	220÷275	265	0.10

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Analyzer of Water Alcohol Solutions IM-1

Description

A type and quality of water-alcohol solutions is explored by the method of dielectric spectroscopy through measuring of frequency characteristics of components of complex conductivity of solution. The device works on principle of impedance spectrometer and provides measuring of total impedance and phase change of the analyzed solution in the frequency range of 5 Hz to 150 kHz through digital filtration (discrete Fourier transformation). Obtained values of active and reactive components of solution resistance.

Basic technical characteristics:

- range of work frequencies – 0.5 Hz ÷ 150 кHz with step of 1 Hz;
- maximally possible rejection of fundamental frequency – ±1 %;
- maximally permissible error of determination of active and reactive constituents of impedance - ±20 % for minimum frequency, ±10 % for maximum frequency;
- connecting of sample block through coaxial cables;
- connection with PC by interface RS232 or USB;
- voltage supply – constant ±12 V or ±9 V;
- maximal consumable current – 0.5 A;
- size – 300x300x70 mm;
- weight – no more 0.5 kg.

Innovative Aspects and Main Advantages

Advantages of device compared to existent analogues are the original method and algorithm of measuring and analysis, portability and small price.

Intellectual property: Vertsymacha Y.I., Kukla A.L., Pavluchenko A.S., Savchenko G.P. Patent of Ukraine on the useful model “Method of determination of types of vodka and cognac drinks”, UA № 19620 G01N 33/14, submit. 14.07.2006, publ. 15.12.2006, Bull. №12.

Areas of Application

The device is intended for express diagnostics of type and admixtures in water-alcohol drinks with large content of alcohol and it can be used in manufactories on the vodka-cognac drinks production, in sanitary control services, on a custom.

Stage of Development

Pilot samples.

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Lviv Research Institute of Epidemiology and Hygiene

Technical Area Keywords: biotechnologies, agricultural sciences and medicine, identification, prevention and control of infectious (including bacterial, viral infections) diseases.

General Information

The Research Institute of Epidemiology and Hygiene (RIEH) in Lviv is one of the leading Ukrainian reference and methodical-scientifically centers for identification, prevention and control of infectious (including bacterial and viral infections) diseases. The personnel of RIEH is involved in surveillance, reporting and control of human infectious diseases performing comprehensive analyses and providing recommendations to government bodies, such as the State Sanitary and Epidemiological Inspection of the Ministry of Health of Ukraine.

Lastly, RIEH is engaged in experimental drug and diagnostic test-systems development utilizing unique collections of viral and rickettsial strains. These collections are considered a national asset by the Ukrainian government.

Institute's Focus

A. Solid core competencies in:

- epidemiological monitoring and disease prevention;
- epidemiological diagnostics, typing, and referencing;
- sanitary-ecological assessment of soil, air and water;
- sanitary micro-biology and ecology;
- new drug and diagnostic test-systems development and approbation;

B. Unique collections of viral and rickettsial strains support.

Valuable Technology Offerings

The laboratory of **rickettsial infections** studies preventive measures against rickettsial diseases, in particular, epidemic typhus, Volynsk-, Marseille- and Q-fevers, and ixodic strain of fevers. The lab conducts epidemiological monitoring for rickettsial taints and renders practical help to public health agencies in diagnostics, treatment and prevention of these diseases. The laboratory of **transmissible viral infections** specializes in monitoring of tick encephalitis and ixodic tick borreliosis including emerging instances of Lime disease transmitted by *ixodes ricinus* ticks.

The **department of epidemiology and clinic tuberculosis and non-specific lung diseases** examines the quality, availability, and effectiveness of anti-TB medications, as well as the emergence of resistance in mycobacterium tuberculosis. The scientists of the department are involved in clinical and experimental studies of tubercular process, mutation of mycobacteria, and development of antibacterial preparations. Also, the department explores innovative TB treatment methods, such as use of ozone and laser therapy for treatment of patients with destructive pulmonary tuberculosis.

The laboratory of **diphtheria** performs diphtheria and tetanus monitoring and participates in the development of a vaccination calendar, a basis for an efficient immune prophylaxis and also develops the new computer system of monitoring of population immunity against diphtheria and tetanus of regional and national level.

The laboratories of **sanitary microbiology and ecological problems of human** focuses on medicoecological evaluation of iodine deficiency diseases caused, among other things, by such environmental factors as the presence of heavy metals and sulfur compounds. The laboratory of sanitary toxicology conducts sanitary-hygienic quantitative assessments of chemical agents in water and investigates alternative methods of toxicological analysis.

Scientific Cooperation and Technology Transfer

The Institute has cooperative relationships with several institutions, both in Ukraine (e.g., Kiev Institute of Epidemiology and Infectious Diseases) and abroad (e.g., National Institute of Hygiene, Poland), but its international ties are far from being extensive. In recent years, however, RIEH has increased its international exposure participating in science and technology exhibitions in Poland and India.

Domestically, the Institute provides extensive R&D support and reference services to diagnostic laboratories of the State Sanitary and Epidemiological Service, which adopt and implement methods and techniques of diagnostics of infectious diseases, epidemiological typecasting and determination of antibody prevalence against different infectious diseases in population developed at RIEH.

The Institute has spun off its production facilities, which became the material basis of Lvivdialik (http://www.lvdialik.lviv.ua), a pharmaceutical production enterprise. RIEH continues to collaborate with the company on the development of new diagnostic drugs.

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Mikrotytrator for Serological Tests and Scientific Studies Connected to Direct and Indirect Imunoflyuorestsent the Method of Hanging Drops

Description

The objective is to create “Mikrotytrator” which provides mikrotytration in serial dilution on a flat work surface, such as substantive glass for microscopy needed for studying the material using the methods of direct and indirect imunoflyuorestsently and hanging drop method, and so on.

The technical nature provides its work, so “Mikrotytrator” works as follows: by feeder 1 with the nipple 2 through the outlet 3 it is filled with solvent in volume equal to the volume of fluid capillary vessels 4. Thus, the studied capillary vessel 4 filled with fluid is overflown and is maintained by mechanism 5 in the start point opposite the nozzle 3 pipe 2. Due to the overflow of capillary vessels the investigated liquid mixes with the solvent so the first fluid dilution is obtained. It titrates with the Score titer of 1:2. Thus one half of the received mixture fills the cavity of the capillary vessels and is equal to its volume, and the second half of the mixture outside covers (envelops) capillary vessels and is held by the surface tension of liquid. With the help of mechanism 5 overflown capillary vessel approaches a flat work surface 7 at a sufficient distance to ensure the transfer to work surface 7 the part of liquid that wets the certain area of the work surface of substantial glass 8 and remains on it as a drop, detached from the capillary vessels . This gap occurs due to the separation of capillary vessels from the work surface at the backward move of the capillary vessels by mechanism 5 in the start point, that is installing of the capillary vessels 4 in front of the nozzle 3 pipe 2 feeder 1. Then, using the mechanism 10 the objective table 9 with the slide 8 is moved to a horizontal surface at a given distance - and thus provides a free work surface for the application of a new dilution . Subsequent liquid dilutions with the increasing titer score according to a geometric progression of 1:4, 1:8, 1:16 etc. are applied by successive repetition of the cycle of these operations to the new free sites of a work surface and thus the mikrotytration is obtained.

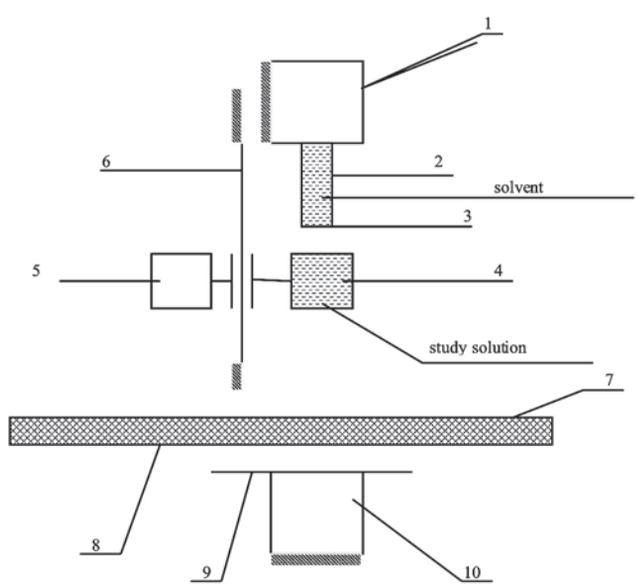
Innovative Aspects and Main Advantages

According to the description of the technical merits device and the beforementioned research, we proved the possibility of mikrotytration on a flat surface, which gives grounds to consider this mikrotytrator as a useful model.

This utility models differs from existing analogue in a way that it allows to obtain mikrotytration on a flat work surface, such as substantive glass for microscopy.

Areas of Application

- Pharmacology;
- Immunology;
- Medicine;
- Microbiology;
- Veterinary medicine;
- Biology;
- Protection of animals;
- Virology;
- Chemical.



Stage of Development

- Tested, available for demonstration – field tested;
- Patented.

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Technology and Device for Photochemistry Modification of Membran Processes for Patients With Lung Tuberculosis and Increase of Efficiency of its Chemotherapy

Description

Therapeutic efficiency of antimicobacterial treatment of tuberculosis remains low as a result of impossibility of overcoming the biological barriers of organism and resistant of causative agent of tuberculosis to drugs. Combination of tuberculosis with concomitant pathology (in particular by pancreatic diabetes) complicates a situation, so as assists development of oxidative stress, which strengthens oxidizing modification of albumens, violation of the structurally functional state of cells, exhausts antioxydant potential of organism which negatively influences on efficiency of treatment. Eferentns methods can solve most these problems, but not used in a full potential as a result of absence of the detailed developments from the biologically tolerant modes of application and checking systems after differentiated individualized of their application. We are develop the new methods of complex application of antimicobacterial therapy from ozone-laser therapy with the use of modulation block with the smooth adjusting of frequency of modulations to 2 mGz.

Innovative Aspects and Main Advantages

In contrast to the methods a new technology of treatment is offered which is effective against multiresistant patogen, allows to decrease the medicinal loading on the organism of patient, to promote efficiency of chemiotherapy, accelerate the processes of reparation and proceeding in membrane-related processes. It provides reduction of duration of the stationary stage of treatment on the average on 12% and allows economy of 1,2 mln UAH on 100 of the first diagnosed patients with a tuberculosis, while application of medicinal patogenetic media does not give such rapid and prolonged effect.

Areas of Application

- Medicine, phtysiatry.

Stage of Development

- Patented;
- Test prototype.

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National Science Center Kharkov Institute of Physics and Technology

Technical Area Keywords: solid-state physics and materials science, plasma physics, high-energy physics and nuclear physics, plasma electronics and new methods of acceleration, theoretical physics.

General Information

Kharkov Institute of Physics and Technology (the KIPT, earlier referred to as Ukrainian Institute of Physics and Technology), being one of oldest and largest centers of physical science in Ukraine. It was created in 1928.

Five research institutes are included in the NSC KIPT:

- Institute of solid-state physics, materials science and technologies;
- Institute of plasma physics;
- Institute of high-energy physics and nuclear physics;
- Institute of plasma electronics and new methods of acceleration;
- Akhiezer Institute for theoretical physics.

Nearly 320 Candidates and 80 Doctors of Sciences, 14 Members of National Academy of Sciences of Ukraine work here. From 1981 more than 80 monographs have been written by the scientists of the NSC KIPT. From 1991 the scientists of the Center have got 9 state prizes in science and technique.

Institute's Focus

Institute's areas of core competencies include the following:

- Scientific support of Atomic Energetics of Ukraine and creation of safe nuclear sources of new generation;
- Elaboration of the stellarator concept of a fusion reactor and high power quasistationary plasma accelerators;
- Investigations of mechanisms of nuclear reactors, structure of nucleii, charged particles-matter interactions. Linear electron accelerators;
- Study of interaction of intense flows of charged particles, electromagnetic and ionizing radiation with substance. High current electron and ion accelerators;

Renewable sources of energy and sustainable technologies.

Among other important **areas of technologies** are:

- Vacuum metallurgy;
- Depositing coatings technologies
- Plasma and plasmochemical technologies
- Radiation and ion-beam technologies;
- Thermogradient technologies for carbon-carbon composite materials production.

Valuable Technology Offerings

- Atomic Industry;
- Industry of pure materials;
- Strengthening of materials for engineering industry;
- Materials for medicine;

- Energy and ecology;
- Agriculture;
- Water purification;
- Sterilization of instruments and materials.

Scientific Cooperation and Technology Transfer

Significant part of research in the NSC KIPT is executed within the framework of international agreements, on contracts with more than 75 organizations and companies of Russia, USA, France, Germany, Italy, Austria, Spain, Holland, Sweden, Great Britain, Brazil, Poland, Korea, China, Japan. The Center supports and develops relations with many international organizations and centers of science (IAEA, CERN, JLAB (USA), Joint Institute of Nuclear Research in Dubna).

The NSC KIPT is an initiator of creation of several R&D companies which produce science intensive products:

- Scientific production enterprise “Rubin” of National Academy of Sciences of Ukraine.

Products: wires and foils from precious metals;

Ag-Ni-Mg alloys;

High pure Ag;

Ni crucibles;

Solders from precious metals.

- Scientific production center “Beryllium” of National Academy of Sciences of Ukraine

Products: vacuum tight beryllium foils;

Beryllium windows for X-rays equipment and neutron sources.

- Pilot production of the NSC KIPT

Products: vacuum electric furnaces – “OTTOM”;

vacuum-arc deposition equipment.

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Billets for Gas Turbine Engine (GTE) Blades

Description

Billets are produced from single crystal alloys on Ni-W basis and single crystals of heat-resistant Ni super-alloys. The billet is formed due to the process of high-gradient direct crystallization. That makes it possible to obtain homogeneous high-dispersed billet's microstructure which is oriented along the heat-sink direction.

Perfect single crystal microstructure of Ni super-alloys can be plastically deformed at high temperatures and a nanostructure is formed under certain conditions.

The technology allows to manufacture billets for the whole existing range of operating GTE blades.

Properties of billets material:

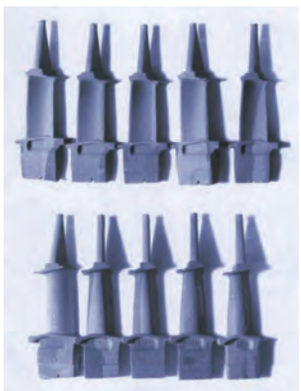
Parameter of dendrite cell λ:

- cast state – 120…180 mcm;
- after extrusion – 60…90 mcm.

morphology of the strengthening γ'-phase:

- cast state – cuboidal particles of 0.3…0.6 mcm in size;
- after plastic deformation – cuboidal or globular particles of 0.05…0.2 mcm in size;
- durability σ_{UTS}^{300K}~150kg/mm^2 UTS300K~ 150kg/mm2;

elongated heat resistance is increased 1.5…2 times.



Innovative Aspects and Main Advantages

- Increase in operating resource;
- Improvement of durability properties;
- Improvement of elongated heat resistance;
- Better stability in connection of blades with protective coating.

Areas of Application

- Manufacture of some parts for GTE operating at high temperatures, under mechanical loadings and corrosion impact;
- Aerospace technology;
- Nuclear power;
- Shipbuilding;
- Power engineering.

Stage of Development

Promotion to the market (commercialization).

- statements of industrial testing.

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Carbon/Carbon for Orthopedic and Other Medical Application

Description

This application of carbon materials is not new; the works in this sphere had been commenced as early as in the period of USSR existence. Main requirements on the carbon-carbon materials used in medicine could be, first of all, their mechanic strength and purity. In terms of mechanical properties, best materials to be used in medicine are carbon-carbon materials with reinforcement structure 'wrap from the very beginning'. These materials were developed first of all, exactly for this purpose. It should also be noted, that in production of 'medicine' carbon-carbon materials we used only viscose-based fabrics. Natural origin of the material completely eliminated problems of their compatibility with human organism. Another important factor is the fact that application of thermal gradient technologies in production of the materials enables obtaining the purest pyrocarbon deposited from the gas phase. This has a significant impact both on the material purity (amount of impurities in the material are within basis points) and its mechanical properties. The conducted researches have demonstrated that strength of the obtained carbon-carbon materials are at the level of uninjured human bone. A number of necessary researches have been made, including tests on laboratory animals, on possibility to use the developed carbon-carbon materials for endoprosthesises. The obtained results demonstrate that in terms of their properties, the developed materials are at least not than currently used materials.

Innovative Aspects and Main Advantages

The conducted researches have demonstrated a number of disadvantages of carbon-carbon material.

- Non-cement fixation provides a significant reduction in surgery traumatism and eliminates thermal injury of tissue inevitable during cement polymerization;
- Material's processability during surgical operations;
- No need for use of protective coatings;
- Easy and simple sterilization;
- Fixation of endoprothesis directly 'into place' enhances quality of connection;
- In-growth of endoprothesis into bone tissue and tissue growing over the endoprothesis tissue provides significant improvement of fixation quality;
- In-growth of carbon-carbon endoprothesises results in significant reduction of postsurgery rehabilitation period;
- Chemical and radiation stability of carboncarbon, absence of induced activity provides for chemother apy and radio-therapy without limits;
- Absence of allergic response to carboncarbon materials. Even ample amount of carbon dust that penetrated into the wound during surgery does not provoke any inflammation;
- Absence of patient's unpleasant sensations (cold sensation, etc.);
- Absence of everyday problems, i.e. passing through metal detectors in airports, etc.

Areas of Application

Orthopedics, gerontological traumatology, bone oncology, traumatology.

Fig.1

Stage of Development

Licensing and certification.

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Cd, Zn and Te Isotope Deep Purification Unit

Description

The unit allows to produce radio-pure Cd, Zn and Te isotopes, containing the impurities of Ni, Cu < 0.2 ppm, Fe, Mg, Mn, Cr, V, Co < 1 ppm, Th, U, Ra, K, Rb, In, La, Lu, Sm < 0,1 ppm, with the minimum irrecoverable losses due to the high cost of those materials.

Operation of the Cd, Zn and Te isotope deep purification unit is based on the principle of material vacuum distillation refining. The unit provides for stage-by-stage purification of isotopes, involving the filtration and distillation process, the potential use of a getter filter, which ensures a deeper purification of cadmium, zinc and tellurium isotopes to remove restricted impurities.

Unit specifications

- Mass of original material charge: 250 g;
- Unit capacity : 50…80 g/hour;
- End product high yield: > 96 % of original charge;
- Dimensions of unit, including heater and shields:
  eight – 400 mm;
  diameter –140 mm;
  eight – 3 kg;
- Crucible and condenser material : graphite of grade – graphite of grade МПГ-7; heater and shields material: graphite of grade МГ-1 ОСЧ 7-3, ТУ 48-20-9082;
- Operating temperature : 350…650 ºС;
- Vacuum under cold and hot conditions: 1.33;
- 10-3 Pa;
- The unit is based on standard furnace units of type СЗВН-0,55.4,5/14-И1.

Innovative Aspects and Main Advantages

- high effectiveness of purification;
- higher yield of end product (> 96 % of original charge);
- minimum irrecoverable losses of material (< 1 %).

Areas of Application

- Production of radio-pure Cd, Zn and Te isotopes as regards restricted impurities for a variety of applications;
- Development of scintillation low-background detectors (116CdWO4, 106CdWO4), 128Te, 130Te;
- Photonuclear processes for production of medical-purpose radioactive nuclides (64Zn, 67Zn).

Stage of Development

Unit prototype.

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Cd, Zn, Te, Ga, In and Pb Deep Purification Unit

Description

Using the source Cd, Zn, Te, Ga, In and Pb technically-pure (99.9…99.99 %) elements, the high-capacity unit allows to produce high-yield end products with their purity being higher than 99.9999 %.

Operation of the Cd, Zn, Te, Ga, In and Pb deep purification unit is based on the principle of material vacuum distillation refining. The unit provides for simultaneous removal of low-volatility impurities by the method of base metal evaporation from the crucible and removal of high-volatility impurities by the method of holding condensate under high-temperature conditions in the process of purification, which ensures a deeper purification of gallium, indium and lead to remove metal impurities and a higher efficiency of the refining process. Also the unit provides for stage-by-stage removal of high-volatility impurities, involving the filtration process, and removal of low-volatility impurities, involving the use of a getter filter, which ensures a deeper purification of cadmium, zinc and tellurium to remove metal impurities, including interstitial impurities (N, O, C) and reduce their content down to 2…5•10-5 mass %.

Unit specifications

- Mass of original material charge: 2.3-2.5 kg;
- Product yield percent: 90 % of original charge;
- Unit capacity: 300…400 g/hour;
- Heater power: 1.0 kW;
- Total power: up to 3 kW.
- Dimensions of unit, including heater and shields:
  height -450 mm
  diameter -240 mm
  weight -5 kg;
- Crucible and condenser material: graphite of grade МПГ-7; heater and shields material: graphite of grade МГ-1 ОСЧ 7-3, ТУ 48-20-9082;
- Operating temperature: 350…1350 ºС;
- Crucible and condenser temperature control: thermocouples ВР-5/20;
- Vacuum under cold and hot conditions: 1.33 •10-3 Pa;
- Use of standard furnace units of type СЗВН-0,55.4,5/14-И1.

Innovative Aspects and Main Advantages

- High effectiveness of purification (from 99.9…99.99 % to > 99.9999 %);
- higher yield of end product (90 % of original charge);
- high capacity (300…400 g/hour).

Areas of Application

Production of Cd, Zn, Te, Ga, In and Pb having purity higher than 99.9999 % for synthesis of semiconducting compounds and generation of heterostructures to be applied in the fields of:

- microelectronics : ionizing radiation sensors (CdTe, CdZnTe); integrated circuits (GaAs);
- optoelectronics : scintillation sensors (Zn,Cd)WO4, (Zn,Cd)MoO4, PbWO4, PbMoO4 infrared-range photodetectors (CdHgTe);
- microwave electronics materials (GaAs, GaN, InP, InAs, InSb, GaAlAs/GaAs, AlGaN/GaN, InGaAs/InP, etc.).

Stage of Development

- Pilot production plant;
- draft design documentation;
- process instructions for production of Cd, Zn and Te, having purity of 99.9999 %, by vacuum distillation method.

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Diamond-Like Coatings Synthesis from Plasma of the Non-Self Maintained Gaseous Discharge

Description

The non-self maintained gaseous discharge where the vacuum-arc plasma gun is used as a source of supplementary charges is proposed as a new technology for the diamond-like (a-C:H) films synthesis. The technology may be realized on a base of production-run equipment for a vacuum arc deposition after its slight modernization (fig. 1).

Innovative Aspects and Main Advantages

Hitherto this kind of discharge was used for the thermo-chem-ical treatment only. The coatings synthesis from plasma of this discharge has been realized for the first time.

In contrast to the methods of diamond-like coatings obtaining by condensation of vacuum-arc plasma or RF-gaseous discharge plasma, the proposed method allows do without the macroparticle filter and RF-generator. Due to the absence of dense fluxes of electrons and high electric potentials in non-self maintained gaseous discharge the coating synthesis run at much more equilibrium conditions. As a result, the coatings have a small internal stresses and may be deposited with a thickness of several microns at frail, non-plastic materials. The decreasing in energetic load on the product surface allows do without its forced cooling. The films been obtained by a proposed method is much more transparent than those obtained by another methods (fig.2).

Areas of Application

The method may find a use for optics, electronics, machinery, medicine.

Stage of Development

Technique developed and tested.

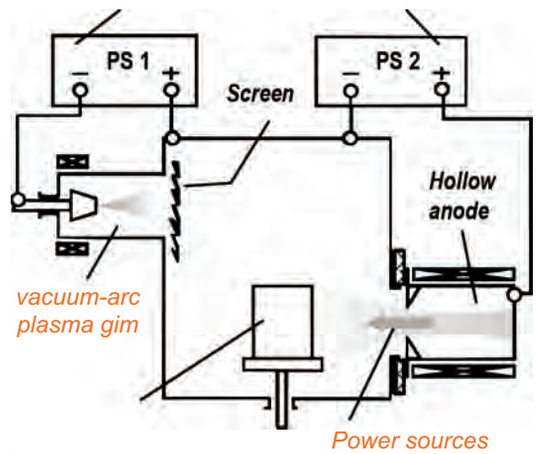

Fig.1. Experimental setup

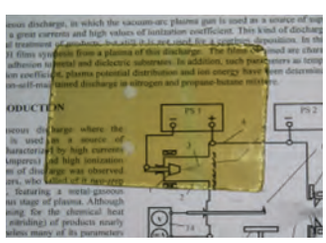

Fig.2. Transparency of the A-C:H film with a thickness of 2.5 microns, deposited onto glass substrate. Two blank spots arose after removing of aquadag masks brushed for the measuring of film thickness.

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Energy-Efficient Technologies for Drying of Dispersed Materials

Description

Energy-efficient technologies for drying of dispersed materials.

Service:

- manufacturing equipment to order;
- development of optimal operation modes;
- assembly, adjustment, training, instructions;
- technical support, warranty and post-warranty service.

Innovative Aspects and Main Advantages

- Power efficiency: reduction of power consumption 2-2.5 times in comparison with traditional technologies;
- No fuel required.

Drying of plant products:

- Environmentally friendly technology: no pollution with burnt fuel;
- Maximum heating temperature: 50-60˚C;
- Preservation of valuable components;
- Possibility of purification from light impurities and insects;
- Bactericidal treatment.

Areas of Application

- agriculture, food industry (cereals, corn, sunflower, etc.);
- pharmaceuticals industry(drug plants);
- chemical industry (drying of brown coal, etc.);
- wood industry (sawdust drying);
- energy sector (zirconium/chalk drying, etc.).

Stage of Development

Pilot sample.

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Facility and Technology of Biogas Utilization

Description

Biogas (methane (CH4) and carbon dioxide (CO2) gaseous mixture) is fuel gaseous mixture with CH4 >50%. The use of biogas is an important task as it would solve ecological (limitation of biogas atmospheric emission) and economical (additional energy source) problems.

We have developed a technology and a facility for biogas utilization..

The facility consists of 6 separation modules working alternately and ensuring continuity of the technological process. Depending on input biogas composition and requirements to products, facility can contain a set of all modules or one of them.

Facility allows to divide biogas into the components:

- liquefied almost pure methane in standard vessels with volume 40-50 litters under the pressure 20 MPa and with purity 96%;
- liquid carbon dioxide in similar vessels under the pressure 5~6 MPa;
- solide carbones dioxyde (dry ice). Technical parameters of the facility;
- overall dimensions, mm – 1700x1050x650;
- productivity in biogas terms – 50 nm3/hour;
- admixtures of the other components in the separated methane and carbon dioxide - ~4%;
- facility weight - ~150 kg.

Pressure swing method was used for this work. Method uses different concentrations of biogas components in the gaseous phase at the upper and lower pressure levels in absorber, that is caused by different absorbability of the carbon dioxide and methane. When gaseous phase is sampled from the absorber at the upper pressure level, we obtain mixture enriched with less sorbent component – methane, when it is done at the low pressure level – more sorbent carbon dioxide.

Facility block scheme, its general view and motor-generator are shown at the pictures.

Innovative Aspects and Main Advantages

The main innovative aspect is the use of the Pressure Swing Method (PSM). The cycle is short and the process requires room temperature. These two factors combined with motor-generator working at the produced methane en sure autonomous facility operation.

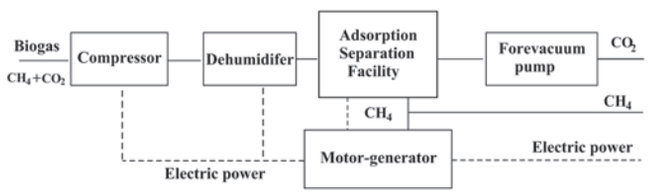

Fig. 1. Block diagram of the autonomous complex facility for bio-gas utilization

Fig. 2.Model of an exper imental industrial facility for biogas separation. General view

Fig.3. Motor-generator

Areas of Application

The facility can be used in different fields in which organic wastes are concerned:

- Agriculture;
- Factories of the food industry;
- Plants of biological purification foul water;
- Solid domestic waste dumps.

Stage of Development

Development phase – laboratory tested, available for demonstration

Patented: Patents of Ukraine: U 38746 A, bulletin #4, 2001; U 44512 A, bulletin #2, 2002; 8870, bulletin #8, 15.08.2005

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High Productive Filtered Direct Current Cathodic Vacuum-Arc Plasma Source

Description

Cathodic vacuum arc plasma source with a magnetic filter, which turns the plasma stream 90o, is described. T-shaped plasma duct with a system of intercepting screens and fins provides a significally higher degree of absorption of macroparticles when compared to conventional "toroidal" filters (more than an order of magnitude). A small ratio of curvature radius of the plasma duct to its inner radius, a large diameter of the plasma guiding channel (200 mm), and an optimal geometry of transporting magnetic fields ensure a high throughput of the filter - up to 55 %. Filtered plasma source proposed may be used in new vacuum-arc industrial setups for the ion plasma processing of materials including deposition of high quality coatings.

Innovative Aspects and Main Advantages

Efficiency of the main versions of known systems and our results

Type of filters	Knee shaped (Falabela)	Toroidal (45˚) (Martin)	Rectangular (Gorokhovsky)	Dome type (Sander)	Wide aperture (our results)
Efficiency Ii/Id×100,%	3,0	2,5	2,5	2,5	about 4

The ratio of the total ion flow at the channel exit to the discharge current (Ii/Id) - the system efficiency coefficient - is commonly assumed to be the criterion of plasma passage efficiency through the system as a whole (generator + filter).

Areas of Application

Filtered vacuum-arc plasma source described can be used for the following coating deposition: DLC, metals (Ti, Cr, Nb, Mo, Cu, Al, etc.), alloys, nitrides, oxides, carbides, composites, multilayers.

Such coatings can be used as:

- wear-resistant coatings at surfaces of fine mechanic elements (hydrodynamic and electrostatic supports of gyroscopes and centrifuges, pistons of fuel pumps, etc.);
- decorative coatings;
- hard protective coatings on magnetic and optic devices;
- transparent conducting oxide films in solar sells;
- low-e films on architectonic glass;
- protective biologically indifferent coatings;
- “back-end” metal layers in ultra large scale integrated circuits.

Above mentioned filtered plasma source may be used:

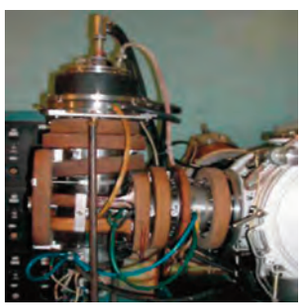
- in new vacuum-arc industrial equipment for the ion plasma processing of materials including deposition of high quality micro- and nanostructural coatings;
- when upgrading of existent vacuum-arc equipment for widening their technological potentiality;
- for high quality coatings deposition processes in machine building, fine mechanics, microelectronics, optics, automobile industries, etc.

Stage of Development

Prototype available for testing, patented in USA,
US Patent #7381311.

T-shaped filtered vacuum-arc plasma source for diamond-like coating (DLC) deposition.

Coating deposition rate is 6 μm/h at the diameter 20 cm.



Elements of the gas dynamic bearing with DLC coatings (convex hemispheres) and with TiN coatings (concave hemispheres).

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High-Field Nanotechnology for Processing a Metal Surface

Description

Various modifications of method of evaporation in high electric fields are the most promising methods of forming surface of different objects of nanometer-scale. However, the main obstacle to the use of this method is the necessity of creation of super high electric fields on a surface of the object subjected to processing. In such fields there are serious technological problems connected with the destruction of objects under the action of mechanical stress generated by the electric field. In this connection, we propose to use phenomenon of high-field evaporation of metals in dielectric liquids at low temperatures. This phenomenon was revealed and studied by our team together with University of Surrey School of Electronic (Surrey, UK) and Hahn-Meitner-Institute (Berlin, Germany). This phenomenon and process of field evaporation in active gases could be used for controlled forming of metal objects with the sizes in a nanometer range. The magnitude of electric fields below the level of field evaporation in high vacuum is required for the realization of high-field evaporation of metals in dielectric liquids. This opens up technological prospects for practical use of this phenomenon.

Innovative Aspects and Main Advantages

- formation of surface with a zero-level roughness (atomical-ly smooth metal surface);
- high degree of localization of field emission;
- atomic sharpness of STM probes;
- lowering traumatic effects of microsurgical instruments Areas of Application;
- field emitters;
- probes for scanning tunneling microscopy and nanotech-nology;
- microsurgical instruments with qualitative changes of a roughness level.

Stage of Development

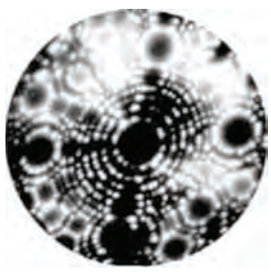
Patents received:

- Method of fabrication of tip objects, Patent of Ukraine, UA;

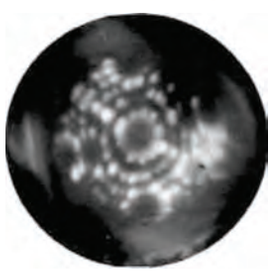
6607 U, 16.05.2005, Velikodnaya O.A., Ksenofontov V.A., Mikhailovskij I.M., Sadanov E.V.

- Method of fabrication of tip objects, Patent of Ukraine, UA;

8336 U, 15.07.2005, Velikodnaya O.A., Ksenofontov V.A., Mikhailovskij I.M., Sadanov E.V.



Pic. 1. Field ion microscopic images of STM probe before high-field sharpening



Pic. 2. Field ion microscopic images of STM probe after high-field sharpering

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Nanostructured Monolithic Metals

Description

Residual porosity and unchecked pollution of powders during their condensation causes need of development of new methods of formation the nanostructured state in monolithic metals and alloys.The most effective directions in this field are the equal-channel angular extrusion (ECAE) and hydroextrusion. As a rule, hydroextrusion is carrying out at room temperature, while ECAE is realizing at elevated temperatures. However, at room and elevated temperatures the processes of dynamical relaxation take place. That sets a principal limit to the defect density attained during deformation and, therefore, degree of the structure dispersion. It explains the search of possibility of the deformation of materials at deep cooling. At different time plastic deformation by tension, rolling, and drawing were realized at cryogenic temperatures. Under these conditions the processes of dynamical relaxation are depressed. However, due to specific character of geometry of acting forces hardening is accompanied by a drastic reduction of plasticity and appearance of a plenty of microcracks.

The task of obtaining of high-strength nanostructured materials but without tendency to brittle failure may be solved by combining effect of all-round compression precluded to appearance of tensile stresses and factor of deep cooling. Depression of the dynamical relaxation was ensured by the pressing of metal through a matrix at low temperature with use as the pressure the plastic transmission medium. Treatment based on this technology insures obtaining of dispersion of material structure at the level of 100 nm and less, which improves their exploitation characteristics. Its level, however, depends on geometry of treated blanks and degree of deformation during treatment, which makes difficulties for control of the structure characteristics, the obtaining in advance given parameters and limits the upper level of material dispersion. This problem was solved by application forces of opposite pressure, which level is controlled.

Innovative Aspects and Main Advantages

Processing of metals in conditions deep cooling at all-round compression is know how of KIPT, this method is protected by several patents and allows to receive such level of thermally steady hardening which known ways of deformation of metals do not allow to obtain.

Areas of Application

Various branches of mechanical engineering, medicine.

Stage of Development

Stage of development – the method is tested by laboratory tests.

« A way of reception the nanostructured metals and alloys and the device for its realization», Khaimovich P.A., the patent application of Ukraine #2004010171 from 09.01.2004, positive decision -January 2006.

Fig. 1 Brittle fracture without opposite pressure (hardening 10-15 %)

Fig.2 Plastic deformation with opposite pressure (hardening 50-70 %)

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Ozone Generators With the Barrierless Gas Discharge

Description

The ozone application market has been strongly increased during last decades. Interest to ozone technologies is caused by unique properties of ozone as strong oxidizing and bactericidal agent. Besides, ozone technologies are environmentally friendly and this fact increases consumer attraction for application of ozone in industry, servicing and medicine.

The key device for the ozone technology is ozone generator. At the present, a silent or barrier discharge for ozone generators are most widely used. At the same time, the expansion of areas for ozone application makes demand for development of alternative methods for ozone generation. One of the advanced methods is a barrierless discharge.

In the NSC KIPT a new ozone generators with barrierless electrode system and high-voltage pulsed power supply have been developed. The barrierless ozone generators have a high reliability due to elimination of the dielectric barrier from discharge gap. It excludes the damage of electrode system in case of accidental spark breakdowns. The barrierless ozone generator has significantly low gasdynamic resistance because the discharge gap is a wider. Besides, the electronic control system of the ozonizer improves operating characteristics of the ozone generator. The advantage of the barrierless ozone generator is a possibility of stable operation by using the ambient air as a feed gas. New barrierless ozone generators have a modular construction that provides a serviceability and allows to vary the ozone output in wide range 5–100 gO3/hour.

Innovative Aspects and Main Advantages

The main innovation of the developed technology is the use of the barrierless electrode system for plasma chemical reactor and special current conductive coating for the anode surface. The coating is not destroyed under impact of plasma and aggressive radicals which are synthesized in reactor. It provides the stable long-term operation of ozone generator.

Thus the barrierless ozonizer has the following advantages in comparison with barrier ozonizers which are commonly used for the ozone generation:

- reliability of operation at presence of nitrogen and water vapour, operation on ambient air;
- reducing of expenses for air preparation ;
- the use of high-efficient high-voltage power supply with the efficiency no less than 90%; power recuperation.
- low gasdynamic resistance of plasmachemical reactor;
- the elimination of dielectric barrier from discharge gap;
- the electrode system has a firmness to the random electrical breakdown;
- the simplified construction of plasma chemical reactor, the weak accuracy requirement on manufacture of reactor components

Fig. 1. Ozone generators with barrierless electrode system

Areas of Application

The most perspective market segments for a new barrierless ozonizers are connected with water treatment, namely the potable water preparation, preparation of water in pools and spa, sewage treatment, disinfection by ozonized water of packing materials, vegetables and fruit.

The barrierless ozone generators can be applied in agriculture for presowing seed treatment what allow to increase the crop yield on 10-15%.

Stage of Development

The development stage for barrierless ozone generator have been fulfilled completely. The samples of ozone generators are available for demonstration, ozone generators have been installed at the potable water preparation systems and at the water purification systems of the pools for 5 years. The barrierless ozone generators have been protected by the patents of Ukraine and USA.

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Ozone Technology for Tires Re-Cycling

Description

The proposed technology for tires re-cycling is an environmentally friendly technology and demonstrates a completely new approach to the problem of vulcanite utilization by means of application of a well-known cracking effect in the ozone environment.

During development of the ozone-dynamic technology for scrap tires destruction and design of the experimental module a set of technological problems is resolved. The main problem during design of the experimental module was to establish the technological process which ensures that the dynamic loading is applied to each element volume of the tire regardless of its structural state. The experimental research has allowed to create the model of dynamic stress of the tire as a result of which a 90-95% tire disintegration has been achieved. At that the disintegration procedure also results in rubber crumb, metal cord, textile which can be applied at various productions.

Innovative Aspects and Main Advantages

Equipment:

- power consumption is 2-3 times less than this parameter at mechanical re-cycling;
- reduction of re-cycling stages;
- low amortization of working parts of the equipment;
- high quality of the resulting product;
- absence of harmful emissions as ozone rather quickly transforms into oxygen which makes re-cycling environmentally-friendly.

Rubber crumb and attendant materials:

- Rubber crumb is of high-quality;
- preservation of properties of the original material in the volume of the obtained fractions;
- developed surface of the rubber crumb;
- good wettability;
- high packed density;
- high purity.
- Metal wire and polyamide threads are preserved practically non-destructed.
- Wire and cord threads contain a minor amount of the remaining rubber.

Areas of Application

- For rubber reclaim production
- For production of minor rubber-technical goods (carpets, rugs, etc.)
- In production of asphalt and euro ruberiod
- In production of composite materials based on various polymer binders.

Stage of Development

Laboratory installation.

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Ozone Technology of Presowing Seed Treatment

Description

Nowadays the eco-friendly agro-technologies have a wide spread. One of promising methods is an ozone technology for presowing seed treatment. This method is a result of investigation on impact of ozone (environmentally friendly oxidant) on the process of activation and growing of seed, as well as the development of ozone equipment that is well adapted for operation under agricultural conditions.

New ozone generators with barrierless electrode system and high-voltage pulsed power supply have a high reliability due to elimination of the dielectric barrier from discharge gap. The advantage of the barrierless ozone generator is a stable operation at the ambient air as a feed gas. New barrierless ozone generators are suitable for operation under agricultural conditions in the best way . New barrierless ozone generators have a modular construction that provide a serviceability and allows to vary the ozone output in wide range 25 – 100 g O3 per hour.

Innovative Aspects and Main Advantages

The main innovation of the developed technology is an application of ozone for presowing seed treatment. It allows in the environmentally friendly way to carry out the activation of seeds and as consequence the increase in the crop capacity up 10-15%.

Thus the ozone technology has the following advantages in comparison with commonly used methods:

- increase of crop capacity on 10-15%;
- improved quality of grain;
- 2-4 times reduction of dosage of chemicals;
- decrease of expenses on operating supply for presowing treatment;
- environmentally friendly technology excludes the harmful impact on environment;
- the ozone is produced at the place of operation;
- the technology can be used for maintenance of seed quality during its keeping in silo;
- for improvement of seed quality by ozone conditioning.

Areas of Application

The technology can be applied in agriculture for crop growing, for keeping, drying and processing of agricultural products.

Stage of Development

The method of ozone presowing seed treatment is now at the stage of commercial introduction. Operation manual for application of method was approved by the Ministry of Agriculture of Ukraine and the Ukrainian Academy of Agriculture. The technology was patented at Ukraine. Technologies of drying and keeping of seed and other agricultural crop are now at the stage of testing under industrial conditions.

Ozone technology of presowing seed treatment

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Plasma Methods and Tools for Structural Materials Surface Modification and Hardening

Description

National Science Center “Kharkiv Institute of Physics and Technology” (NSC KIPT) proposes efficient method for surface modification. This method employs the impact of ultrashort (10-6 s) energetic plasma pulses onto metallic surface ensuring effective diffusion of plasma ions into material depth (20-100 μm: nitriding, boronizing, alloying) accompanied by super-fast quenching. Depending on plasma parameters, metal surface can be modified into fine-grained or quasi-amorphous layer with tailored combination of physical-chemical properties and essentially enhanced tribological characteristics.

IIn particular, the proposed method provides:

- Increment of surface micro-hardness up to 4 times even for previously quenched steels;
- 4-10 times grows of wear resistance depending on type of steel;
- Enhancement of corrosion and erosion characteristics (proved by cavitation tests in water).

Relevant publications:

- I.E. Garkusha et al., Vacuum, V. 58/2-3, 2000, pp 195-201
- V.I. Tereshin et al. Vacuum, Vol 73/3-4 ,2004, pp 555-560.

Innovative Aspects and Main Advantages

The proposed method combines ultra-fast quenching and alloying. Contrary to traditional nitriding techniques, and enables control over parameters (depth, amount of dopants and structure) of modified layers.

Areas of Application

Hardening of working surfaces of cutting tools dies for cold and hot pressing, moulds, etc. as well as for sites of machines, engines, compressors, hydraulic drives, hydraulics, aviation and automobile technique.Practical implementation of the developed method will allow:

- Essential increase in operation life of elements in conditions of dry friction;
- Possibility of replacement of expensive alloyed steels in different mechanisms by cheaper ones, but with necessary physical properties;
- Healing of defects (microcracks, voids, scratches) in the surface layer.

Stage of Development

Method is laboratory tested and mastered. Laboratory plant equipped with lock chamber for parts carrying-in is available for performing of plasma processing of goods and samples. Additionally the Institute of Plasma Physics of the NSC KIPT provides services on the development of technologies for modification and hardening of different materials to mach customers specific requirements. NSC KIPT may perform development, manufacture, delivery of plasma devices and equipment, adapted to specific tasks.

Fig.1 Laboratory plant for pulsed plasma processing, developed at PP NSC KIPT.

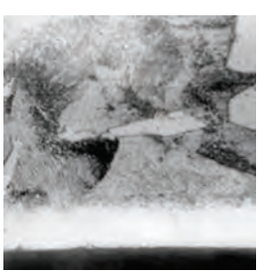

Fig. 2 Cross section of processed steel. Modified surface layer, which is resistant to etching, is shown in white color.

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Production of Functional and Composite Nanostructured Materials

Description

Functional and composite materials are produced by the following methods:

- vacuum quasi-isostatic-pressure sintering in electric fields;
- hot isostatic pressing.

The manufacturing methods being in use allow to produce irregular-form sintered articles characterized by the uniform volume density and minimum concentration of macrodefects, enhance quality and service performance of the products due to generation of nanostructure in materials of products.

Specifications:

Product	Density	Mechanical strength (bending strength)	Dimensions	Microhardness
Nozzles based on Al2O3 (95%)	3.2 – 3.9 g/cm^3	max. 550 MPa	outer diameter: max. 29 mm, height: max. 54 mm	
Nozzles based on B_4C	2.5 g/cm^3	450 MPa	-	25 GPa
Cutting-tool plates	14.42 g/cm^3	-	cutting plate size: 14×14×5 mm	24 GPa
Medical restoration blanks based on Y-TZP	6.02 g/cm^3	max. 1300 MPa	diameter: max. 140 mm, height: max. 50 mm	-

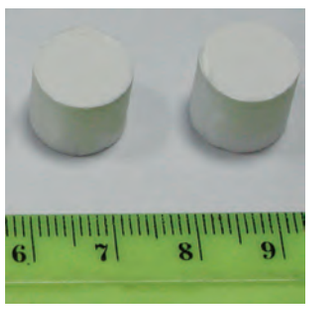
Innovative Aspects and Main Advantages

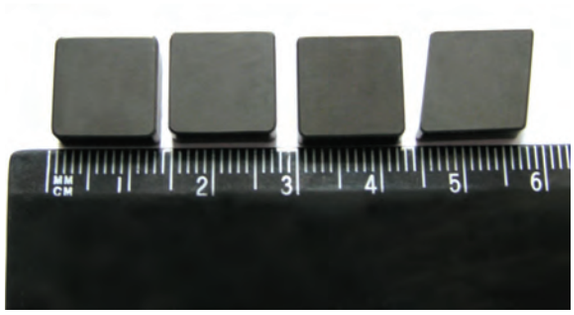
Nozzles and cutting-tool plates:

- high wear resistance;
- chemical stability;
- heat resistance;
- *high physical-mechanical characteristics.*

Medical restoration blanks:

- bioinert materials;
- high hardness and wear resistance;
- corrosion resistance;
- lower friction factor;
- long service life.





Areas of Application

Nozzles and cutting-tool plates:

- mechanical engineering – cutting tools;
- automotive and aerospace industry;
- ship-building and ship-repair industry;
- textile industry sector where drawing tools are used;
- chemical and petrochemical industry – sealing elements to be used in corrosive media;
- mineral resource industry – rock-drill mountings, rock cutting tools.

Medical restoration blanks:

- medical institutions (dental clinics).

Stage of Development

Nozzles and cutting-tool plates: - promotion to the market.

Medical restoration blanks: - laboratory sample.

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Protective Layer's on Polyacrylic Fresnel Concentrator Photovoltaic Modules

Description

The direct conversion of solar energy into electric power, as can be realized by semiconductor-based photovoltaic (PV) solar cells, has not been widely used at the present because of the relatively high costs when compared with traditional power generation methods. Amonix Inc. of USA has achieved an efficiency of 26,4% at 250x sun, the highest ever produced for silicon cells used in commercial concentrator PV modules. Cost-wise, solar cells are the most expensive part in a PV module. More power can be generated with the same amount of solar cells with the use of concentrators. Fresnel lenses (FL) made of polyacrylics have been used as concentrators with reasonable costs and are very suitable for large-scale commercial applications. However, polyacrylic FL is a mechanically somehow rigid polymeric material that may be subject to environmental and weathering – induced degradation. Protection of its long-term performance against ultraviolet (UV) radiation, moisture ingress, mechanical impacts or abrasion, and chemical air pollutants is highly desirable. The combination of a higher power output and longer service life can lead to a substantial reduction of the overall power generation costs when concentrator PV modules are used.

To protect FL, a high-performance AlN coating technology have been developed at the Kharkiv Institute of Physics and Technology for reinforcement of the large-area FL by condensing an aluminum vacuum-arc filtered plasma flow on the poly-acrylic substrate in nitrogen ambience.

Innovative Aspects and Main Advantages

The AlN coating is deposited on a polymer substrate by condensing the aluminum plasma flow in nitrogen ambience. Unlike to known methods the plasma flow is generated by the DC vacuum-arc plasma source with magnetic plasma filter. The latter will be used to clean the plasma flow from macroparticles (droplets) of the eroding cathode material (aluminum). Principle of magnetic filter action consist in spatial separation of the ion-electron flow (useful component) and macroparticles trajectories (undesirable component). In particular, the principle of a small ratio of a plasma duct curvature by its inside width have been used. Geometry of the intercepting baffles and screens system for interception and absorption of macroparticles has been calculated using the computer code developed by experts. Parameters of the filtered plasma flow generated by the source developed ensured deposition of the uniform protective coating onto the polymer plate of 210mm x 210mm in dimension.

Areas of Application

Energy production for small to medium energy consumers.

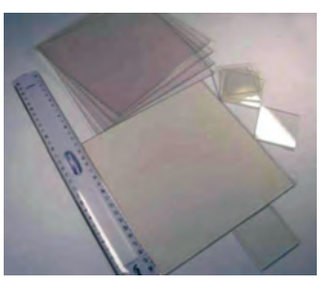

Fig.1 Fragments of polyacrylic Fresnel concentrators with protective aluminum nitride coating for Photovoltaic Modules

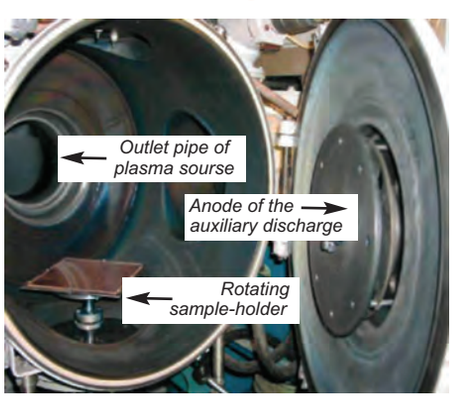

Fig.2 Updated vacuum chamber "Bulat-6 sou"

Stage of Development

The experimental equipment and several batches of samples are available

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Refinement of Materials and Products of Complex Configuration

Description

Pneumoimpulsive installation is aimed at refinement of details of complex configuration. The key element of the equipment is impulsive pneumoacoustic radiator which should inject compressed gas into gas or liquid media in order to excite acoustic oscillations.

Acoustic oscillations perform effective refinement of both outer surface and inner cavities and blind holes of the product up to 1mm in size. The refinement of items is mostly carried out without heating of the cleaning liquid.

Parameters of pneumoimpulsive installation:

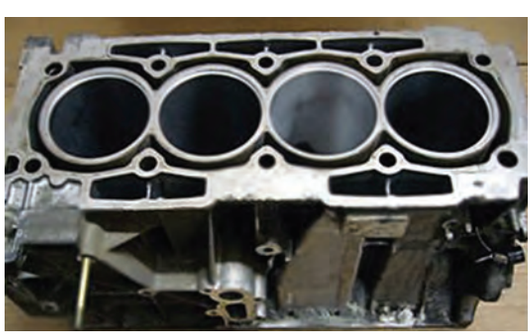
- Power source – 220 V, 50 Hz;
- Volume of cleaning chamber – 30-500 l;
- Power consumption of pneumoradiator – 50 W;
- Power flow per 1kg of the refined products;
- with water heating - 50 kJ;
- without water heating – 15 kJ.

Innovative Aspects and Main Advantages

- combines several technological activities (washing and refinement, wringing, drying) in one installation;
- reduces power consumption due to the absence of stable operation and usage of the pulsed operation;
- reduces the time of refinement;
- increases the quality of refinement of the items of complex configuration with blind holes, inner cavities or channels;
- reduces the cost of refinement;
- makes it possible to refine not only the items of complex configuration but also dispersed materials (silica and molding sand, feldspars);
- does not require usage of chemicals.

Areas of Application

- Machinery engineering: refinement, washing and degreasing of the items from organic and non-organic contaminants.
- Service: cleaning and washing of clothes, fabrics, furs.
- Ore-dressing and processing field: dis-ironing of silica and molding sand, feldspars.



Stage of Development

Experimental-industrial model

- experience of the installation application for industrial use.

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Technology for Pure H2 production

Description

The technology allows to produce extra-pure gaseous hydrogen as a result of combustion of flammable hydrogen-containing materials (such as natural gas, coal, gasoline, alcohol, etc.). Figure 1 depicts the process to produce extra-pure hydrogen. The flow of hydrocarbons, such as gas, alcohol or gasoline, is supplied to the combustion chamber 1. The heat of combustion is mainly used to heat up water. Some minor quantity of the heat of combustion is used for heating of the hydrogen generator. Hydrogen being generated is supplied to the chamber 2 isolated from the combustion chamber. Then hydrogen is supplied to using equipment, for example, is puffed into the vacuum system. If it is necessary, hydrogen can be accumulated in a special storage unit (so called "compremator") based on intermetallic compound.

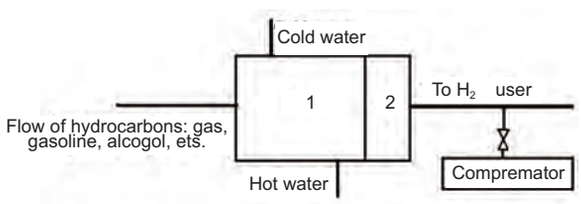


Fig 1. Process to produce extra-pure hydrogen as result of combustion of hydrocarbons 1- combustion of hydrocarbons, 2- chamber for extra-pure hydrogen generator.

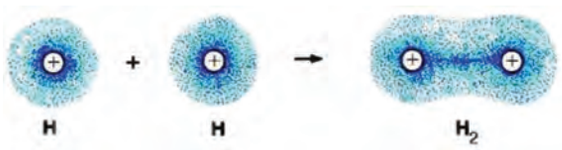
Specifications:

- Hydrogen generator temperature: 300-700 oC;
- Hydrogen generator capacity (at 700 ºC): ~ 1 Ncm3(H2)/s (3.6 l/hour);
- Hydrogen purity degree: higher than 99.9999 volume percent;
- Pilot plant capacity: 5 – 500 liters/hour.

Innovative Aspects and Main Advantages

- Extra-pure hydrogen is produced as hydrocarbon combustion co-product;
- extra-pure hydrogen is generated in the course of single process;
- low part of the main technological process power inputs to generate final product;

Areas of Application



for equipment to produce extra-pure H2:

- it is deemed advisable to adopt the suggested process for extra-pure hydrogen generation at enterprises where hydrocarbon raw materials are reclaimed (combusted) in large quantities, for example, at boiler houses or other hydrocarbon combustion facilities;
- chemical-, electronic-industry enterprises;

for extra-pure hydrogen:

- gas chromatograph detectors;
- hydrocarbon analyzers;
- laboratory plasma machines and plasmachemical reactors;
- other analytic devices used by research and factory laboratories.

Stage of Development

- Pilot laboratory plant, having capacity 1 Ncm3(H2)/s (3.6 l/hour)
- engineering concept of construction of 5-500 l/hour pilot plants for production of extra-pure hydrogen.

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Thin Vacuum-Tight Beryllium Foils for X-Ray Windows

Description

National Science Center “Kharkov Institute of Physics and Technology” (NSC KIPT) has started production of thin (8-100μm thickness) vacuum-tight Be-foils. These foils are the best candidates for the manufacturing of X-ray input/output windows and covers for advanced detectors of X-ray and nuclear radiation. The manufacturing process implies metal refining, obtaining of semi-finished products in the form of defectless billets with fine-grained structure and their subsequent rolling into foil at specialized flatting mills. Processing methods for each stage have been developed and mastered at KIPT. Such an approach for beryllium foils production is new and it has newer been practically implemented in any country. Vacuum tight areas of up to 100cm2 can be made from 25 μm foils.

Image 1. Beryllium foils

Innovative Aspects and Main Advantages

Originality of the proposed goods lies in usage of highly purified beryllium (up to 99.999 % weight Be on metallic admixtures) obtained by vacuum distillation technique.

Authorized technology for thin beryllium foils rolling includes pre-rolling grain size refinement and subsequent multistage flatting of beryllium billets enveloped in stainless covers accompanied by intermediate vacuuming and heat treatment.

This is the only foils made of beryllium of 99,95-99,999 % purity available on the market.

The impurity-less and vacuum-tight foils provide superior X-ray transmission. This improves image definition and/or allows the use of lower intensity X-ray sources. The foils also possess excellent mechanical properties and high corrosion resistance, along with low surface roughness.

Areas of Application

Windows for : X-ray tubes, X-ray detectors, X-ray lithography facilities, proportional counters, neutron sources, etc.

Stage of Development

Development is in the stage of commercialization. There is possibility to produce: vacuum-tight foil of different sizes; windows for radiation input/output with tailored dimensions, high-clean beryllium.

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Ultra Fine- Grained Tantalum, Titanium and Stainless Steel for Medical and other Applications

Description

During the last 25 years the activity of our team from NSC KIPT was focused on ultra fine-grained materials with high strength and ductile characteristics for nuclear and space industries (Beryllium, Zirconium and other metals and alloys).

Now we have redirected our technological experience and knowledge of ultra fine-grained materials for the purposes of medicine and other civil applications. Owing to their acceptable biological compatibility and relatively high manufactura-bility, stainless steel, titanium and tantalum are the metallic materials that are most widely used in current medicine. However, the existing combination of strength characteristics and ductile

behavior of the materials is often inadequate to provide the reliable and efficient operation of various-purpose medical instruments and devices such as cardiology stents, oncology needles and applicators, dental and orthopedic implants. Traditional methods of mechanical-thermal treatment have practically exhausted all their resources as regards the improvement of mechanical characteristics. A cardinal improvement in strength and ductility characteristics, and with it a significant improvement in the functional properties of medical instruments and devices, may be attained owing to creation of ultrafine-grained structure in tantalum, titanium, and stainless steel.

Innovative Aspects and Main Advantages

We developed unique technologies for production of various ultra fine-grained semi finished products such as foils, wires, thin-walled tubes to produce various medical implants and instruments.

Our thin-walled tubes made of tantalum and stainless steel (outer diameter down to 1.5 mm, wall thickness down to 40 to 50 μ) have excellent future trends in coronary stents production because of their high mechanical properties. For example, tantalum (biocompatible material, well-visible in X-ray tomograph) made on standard scheme has the yield strength (YS) ~ 300 MPa, the ultimate tensile strength (UTS) ~ 500 MPa, total ultimate elongation ~ 28% , but tantalum made by our scheme has grain size 2-3μ and YS > 360 MPa, UTS > 620 MPa, total elongation > 38%. Now we are developing ultra fine-grained titanium and biocompatible Ta- Ti- Zr- Nb alloys with high mechanical properties.

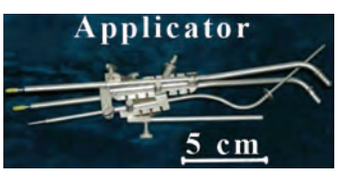
The application of ultra fine-grained materials in modern medicine will increase flexibility and radial stability of stents, will improve an axial stability of long-sized oncology needles, and will decrease vessels injury in cardiologic operations. Moreover we developed and also have patents on two-layer drag-eluting stents with internal holes for antirestinosis drugs.

Areas of Application

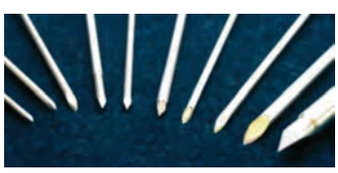
Medicine: cardiovascular stents, dental and orthopedic implants, long-length oncology needles and applicators for radiotherapeutic treatment of prostate, uterus, and breast tumors.

Chemistry: corrosion resistant ultra-thin–walled tubes.

Electronics: high energy capacitors.



Pic.1 Applicator



Pic 2. Oncological neddles Stage of Development

Stage of Development

We can organize small butches production of products made of ultra fine-grained materials (tantalum, titanium and stainless steel thin-wall tubes, foils, wires and others) . We have also the experience of some medical tools production. Moreover we have patents on two-layer drag-eluting stents. License agreements and cooperation for further development are sought.

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Ultra Thin High-Performance Permanent Magnets

Description

Ultra thin high-performance Nd-Fe-B and Sm-Co permanent magnets of the thickness in the range of 50-1000 microns are produced by the cold deformation of melt-spun alloys. The fabrication process of miniature nanocomposite magnets includes the dragging and rolling of quenched alloy. The technology allows to produce many standard magnets with high magnetic characteristics, but our strength lies in the ability to modify our products to the specific requirements of miniature assembly manufactures or produce virtually any permanent magnet systems with optimum design and performance.

Properties:

- Remanance Br=1,0-1.3 T;
- Coercivity Hc=800-1200 κA/m;
- Maximum energy product (BH) max =250-300 κJ/m$^{3;}$
- Work temperature T= -100 to 2000C.

Innovative Aspects and Main Advantages

- High magnetic properties per specific volume of magnetic material;
- Low price in comparison with competitive technologies;
- High corrosion resistance.

Areas of Application

- **MAGMAS** devices, micro-drives (Magnetic micro-actuators and micro systems);
- **Biomedicine** -implantable μ-valves and μ-pumps;
- **Information Technology** – addressable RF μ-switches and optic fibre μ-commutators, adaptive optics;
- **Energy transformation** – μ-motors, electrical μ-generators;
- **Scientific experiments.**

Stage of Development

Promotion to the market:

- manufacture and sales of products.

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Water Purification by a Combined Action of Ozone and High-Energy Electron Beam

Description

One of the possible alternatives to chemical disinfection is electron beam irradiation applied simultaneously with ozone. Electron beam irradiates water with a beam of high-energy electrons, causing the formation of transient reactive species: aqueous electrons, hydroxyl radicals and hydrogen radicals. The cell membranes of the microorganisms are destroyed due to synergistic effects, making the treatment more effective. The fundamental investigations have proved that the beam-ozone techniques elaborated are very prospective for the water purification from injurious bacteria, pathogenic viruses, medicines and chemical compounds.

In natural water samples, this factor is brought down to the standards stipulated for drinking water. In addition, (30-50)% of organic compounds can be split by these techniques. Up to 40% of oil products become destroyed. Inorganic compounds (nitrites) are decomposed by 85% (to compare with their starting content). The total destruction of antibiotics is achievable. As it is proved, the regimes optimal for the water processing depend on the degree of bacterial and chemical contamination as well as on the temperature of water and its pH-index. This technique of water disinfection causes temporal changes in biological characteristics of the residual microflora that still has remained viable after processing with the beam and ozone. Changes in sanitary-model microbes' characteristics indicate themselves via deterioration of sensitivity to many antimicrobial medicines, the persistent potential lowering down and a steep decrease in toxin-generating bacteria' ability to produce exotoxin.

A new technique of the water disinfection is also developed, where copper ions are added to the water processing with the beam and ozone. Copper ions synenergetically intensify the oxidizer antimicrobial effect more than 10 times. A new barrier-free ozonizer "OzWW 4/2" is also proposed. In this device, ozone is synthesized due to the pulse glow discharge in the oxygen atmosphere. The ozonizer generates an ozone-oxygen mixture where the ozone concentration is high (>3%). The ozonizer mode of operation is very stable, the maintainability of this device being high. The plasma-chemical reactor of ozone synthesis consumes the energy about (6-8) W*hour 1 g of ozone during one hour, which corresponds to the best world achievements. Two accelerators were used: resonance accelerator (the energy is (3-4) MeV and the linear inductive accelerator (LINAC) that provides the electron energy up to 2 MeV.

Innovative Aspects and Main Advantages

Disinfection of sewages from medical, the industrial and domestic water suppliers.

Areas of Application

- Operational monitoring of industrial lasers and other sources of radiation, both coherent and non-coherent;
- Certification of coherent and non-coherent laser sources;
- Measurements of laser beam power characteristics in scientific and medical applications.

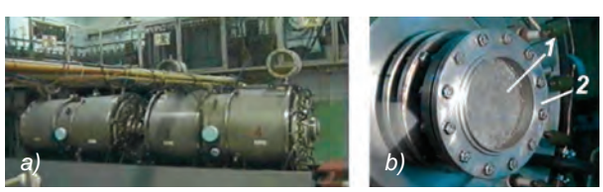

Fig.1 The general view of LINAC (a), and the beam extraction windows (b) - "1" is the window made of CCCM; "2" is the extraction window mounting.

Fig. 2 Glow discharge ozonizer OzWW 4/2

Stage of Development

Ready for application.

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X- and Gamma-Ray Detectors made from Semiconductor Compound CDTE (CDZNTE)

Description

X- and gamma-ray detectors from semiconductor compounds CdTe (CdZnTe). The observation of the offer in the market of semiconductor detectors of ionizing radiations over the years 1990 — 2006 shows that increasingly stable position in it is taken by CdTe and CdZnTe detectors. In a number of cases they push aside widely used silicon and germanium semiconductor detectors, let alone traditional gas and scintillator detectors.

Innovative Aspects and Main Advantages

The main advantages of CdTe and CdZnTe detectors are their ability to operate at room temperatures (without cryogenic equipment) and high sensitivity to the radiation at small size. The main disadvantages are relatively high cost of semiconductor crystals and the absence of widely known technologies of processing crystals.

The production of CdTe or CdZnTe detectors in CIS countries does not exist. In developed countries such products are manufactured by custom request only at the following specialized firms: eV-PRODUCTS, AMPTEK, DIGIRAD — USA, EURORAD, CEA Leti — France; ACROTEC — Japan. The preliminary estimations allow us to assert that the detectors cost will be 1.5–2 times lower than in the listed above companies. At the same time the performance characteristics (discrete and analogue sensitivity, dark current, radiation resistance) of our detectors will not be inferior to the world level.

NSC KIPT and RPC "Sensor" Ltd., developed and during several last years supplied CdTe and CdZnTe detectors to different enterprises of Ukraine and Russia. The specifications for the detectors from CdTe and CdZnTe (TX201AP) were developed in NSC KIPT and are registered in the State Committee for Standardization, Metrology.

Specimens have passed the preliminary tests in NSC "Institute of Metrology" (Kharkov).

Areas of Application

- Medicine: for X-ray and positron tomography (PET), patient dose load measurements at radiation diagnostics and therapy;
- Nuclear power: for dosimeter and monitoring of NPP territory (including Chernobyl zone), isotope composition analysis and tightness monitoring of fuel pins;
- Geology: for aerospace investigation;
- Scientific researches.

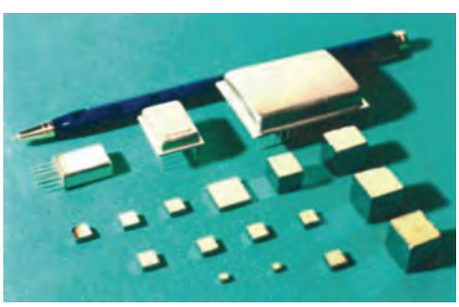

Fig 1 Gamma-ray detectors from CdTe (CdZnTe)

Stage of Development

Analysis of technical feasibility.

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Cleaning, Disinfection and Sterilization of Instruments

Description

Multi-functional low-temperature sterilizer. The proposed sterilizer makes it possible to clean, disinfect and sterilize the instruments and materials of various usage in water saturated with ozone of high concentrations simultaneously applying ultrasound.

Cleaning by the ultrasound is based on the cavitation process, i.e. on formation of the smallest air bubbles due to the impact of the ultra-sonic wave. Cleaning of the treated surface is a result of explosion of such bubbles.

Ozone of high concentration in water is required to perform efficient and full sterilization of the objects. It is usually achieved by means of water temperature reduction.

Characteristics of the ozone sterilizer:

- Working gas – dried air;
- Working gas flow – 0,5 – 1 l/min;
- Input ozone concentration– 30 mg/l;
- Ozone concentration – up to 12 mg/l;
- Ozone efficiency – up to 1 g/h;
- Voltage – up to 300 W;
- Sterilization temperature - 10-15 0C;
- Chamber volume – 1 -101.

Innovative Aspects and Main Advantages

- sterilization of the objects sensible to high temperature sterilization;
- treatment of the items with complex surface or inner cavities ;
- reduced cost of sterilization;
- decreased time of the sterilization cycle;
- reduced power consumption for the process;
- applicable for obtaining gas ozone and ozonized water
- ozone is easily converted into oxygen after sterilization is finished;

Areas of Application

Sterilization of the instruments which may have a contact with humans:

- medicine;
- veterinary;
- cosmetology.

Stage of Development

Pilot sample.

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«TIDIS» - Department of technology transfer, investments activity and intellectual property

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National Technical University of Ukraine "Kyiv Polytechnic Institute"

Technical Area Keywords: education and science. Information technologies, mechanical engineering, heat- power engineering, renewable energy, electronics, welding, chemical technologies, biotechnologies, telecommunication technologies.

General Information

National Technical University of Ukraine 'Kyiv Polytechnic Institute' is one of the oldest and largest technical universities in Europe. It was founded in 1898. NTUU KPI is famous for its academic excellence and leading innovative research.

NTUU KPI ranks first nationally, and is world recognized in the number of graduate academic and research programs in the top ten in their field. 40 500 students study at 29 University Colleges. NTUU KPI has drawn 1 500 students from all over the world. Our students receive the highest level of education provided by the Academic and Research staff of the University. There are fifty-eight Academicians and ten thousand Professors and Researchers among its active faculty. There are 20 Colleges, 9 Academic and Research Institutes, 12 Research Institutes, 13 Research Laboratories, and other Scientific Units. KPI has Colleges of Sciences as well as Colleges of Arts, like Management and Marketing, Law, Social Studies, Linguistics, Biotechnology and Bioengineering, Medical Engineering, Athletics and Sports

The glory and traditions of the University have been created by the famous scientists such as D. Mendeleyev, I. Sikorski, S. Korolev, S. Timoshenko, V. Kirpichev, E. Paton, I. Bardin, O. Mickulin, L. Luliev, O. Vinter, B. Vul, A. Lulka, V. Plotnikov, and others.

Institute's Focus

The applied researches have aimed at the implementation of the innovative technologies which focused more on getting the final result (the new technologies, the new types of equipment, the new materials, etc.). It will improve their competitiveness and ability to extend the implementation of the results.

Today, the main goal of the NTUU “KPI” is to prepare the highly qualified specialists and the research for “breakthrough” of Ukraine’s economic development in the following priorities as:

- the modern technologies in computer science, engineering, chemistry, materials;
- the networks for telecommunications and information technologies;
- the problems of energy saving and the development of energy saving technologies ;
- the monitoring and environment protection;
- the elimination of the nuclear and technological disasters;
- the aviation and space technologies;
- research and use of the human recourses;
- the medical engineering;
- the system analyzing and making decisions, etc.

Valuable Technology Offerings

The main results of the scientific research concern the following areas:

- the environment saving and sustainable development;
- the new biotechnologies, diagnostics and treatment of the most common diseases;
- the new computer tools and technologies of the information society;
- the new technologies and recourse saving technologies in energetic, industry and agriculture;
- the new substances and materials.

Scientific Cooperation and Technology Transfer

The NTUU "KPI" cooperates with many institutions of the National Academy of Sciences of Ukraine, including the Paton Electric Welding Institute, the Physical and Technical Institute, the Institute of Cybernetics, the Institute of Metal, the Institute of Magnetism, the Institute of Physiology, the Institute of Theoretical Physics, the Institute of Semiconductor Physics, the Institute of Surface Chemistry, the Institute of General and Inorganic Chemistry.

Together with the institutes there were held work in such issues as: nanophotonic, nanomaterials and nanotechnologies, the water preparation and water cleaning, the industrial safety, providing the mutual impact assessment with electromagnetic compatibility, the energy audit and the energy management, solar using in the power engineering, the alternative and renewable energy, the new methods of metal processing, creation of the new laser technology systems, the intellectual speech information processing, the technical protection of the information in such areas as power engineering, telecommunications, electrical engineering.

The NTUU “KPI” is successfully cooperating with 91 technical universities in 34 countries, many international organizations (EU, CU, UNDP, UNESSO, UNIDO, WIPO, NATO, EDNES, ICSU, CODATA, STCU) and leading companies (MOTOROLA, SIEMENS, FESTO, SAMSUNG, INTEL and others). The NTUU “KPI” is taking part in the international educational and scientific projects and programs in such countries as Germany, Sweden, Holland, Spain, Estonia, Poland, Japan, Korea, China, Vietnam, Mexico and others.

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Mobile Reference-Class Voltage Transformer Etn-110

Description

Rated primary voltage, V	110000√3;
Rated secondary voltage, V	100/√3;
Tolerance	0.05; 0.1;
Overall dimensions, mm	300 x 470 x 1060;
Weight, kg	100.

Innovative Aspects and Main Advantages

In comparison with other world analogues, this reference-class voltage transformer has extremely reduced overall dimensions and weight.

Areas of Application

Mobile systems and laboratories for measurement of electric power quality, definition of electric energy losses, metrological certification of the systems of commercial account of the electric power in 110 kV networks, directly, in field.

Stage of Development

The transformer has metrological certification and is used in the mobile testing laboratory MPL 0.22…110 kV in the State Enterprise 'All-Ukranian state research and production center of standartization, metrology, certification and consumers' rights protection' (SE 'Ukrmetrteststandart').

Patent's application in Ukraine a 2009 11004 (2009-10-30).

On the photo: the transformer ETN-110 (on a left-hand side) in comparison with the prototype - transformer TNO-110.

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E-mail: patent@kpi.ua

Photovoltaic Cell

Description

Direct conversion of solar energy into electrical energy

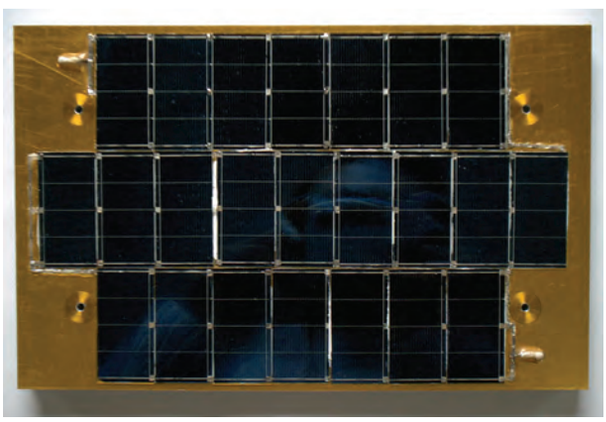
Open circuit voltage 620-630 mV;

Short-circuit current density 34-38 mA/sm2;

The efficiency of conversion of 16,5-19%;

Dimensions, 125x125 mm;

Transparency capsule - 94-97% of the concentrated solar radiation.



Innovative Aspects and Main Advantages

- High efficiency
- Protection of photovoltaic cell by polymer coating.

Areas of Application

Creating photovoltaic stations from solar batteries, established on the basis of the proposed photovoltaic cells

For example:

Made “Photovoltaic module for space purposes”on the basis of monocrystalline photovoltaic cells with conversion efficiency of 18% under AM 0 (space) and 20.6% under AM 1.5 (on Earth |).

New radiation-resistant semiconductor materials are used with high stability of characteristics

New designs

Converter Specifications:

- open circuit voltage 635-640 mV;
- short-circuit current density 46-48 mA/sm2 (AM 0), 39-40 mA/sm2 (AM 1.5)
- Efficiency of conversion 18% (AM 0) 20-20,6% (AM 1.5);
- Dimensions 50x25 mm

Module Specifications:

- open circuit voltage 17-17,4 V;
- short-circuit current 575-600 mA;
- Efficiency of conversion of 17.8% (AM 0), 19,4-20,0% (AM1, 5);
- Dimensions 240x160 mm.

Stage of Development

Research sample

Covered by patents of Ukraine #2006 77337.

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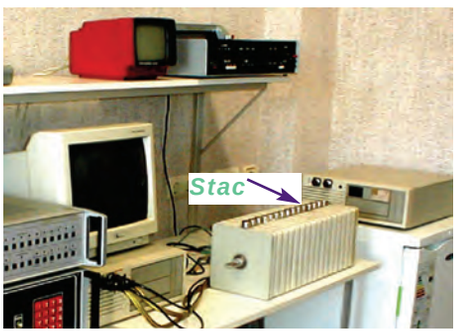
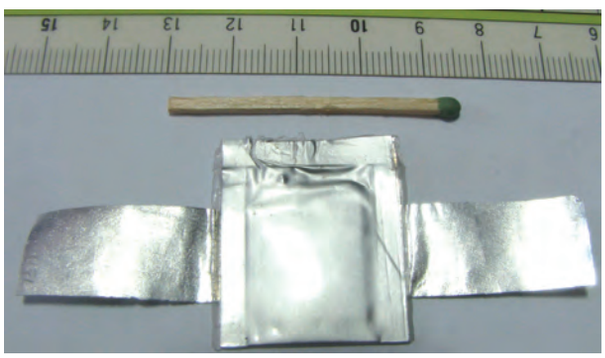
Ultracapacitor

Description

Condenser's capacity increases along with the increase of the effective electrode surface and the decrease of the non-conductor thickness. Nanoporous composite materials with the rank effective surface 10^3 m^2/g, electricity-conducting, as electrodes. Little thickness of a double electrical layer (1 nanometer rank)/ High condenser volume efficiency - 10 Farad/sm^3 and higher.





Innovative Aspects and Main Advantages

- possibility of recharge and discharge with high currents in a matter of a few seconds;
- unlimited quantity of the 'recharge-discharge" cycle;
- low requirements to the charge;
- no toxic heavy metals, alkalis, acids, possible harmless recycling;
- fire- and explosion-safety.

Areas of Application

Emergency power or impulsive energy sources as a unit with solar or lithium batteries in digital cameras, cell phones, etc.

Stage of Development

Research sample

Covered by patents of Ukraine #2008 35069.

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Palladin Institute of Biochemistry

Technical Area Keywords: biotechnologies, agricultural sciences and medicine, chemistry, new methods of production and practical application of biologically active substances for medicine and veterinary as well as biosensors for medicine, industry, agriculture and ecology

General Information

This Institute, founded in 1925 in Kharkiv as the first biochemical Institute in the former Soviet Union, moved to Kyiv in 1931 and became a part of the Ukrainian Academy of Sciences. It was directed by its founder, very prominent scientist, Acad. O.V. Palladin, for almost 45 years. During its existence, a number of important discoveries and inventions took place at the Institute. Haemostatic drugs were developed, capable of accelerating the wound adhesive process, that are widely applied in hospital practice even today. The Palladin Institute of Biochemistry (IBC) of National Academy of Sciences of Ukraine has 9 scientific departments, 5 laboratories, and 3 Research Centers. It now employs about 370 people, with more than a 110 having an equivalent of a PhD or above (Dr.Sc.).

Institute's Focus

Institute's areas of core competencies include the following:

- Investigation of the structure, physical and chemical properties and biological functions of complex protein and supramolecular systems;
- Identifying biochemical mechanisms of metabolism regulation by means of low-molecular substances (peptides, vitamins, coenzymes, metal ions etc.);
- Studying mechanisms of cell signaling;

Among other important areas of research in functional biochemistry are:

- muscle biochemistry;
- neurochemistry;
- biochemistry of nutrition;
- metabolism regulation;
- lipid biochemistry;
- molecular immunology;
- coenzyme biochemistry;
- protein structure and functions;
- enzyme chemistry and biochemistry;
- molecular biology;
- medical biochemistry;
- biochemical kinetics;.
- nanotechnologies;
- the early diagnosis of the threat of thrombus formation, etc.

Valuable Technology Offerings

- Medical and veterinary diagnostics;
- Biosensors for medicine, industry, agriculture and ecology;
- Production and application of biologically active substances;
- Industrial technology for water soluble preparation of Vitamin D3 complexes for babies and another one for prevention of human osteoporosis;
- Methods for accessing the status of human hemostasis system;
- Industrial technologies for virus- and prion-safe proteins made of human blood plasma (clotting factors VIII and IX) for intravascular administration etc.

Scientific Cooperation and Technology Transfer

IBC collaborates with international laboratories and institutes:

- Lab. of Phisyology, Liverpool University, UK;
- National Oncology Center of Japan, Kashiwa, Japan;
- Center of Immunologic Investigation, Marcel-Lumini, France;
- Nencki Institute of Experimental Biology, Warsaw, Poland;
- Tomas Jefferson University, Philadelphia, USA;
- Pasteur Institute, Paris, France, and others.

The Institute has extensive experience in manufacturing technologies of medicinal preparations, including the following:

- VICASOL — a water-soluble analogue of K3 vitamin accelerating blood clotting;
- MEDICHRONAL — effective anti-alcoholic drug;
- CALMIVID — a composition of D3 vitamin with calcium;
- MEBIPHON — an anti-cancer agent etc;
- MEBIVID — pharmaceutical compound for treatment of bone tissue diseases;
- FILOMEK — a drug for prophylaxis and treatment of disorders of the reproductive human system;
- TOCOPHEROL — a technology of the new natural vitamin E metabolite industrial synthesis and application for protecting organism against oxidative stress;
- Tests for detection of antibodies against diphtheria toxin subunits;
- A technology of the new natural vitamin E metabolite industrial synthesis and application for protecting organism against oxidative stress.

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A Technology of the New Natural Vitamin E Metabolite Industrial Synthesis and Application For Protecting Organism Against Oxidative Stress

Description

Laboratory technology of a chemically synthesized new vitamin E derivative was designed and can be utilized to produce medication, biological active ingredient as well as food supplements and veterinary products. Mentioned above new vitamin E derivative is a natural metabolite of the vitamin E and possessing additional biological properties compare to the native vitamin E. Proposed vitamin E derivative can be used for prophylactic as well as treatment of variety pathological states with oxidative stress etiology. Product provides more effective protection against such pathologic conditions as hypoxia, vitamins deficiency, intoxication est. Proposed vitamin E derivative can be used as an independent product as well as the component of an existing medications and therapies for treatment of disease and pathological states of oxidative stress etiology in human as well as animals.

Innovative Aspects and Main Advantages

Results of our research has shown that chemically synthesized new vitamin E derivative:

- increases viability at stress conditions;
- normalizes lipid structure of the cells membrane;
- regulates free-radical processes in cells and organism;
- effects activity of the antioxidant enzymes;
- taken as oil form per os in ambulatory conditions decrease hospitalization time.

Production of this new vitamin E derivative is related to the chemical industry particularly organic synthesize. Ingredients and technology for this new vitamin E derivative production are quite similar to the original vitamin E manufacturing. Thus, an existing technological

apparatus, already training and available personal, in-house quality control methods and equipment can be used for production of this new vitamin E derivative. The use of an existing technological line, human recourses as well as cheaper ingredients decreases production expenses over all by 25% and brings a new product with an additional biological and medical properties to the market. So, implementation of this technology is mostly suitable for the factories as well as plants which are already synthesizing vitamin E.

Areas of Application

Medicine, pharmacology, food supplements, veterinary.

We are seeking for the scientific research cooperation and industrial partners in pharmaco-, bio- and chemical technology sectors of biological active ingredient as well as food supplements production. The priority partners are expected from the vitamin E chemically synthesized manufacturers, factories, plants, etc.

Stage of Development

Series of laboratory chemical synthesis has been performed to optimize conditions for maximal product yield and purity of this new vitamin E derivative. Laboratory regulatory documents such as reglament were prepared. Pre clinical laboratory research of this vitamin E derivative in vitro on 3 cell culture lines as well as in vivo on mice were finished. Patenting documents are under preparation. Search for partners for further cooperation, vitamin E derivative industrial production and human as well as veterinary clinical trials in Ukraine and abroad were performed.

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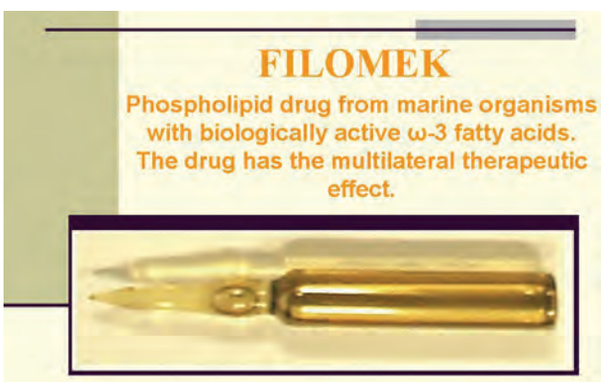
“Filomek” is the Drug for Prophylaxis and Treatment of Disorders of the Reproductive Human System

Description

The invention relates to the pharmaceutical industry, in particular to producing medicinal agents from reproductive tissues of sea hydrobionts and can be used in the form of a prophylaxis agent for restoring a human reproductive system and for treating hormonal deviations in a hypophysis gonads system.

The drug “Filomek” is obtained from tissues of marine hydrobionts according to the development authors' technology. The complex of phospholipids with omega-3-polyunsaturated fatty acids (ω-3-PUFA) serve as the medicine basis. The drug “Filomek” also includes the short-chain regulatory peptides, essential amino acids, nucleotide components, and vitamin E.



Innovative Aspects and Main Advantages

The novelty of the developed compound lays in the effective combination of phospholipids with omega-3-polyunsaturated fatty acids, short-chain regulatory peptides, essential amino acids, nucleotide components, and vitamin E.

The preparation “Filomek” has adaptogenic activity and hormone-like properties and can be used for restoring of human reproductive system function under sexual disorders and for treatment of sterility.

Manufacturing of the preparation“Filomek” will allow to solve a problem of recycling of waste from industrial processing of the squids and to obtain valuable biologically active preparations from them which realization will give additional profit to the enterprise.

The complex of the equipment can be placed on coastal fishing enterprises or fishing vessels.

Areas of Application

- pharmaceutical industry - a substance is for preventive and medical purpose as facility for recovering the functions of the reproductive system of the person under her(its) frustration, for treatment of the hyperplasia endometrium and the other profilactive processes in the human organism, for increasing level of testosterone, for reinforcement of the abilities to fertilization, for treatment of prostatitis, erectile dysfunctions;
- make-up industry - a substance is used as additional facility for baths and washing hair, which has the low removing fat properties, high foaming and ability to adjust water-fatty balance on surfaces of the skin;
- food industry – substance is used as a valuable food addition stable to oxidation.
- agriculture – folder protein obtained from the waste of the drug "FILOMEK" production is used;
- biotechnology – substance is used for the obtaining of DNA from the folder protein.

Stage of Development

Technological regulations, Technological instruction and Standard specifications of the substance production from the waste of the sea organisms are prepared.

The intellectual property rights are protected by the patent for invention “Medical agent for prophylaxis and treatment of a human reproductive system disorders and method for the production thereof” EA200701147, 2007-12-28; UA20041109612, 2004-11-23; WO2005UA00052, 2005-11-21.

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Pharmaceutical Compound for Treatment of Bone Tissue Diseases «Mebivid»

Description

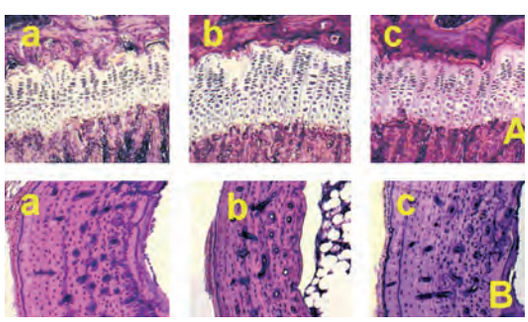
The efficiency of the developed compound «Mebivid» (complex of vitamin D3, calcium and bisphosphonate) is shown in the alimentary model of osteoporosis, which is based on the insufficient supply or metabolism deficiency of vitamin D3 and mineral components. In the process of osteoporosis the amounts of inorganic phosphate, general calcium and its fractions (albumin linked and ultrafiltrated) in organism decrease while the activity of alkaline phosphatase and its isoenzymes increase. Lipid metabolism and structure of bone tissue become disrupted as a result of the decrease of 25OHD3 levels, which are used for determination of the amount of vitamin D3 in organism. Treatment of rats that have alimentary osteoporosis with «Mebivid» normalizes the above mentioned parameters and structurally-functional activity of bone tissue. These data indicate highly specific efficiency of the compound for treatment of osteoporosis.

Innovative Aspects and Main Advantages

The novelty of the developed compound lays in the effective combination of three components most essential for the treatment of bone system diseases: bisphosphonate, calcium, and vitamin D3 supplemented with vitamin E. The form of bisphosphonate chosen (disodium salt dihydrate of methylenbisphosphonic acid) is more effective as compared to commercial preparations used for treatment of bone tissue pathologies due to its ability to prevent bone resorption by binding to the crystalline surface of hydroxyapatite and regulating osteoblasts activity. Calcium deficiency and chronic D-hypovitaminosis are involved in the development of osteoporosis in elderly people, women after the menopause and patients with oncologic diseases of bone tissue treated with corticosteroid hormones. Advantages of the compound are the usage of the most biologically acceptable form of vitamin D3 as protein complex with casein («Videin») and extension of storage duration.

Areas of Application

The compound belongs to the group of medical compounds which contain inorganic and organic ingredients, in particular calcium, vitamin D3, vitamin E and biologically accessible salt of methylenbisphosphonic acid. It can be used in pharmacology and medical practice for treatment of different forms of osteoporosis, osteomalacia and diseases, characterized by the softening of bone tissue.



Effect of complex preparation MEBIVID on structure-functional organization of the bone tissue (B) and the proximal epiphyseal cartilage (A) of the tibia in rats under D-hypovitaminosis: a – control; b – hypovitaminosis; c - + MEBIVID.

Stage of Development

A semi-industrial technology for the production of compound and its ready-to-use form «Pharmaceutical compound for treatment of bone tissue diseases – Mebivid» are developed and analytical normative documentation is prepared. Experimental batch of the compound is produced. The intellectual property rights are protected by the patent for invention № 85494 from 26.01.2009.

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Tests for Detection of Antibodies Against Diphtheria Toxin Subunits

Description

The diphtheria toxin contains two functional subunits: A (active) and B (binding). Each subunit carrying a distinct biological function implicated in the intoxication of the cell. It was shown in our studies that antibodies against A-subunit of diphtheria toxin (DT) prevalent over antibodies against B-subunit of DT more often in blood serum of children with diphtheria as in blood serum of carriers or health vaccinated children. Therefore we propose to use immunologic test with recombinant A- and B-subunits as antigens for detection of antibodies against DT. Whole molecule of DT or toxoid (toxin after formaldehyde treatment) are used in others methods for this aim.

Variant 1. Immunoenzyme assay.

This assay allows determining quantity of antibodies against A- and B-subunits of DT in the generally accepted international units (IU). The level of antibodies against B-subunit 0.1 IU or more is testifying to protectability against diphtheria. Therefore this assay may be used not only for diphtheria diagnosis, but for monitoring of protect antibodies' level in population also.

Variant 2. Immunochromatography test.

Principal structure of immunochromatography test-system is shown on the picture. This test-system based on development of complexes antigen-antibodies by conjugate of protein A with colloidal gold. Results can be obtained for 10-15 minutes. Assay in variant 2 allow detecting a level of antitoxic antibodies only qualitatively. The intensity of band's painting may be estimated quantitatively by densitometry.

Results of our laboratory investigations confirmed high specificity of developed test-systems and their correct work. We carried out investigation of antitoxic antibodies levels in blood serum of volunteers vaccinated against diphtheria. The obtained results verified possibility of clinical trials realization.

Innovative Aspects and Main Advantages

The main innovation of developed technology is separately using recombinant A- and B-subunits of diphtheria toxin as antigen for detection antibodies against diphtheria toxin. In others traditional technologies (RPGA or ELISA tests) whole molecule of diphtheria toxin or toxoid is usually used for this aim.

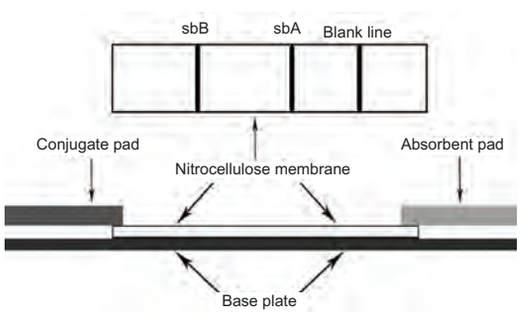
Key technical or competitive advantages by comparison with prevailing technologies:

- Additional information about level of antibodies against each toxin subunit is important for diphtheria diagnosis;
- Possibility to use test for broad screening investigations of immunity against diphtheria in human population;
- Impossibility of influence therapeutic horse serum on the assay results;
- High antigenic specificity of test due to more similarity of native diphtheria toxin to recombinant subunits than to anatoxin modified by formaldehyde;
- Ease and rapidity of use;
- Decreasing of assay value due to the fact that recombinant antigens are more chipper in comparison with native antigens.

Technical possibility to create others test-systems on the base developing approach.

Areas of Application

Immunodiagnosis of diphtheria, population investigations of immunity against diphtheria.



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A. Pidhorny Institute of Mechanical Engineering Problems

Technical Area Keywords: industrial technologies, fluid mechanics, power machine building, nontraditional power engineering, modeling in the field of heat physics and simulation of non-linear heat processes, mechanical engineering

General Information

The Podgorny Institute for Mechanical Engineering Problems of NAS of Ukraine (IPMash) was founded in 1972.

The first Director of the Institute from 1972 to 1996 was Academician of NAS of Ukraine, A.N. Podgorny (1932-1996).

Yu.M. Matsevity, Academician of NAS of Ukraine, has been the head of the Institute since 1996.

IPMash has 17 scientific departments with a staff of 352 specialists (187 research workers, including one Academician and three Corresponding Members of NAS of Ukraine; and 27 Doctors and 77 Candidates of Science). The Institute also has a special Design-and-Engineering Bureau, and a pilot production facility. The Scientific-and-Engineering Concern IPMash NASU was founded in 2000.

Institute's Focus

Core competencies of the Institute represent key areas of scientific expertise developed over the years and include the following:

- Hydraulic machines and fluid mechanics;
- Heat physics and thermal mechanics;
- Dynamic strength, stability and reliability of machines and mechanisms;
- Physical and mathematical modeling of mechanical processes;
- Non-conventional power engineering and energy saving technologies;
- Advanced design and development methods in power machine building;
- Industrial processes optimization.

Valuable Technology Offerings

- optimization of processes in power machinery, and improving their design;
- energy saving technologies and nonconventional power engineering facilities;
- predicting the reliability, dynamic strength and life of power equipment;
- simulation and computer technologies in power machine building;

The Institute conducts focused applied research in advanced integrated problems for the national economy.

Scientific Cooperation and Technology Transfer

Collaboration with power generating equipment manufacturers, power plants, and machine-building industry has been a traditional opportunity area for the Institute making use of its hardware engineering expertise, as well as novel analytical, diagnostic, and experimental methods. For example, IPMash developed an innovative methodology to effectively analyze the static strength and oscillations of complex-shape blades, blade packs and impellers of steam, gas and hydraulic turbines by employing a hierarchical system of mathematical models including 3D visualizations. The methods are used at turbine machine building enterprises in Ukraine, Russia, and Czech Republic.

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A High-Cycling Steam Turbine Installation with Increased Energy Efficiency Based on a 300 Mw Steam Turbine

Description

The operation of the installation is based on the thermodynamic cycle suggested by IPMash NAS of Ukraine specialists. The cycle is implemented on a high-temperature small-capacity turbine (25 MW) combined with an operating high-capacity power unit (300 MW).This turbine is driven with steam extracted from the main (base) turbine when it is necessary to generate peak power for the energy grid. Subsequently, the steam is superheated to a higher temperature, used in the high-temperature turbine and returned to the base turbine.

Innovative Aspects and Main Advantages

The installation generates additional power in peak load conditions, which will be 45 to 60 MW on the 300 MW unit depending on the design and operating conditions of turbine-driven sets (base and peak ones).

Using the installation offered allows:

- to extend the service life of power units;
- to increase the operating efficiency of existing power units at thermal power plants by 3-5 % when generating under peak and cycling load conditions;
- to increase the total capacity of the power unit by 15-20 % when operating under peak load conditions;
- to ensure operation of basic power unit equipment in derated conditions without significant overloading of the most thermal stressed parts.

Areas of Application

Thermal power engineering enterprises in Ukraine, the CIS countries and in East European countries.

Stage of Development

The thermodynamic fundamentals of a peak-load turbine operating in commercial power units at TPPs and cogeneration plants have been worked out. The peak-load turbine design philosophy has been established, and patent applications have been filed.

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A Technology of Environmentally Clean Processing of Low Calorific Coal and Coal Waste at an Integrated Energy-Metallurgical Plants

Description

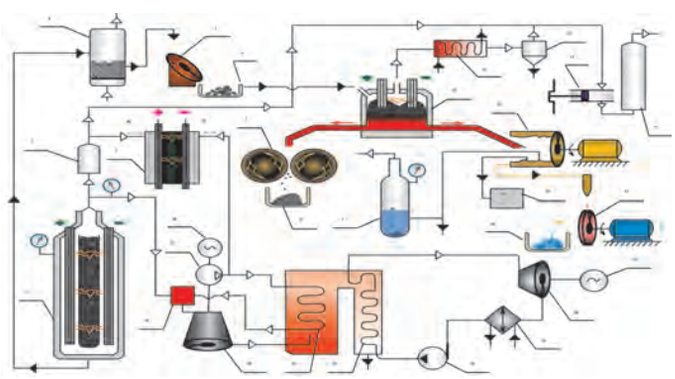
The technology ensures integrated processing of low-calorific coal and coal waste as well as ash at fossil power plants. Interconnected installations output hydrogen, methanol, alloys, aluminium, a concentrate of rare elements, coal tar, electric energy and heat.

Produced in the result of technological processing a ferro-silica-aluminium (FSA) alloy is separated into components which then can be used for methanol production.

Ukraine can consume annually: 50 000 tons of FSA and 30 000 tons of by-product methanol.

The estimated annual output of a commercial energy-metallurgical facility with a power capacity of 150 MW is 50 000 tons of FSA and 30 000 tons of methanol (up to 2012).

Schematic diagram of an integrated energy-metallurgical plant



1– coal slurry electrolyser, 2 – absorber, 3 –fuel cell, 4 – drier, 5 – granulator, 6, 8, 18 – vessel, 7 – rollers, 9 – hydrogen reactor, 10 – ore smelting furnace, 11 – hat exchanger, 12 – cyclone, 13 – piston compressor, 14 – methanol synthesis column, 15 – high-temperature centrifuge, 16 – aluminium receiver, 17 – amorphisizer, 19, 28 –electric generator, 20 – steam turbine, 21 – condenser, 22 – pump, 23 – steam generator, 24 – calorifer, 25 – gas turbine, 26 – combustion chamber, 27 – centrifugal compressor

Innovative Aspects and Main Advantages

A unique technology has been developed for utilising energy resources and production waste, and the cost effectiveness of commercial processes have been improved.

EPI are based on advanced processes that reduce material input for generating electric power by 15-20 %.

Areas of Application

Metallurgical industry, petrochemical industry, aviation and rocket- space industry, heat power engineering, machine building, electrical engineering, and meteorology.

The technology and products are oriented to the consumer and corporate markets in Ukraine, the CIS countries, Europe, the U.S.A., south-eastern Asia countries, China and others.

Stage of Development

The technology of smelting an FSA alloy from coal waste of Ukrainian mines has been tested at a pilot industrial 2.5 MW furnace at the Nikopol' Ferro-Alloy Plant.

Currently, the conditions of pressurised electrolysis of coal sludge and separating the FSA in a high-temperature centrifuge are being checked.

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Analytical R-Functions-Based Design of Complex Constructions

Description

The work is based on fundamental research in the R-functions theory developed by V.L. Rvachev, Academician of the National Academy of Sciences of Ukraine. The R-functions theory has allowed solving the inverse problem of analytical geometry formulated first by Descartes: given a geometrical object, it is necessary to write down its equation. The R-functions theory allows describing geometric objects with the help of continuously differentiable functions whose values define the boundary, the interior part and other properties of the simulated object. These functions allow accounting for geometrical information analytically, and they are convenient for executing different integro-differential computations.

Innovative Aspects and Main Advantages

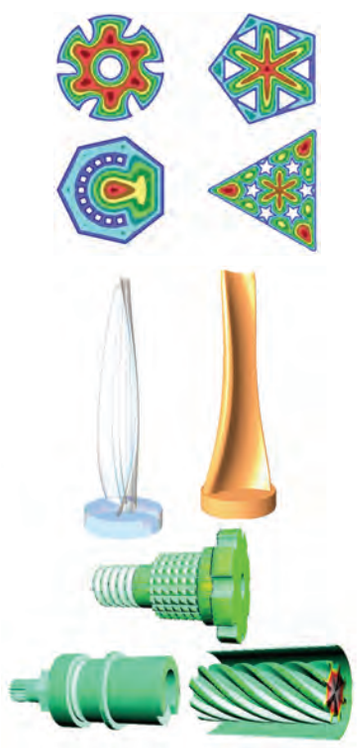
New technologies have been developed for synthesis and analysis of complex constructions in analytical design systems with computer-based building of multiparameter normalized equations in 2D and 3D space for mechanical engineering objects. Methods have been developed for building normalized equations of boundaries of geometrical objects possessing translational, cyclic and helical-type symmetry. Methods of translation for finite intervals have been developed. It is first proposed to construct equations of complex geometrical objects using standard primitives. This is a technological basis for automating the process of constructing these equations. Representing a geometric object as an analytical formula dramatically reduces the volume of data describing the type and spatial orientation of the object. To construct a complex geometric object, one needs but parameters that describe its constructional elements instead of huge FEM data arrays. Collections of elements (primitives) can represent a wide spectrum of geometric forms that depend on the subject domain.

Areas of Application

Mathematicians and scientists in many countries of the world use the theory of R-functions for solving problems in geometrical design, solid-state modeling, pattern recognition and research in physico-mechanical fields in complex-shape objects. It can be used for building solution structures, which precisely satisfy all boundary conditions in a boundary- value problem. Such structures can be combined further with many numerical methods for finding approximate solutions of a problem without dividing fields into grids.

Stage of Development

Computer implementation of fluid dynamics, electromagnetic, thermal, strain and other field problems is done using the POLYE system developed at the Podgorny Institute for Mechanical Engineering Problems of NASU. Representation of geometrical and physical information with alphabetic parameters allows for multivariant computations. 3D visualization of constructed equations of geometrical objects is done with the RANOK system developed at the Zaporozhye National University.



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Apparatus for Nondestructive Testing of Vibratory State of Industrial Equipment

Description

Stationary apparatus is intended for continuous inspection.

Stationary apparatus includes:

- MIAD-1M (measuring instrument of axial deflection);
- CD-3 (bearing vibration control device);
- ET-300 (electronic tachometer) (1);
- MIP-1000M (measuring instrument for peak module of vibratory displacement);
- EMI-2M (eccentricity measuring instrument);

Eddy current probes with frequency modulated signal output developed at IPMash NAS of Ukraine are used in the apparatus (2).

1

2

Portable apparatus is intended for on-line testing.

Portable apparatus includes:

- VMISA-07 (vibration measuring instrument with stripe analyzer) (3);
- disbalance characterization device (4);
- vibro-tester (5).

3

4

5

Innovative Aspects and Main Advantages

All proposed apparatus by its technical and economic indices doesn't give way the best world analogues and 2-3 times cheaper.

Areas of Application

Power engineering and oil and gas industry, mechanical engineering.

Stage of Development

The apparatus is applied in small-lot production.

It is applied in several industrial works.

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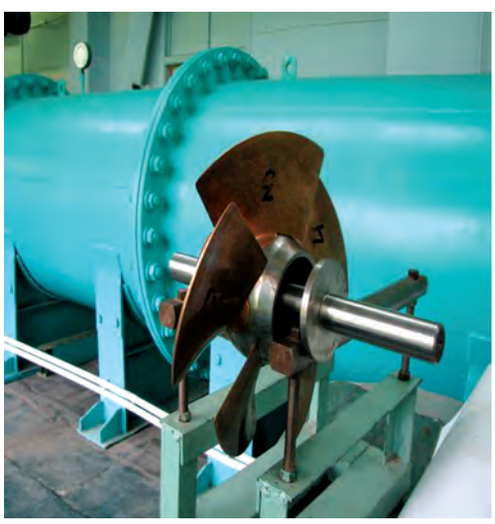
Bench for Testing Kaplan Turbines and Combined Pump-Turbine Units

Description

The versatile flow bench for testing hydraulic machines (hydraulic turbines, pumps, micro hydropower units and their components) is a unique construction with a system of tanks, pipelines, circulation pumps, electrical machines, computation-measuring complex and auxiliary equipment. It is made as closed-circuit hydraulic system and intended for investigating working procedures and conducting complex experimental tests of the models of hydraulic machines including approval tests in compliance with requirements of international standard IEC 60193.

In the process of testing models of hydraulic machines measurements of necessary parameters and processing of results are performed automatically by computation-measuring complex.



Innovative Aspects and Main Advantages

Basic characteristics of the bench

Maximum power (at rotational speed 1,500-3000 min^{-1}), kW	100-200
Maximum test discharge head, m	20
Head when testing turbine models, m	5 to 15
Rotational frequency when testing hydraulic machines, min^{-1}	800 to 1,200
Maximum flow rate, l/s	750
Diameter of a rotor wheel model, mm	350-380
Total relative error in defining net efficiency, %	+ -0,25

IIn 2006 laboratory bench of hydraulic machines of IPMash NAS of Ukraine obtained a status of national patrimony.

Areas of Application

IPMash NAS of Ukraine has developed and investigated several models of flowing parts for hydraulic turbines and combined pump-turbine units including for Kahovskaya, Dneprodzerzhinskaya, Kievskaya HPS (Ukraine), Viluyskaya HPS (Russian Federation), Shamhorskaya HPS (Azerbaijan), Thak-Ba HPS (Vietnam), modernization of Kievskaya pumped storage plant, and also Dnestrovskaya pumped storage plant. In 2008 together with "Kharkovturboengineering" approval tests of axial-flow turbine model for HPS San-Joan (Brazil) have been conducted.

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Elastic Coupling

Description

It is intended for coupling and transmitting torque in rotating shafts in different machines and mechanisms.

IPMash has developed a unique design of an elastic coupling. It allows for simplifying to the utmost assembly and disassembly of joints.

Innovative Aspects and Main Advantages

The developed elastic coupling consists of practically 3 parts. As compared to known designs of couplings, it has the following advantages:

- coupling parts are not subject to bending and shear stress;
- there are no fasteners (keys, bolts, studs, nuts, washers, etc.) common to designs of elastic couplings;
- joint assembly and disassembly time is 1-1.5 minutes without dislocating the shafts;
- it is capable of transmitting torques with no constraints on shaft diameters;
- all other conditions being equal, the outer diameter, length and weight of the elastic coupling is 1.6 – 2.2 times less than that of known designs;
- an elastic gasket over the entire inner surface of semi couplings compensates in admissible limits for variation from ideal arrangement of shafts: longitudinal displacement of shaft ends upon coincidence of their geometric axes, radial displacement of shafts with retaining of their parallelism, and angular shaft skewness;
- the possibility of transmitting the torque to other parallel shafts with different transmissions

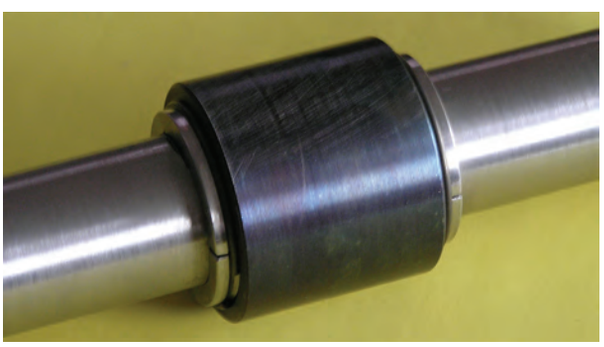
  (V-belt, gears, and others).

Areas of Application

Machine-building.

Stage of Development

A prototype of an elastic coupling has been made; serviceability is being checked, and a parametric line of elastic couplings is being developed.



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Electrochemical Technology of Hydrogen Generation

Description

Energy saving technology of electrochemical generation of high-pressure hydrogen with the use of gas-absorbing electrode. Cyclic technology of water decomposition comprises half-cycles of hydrogen and oxygen gassing. Generator design is based on the new method of time separation of gas liberation processes (cyclic principle of operation of electrolysis system it consists of alternate periods of hydrogen and oxygen liberation). Experimental research yielded the dependence of temperature and running of electrochemical reaction of water decomposition from alkaline electro-lyte. Reducing electric power consumption for hydrogen generation is realised by increasing reaction temperature (increasing temperature from 280 K to 398 K reduces electric power consumption during hydro-gen generation by 15%-17%, electric power consumption is 4.0-4.1 kW per 1 m3 of hydrogen and 0.5 м3 of oxygen).

Innovative Aspects and Main Advantages

Cyclic generation of hydrogen and oxygen requires no separation membranes, allowing generating high-pressure hydrogen and oxygen witha rated range of 0.1 MPa to 70 Mpa and increases reliability and safety of operation of hydrogen and oxygen generator. The electrochemical high-pressure hydrogen generator doesn't use rare metals and platinum group metals for activating electrode materials.

Areas of Application

Application of electrochemical generators of hydrogen and oxygen of high-pressure allows solving several important problems in the field of power engineering, and also at enterprises applying hydrogen technologies as energy carrier or reducing medium.

Stage of Development

Experimental models of equipment for applying electrochemical techno-logy of hydrogen generation are developed. They are distinguished by increased reliability and efficiency. Laboratory and full-scale tests are conducted.

The main operating conditions of the technology and design characteristics of the equipment are defined.

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Ferromagnetic Material Fatigue Monitoring by Non-Destructive Magnetic (Coercive Force Meter) Method

Description

Magnetic coercive force meter method of monitoring fatigue state of ferromagnetic steel and cast-iron production and construction. Preferred field of its application – stress concentration zone in which operational fatigue develops and accumulates with advance speed. Displacement of these zones on many productions is well-known because it is logically predetermined by their construction. As dimensions of stress concentration zones in comparison with microflaw dimensions are quite big so they are surely discovered without any searching complexity.

Advantage of the method – in simplicity of measuring process and in a device for its realization. Sample time ˚10 C, monitoring metal doesn't need special surface preparation, assuming its considerable roughness and curvature, environment temperature doesn't influence on monitoring, monitoring is possible through paint coat up to 3 mm.

The method is realized on the base of application of magnetic strukturoskop-coercive force meters of KRM-C type developed by the firm "Special scientific developments" which were certificated and entered into Russian Federation register. Since1997 state engineering supervision allowed using the method for technical diagnosis of all types of climbing cranes, service elevators and since 2003 for diagnostics of pressurized cylinders.

Innovative Aspects and Main Advantages

The method and device has not analogues. The main advantages of the method – possibility of qualitative and quantative assessment of metal state defining its residual life, simplicity of measuring, fast response, productiveness, reliability and cheapness of its realization.

Areas of Application

Stress concentration zones on production from mild steel and medium carbon steel in plastic state during static and repeating loadings with great amplitudes (i.e. during aggressive and low-cycle fatigue loadings).

Stage of Development

Improvement and modernization of instrument base.

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Highly Effective Protective Ion-Plasma Coatings for Cutting Tools and Friction Assembly Parts

Description

In the line of developing new technologies for surface modification of metals and alloys, IPMash NAS of Ukraine developed technologies of thin wear-resistant coatings based on refractory compounds. Their application ensures high wear resistivity and frictionless rubbing surfaces under excessive thermal and force effects, and insufficient lubrication. For example when using cutting and stamping tools; in friction assemblies of heavily loaded units, etc.

Ion-plasma coatings and technologies of their production allow dramatically reduce seizing between rubbing parts and between tools and machined materials, due to such coatings, the durability and reliability of friction assemblies and cutters increases 8-50-folds.

Innovative Aspects and Main Advantages

Technologies of ion-plasma coatings allow obtaining coatings with low adhesive activity – making it possible to control seizure of contacting surfaces during friction and cutting. Such coatings increase many-fold the durability and reliability of both friction assemblies and cutters, and reduce the cost of making new parts and tools with usage of expensive materials.

It increases the serviceability of brittle superhard tooling materials, allows developing high-performance tools for working hard-to-machine metals and alloys.

These technologies in engine building increase the service life of internal combustion engines by 10 times, and reduce their cost, as compared to the current one, by 20 %.

Areas of Application

Machine-building.

Stage of Development

In-depth research has been conducted in the physics of solids, low-temperature plasma, and the physics of cutting and friction. Principles have been formulated and theoretical basics have been worked out for obtaining highly effective ion-plasma coatings.

Experimental research has been focused to improving the technology of obtaining protective coatings for cutters and friction assembly parts.

Documents are being drafted for patenting in Ukraine.

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Magnetic Vortex Hydrodynamic Activator (Mvhda) for Magnetic Treatment of Water Systems

Description

It is intended for magnetic treatment of water systems with the object of increasing efficiency of heat exchange processes due to nonchemical prevention and elimination of old scale formed on heat exchange surfaces.

Principle of MVHDA operation is based on experimentally discovered phenomena of physico-chemical properties of liquids treated in constant magnetic field under certain magnetic hydrodynamic flow regimes. Without magnetic water treatment hardness salts dissolved in water form a sediment on heat exchange surfaces mainly in the form of tiff but after treatment precipitate in corpore as insoluble aragonite sludge that is easily decalcified by way of sludge-catchment basin. Due to gas solubility change, particularly oxygen, immunization of heat exchange surfaces is taken place (pellicle of dark colour is formed that mainly consists of magnetite), that leads to intensity reduction of corrosive wear.

Innovative Aspects and Main Advantages

It has the following distinctive properties:

- flowing part profile of apparatus reactor zone is profiled in such a way that allows providing necessary speed flow conditions in a working gap in wide range of changing metering flow conditions;
- basic construction has constant magnetic system with high performance specification in stability and durability in a wide range of temperatures;
- apparatus is provided with magnetic induction sensors for monitoring state and efficiency conditions of magnetic system;
- shields of magnetic systems allow reducing to a minimum external influence on working settings of MVHDA in working gaps.

Areas of Application

- Processes and equipment where magnetic hydrodynamic method can be applied;
- Water treatment: defecation and precipitation processes, ion exchange;
  (installation of activators before clarifiers and filters);
- Reactors of producing lime milk
  (installation of activators on water flowing for dissolution);
- Deaerators
  (water treatment before deaeration);
- Hot water supply
  (installation of activators before boilers and heaters);
- Compressor houses
  (installation of activators in water cooling systems);
- Oil coolers
  (installation of activators in water cooling systems);
- Condensers;
- Average payback period of MVHDA is no more than one year.

Stage of Development

MVHDA has design documentation

(TY Y 28.3-31063720-001:2005) and it is produced to made to order at pilot production of IPMash NAS of Ukraine (Du5 – Du 600).

Structural circuitry of MVHDA allow designing and producing apparatus with automatic, self-stimulating and manual adjusting of constant magnetic induction in the range of working temperatures up to + 2300C and pressure up to 30 atm. for a pipeline with a diameter of Du 5 to Du-2500 mm.

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Method of Complete Processing of Oil Products, Producing New Kinds of Artificial Composite Fuels (Including Biofuel), and Improving Their Power Ecological Indices

Description

Developed experimental installations *(know-how of A.N.Podgorny institute for Mechanical Engineering problems of NAS of Ukraine)*, principle of their operation is based on mechanochemical activation and cavitation phenomenon in liquid mediums, results in low-temperature hydrocracking (up to 1000 C) of oil products including black oil, and also in modification of hydrocarbon fuels with the purpose of improving their consumer and ecological indices have been obtained. Results in producing new kinds of artificial composite liquid fuels and biofuels are also of great interest.

Innovative Aspects and Main Advantages

Obtained experimental results open principally new opportunities in the field of processing of hydrocarbons and producing new kinds of fuel oil and motor fuel. The proposed method allows realizing complete processing of oil, black oil omitting coking stage.

The method doesn't have analogues.

Applying the method allows increasing completeness of processing of oil products, i.e. to increase light fraction yield, to improve power ecological indices of produced fuels, allows using biological waste products for producing motor fuel and fuel oil.

Areas of Application

Future trends of using this method are the following:

- complete processing (more than 90%) black oil to distillation fractions (benzene, diesel oil);
- reducing oil products viscosity for more effective transportation;
- Modifying and enhancing the quality of fuel (reducing the content of sulphur, salts, mineral residue, unbound water, resin removal, increasing the octane number and others.);
- producing the new kinds of artificial composite fuels including biofuels;
- degassing of liquid fuels.

Stage of Development

Experimental setup has been developed. Preliminary tests have been conducted. Positive results have been obtained. The technology is protected by Ukrainian patents.

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Methods of on-Line Diagnostics of Surfaces Condition of Manufactured Articles

Description

Microprocessor-based device – diahardprofilometer ensures simultaneous complete control, efficient determination and selection of optimal parameters of initial roughness, microhardness and form deviation or work surfaces arrangement during their making, operation or repair, promotes developing the new energy-saving computer technologies of optimal treatment of these surfaces.

Innovative Aspects and Main Advantages

The proposed technology replaces replica or visual methods of in-process measurements of surfaces irregularities of different details, allows to get the total evaluator of surfaces condition of manufactured articles with the help of one device - diahardprofilometer With the help of this device it is possible to define and set energy saving industrial regimes and also their sequence, which subject to current status of processing equipment, tooling can provide quality of treated surfaces under the condition of minimal allowance of work material and their productive time.

Areas of Application

This technology can be applied at enterprises where grinding or other surface treatment is carried out, also in measuring laboratories, certification centers and etc.

Developed devices can be applied both in Ukraine and abroad, particularly, in European countries, USA, Canada, CIS, China, India and others.

Stage of Development

The first industrial consignment has been produced and applied at state enterprise “Electrotiajmash”.

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New Highly Effective Technologies of Grinding of Hard-to-Machine Materials

Description

Idea of the development is based on decreasing energy and force parameters of chip formation due to providing conditions for the utmost adsorption interaction of juvenile strips on the cutting zone surface with cutting fluid components. It helps reducing energy of plastic deformation, formation of a new surface and considerable reducing of adhesive phenomena by improving kinematics of shaping process.

Innovative Aspects and Main Advantages

Depending on curvature of a work surface, rotary part drive or abrasive tool can be subjected to modernization.

During circular or circular shaped grinding of parts' surfaces with a diameter up to 30 mm and curvilinear parts' surfaces (turbine buckets, camshafts) a group production in devices of drum type is carried out. In such a way portable travel of parts by circular path around common axis with controllable turning around planetary pivot pin is provided.

Grinding and deep grinding of flat and flat-shaped surfaces implies using special multi-spindle planetary-grinding instrument. It is mounted on the grinding stock spindle instead of an abrasive wheel. Abrasive wheels are fastened hard on planetary spindles and gain translational motion around center line of machine spindle and rotation around planetary axes with preset speed ratio.

Standard abrasive wheels of straight profile or cup wheels of medium structure are used as cutters. Grade of grinding wheels is accepted higher than traditionally recommended.

The developed methods provide:

- Reducing specific energy consumption by 3 to 10 times;
- Increasing specific intensity by 5 20 and more times;
- Increasing productivity of machining by 2,5 5 times;
- Reducing consumption of liquid coolant by 5 10 times;
- Reducing abrasive discharge intensity by several times;
- Reducing loading during machining of high-plastic and ductile materials;
- Cutting zone temperature is bellow 1000C, that entirely excludes grinding defects caused by thermal factor.

Areas of Application

Low-cost modernization of multi-purpose and special grinding machines without modification of main motion drive for technological enhancement of equipment.

Stage of Development

Several pilot and experimental-industrial models for group grinding have been developed: cylindrical production of small diameter (fig.1), turbine blade profiles with length up to 500 mm, centering plugs and camshafts up to 600 mm length, and also planetary-ganged and planetary grinding (fig.4) of flat and flat-profiled surfaces, deep grinding of jumbo size flat surfaces (Fig.3). Conducted tests revealed high efficiency and technological succession of the new methods of grinding.

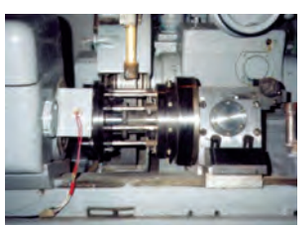

Fig. 1

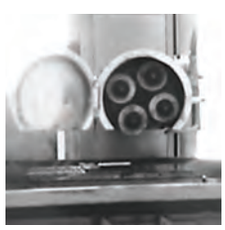

Fig. 2

Fig. 3

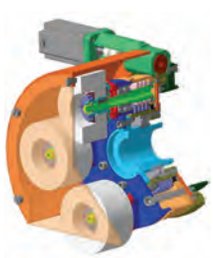

Fig. 4

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Production Technique of a Bird Imitator for Testing Structural Optics to withstand Impact by Birds

Description

Actual tests of airplane structural components to withstand impact by birds are carried out, as a rule, with the use of birds' carcasses or with the help of equivalent imitators.

Developed by IPMash of NAS of Ukraine imitator of principally new construction for certain imitates impact parameters produced by a bird during a barrier blow, that is proved to be true by actual comparison tests for various angles and speeds of collision.

A bird imitator is a cylinder connected with hemispheres. Geometry of the imitator: length cm, diameter cm. It is made of silicone, elastic properties and density of which are similar to muscle tissue characteristic of a bird (1,1 г/см3). Lengthwise the axis of the imitator there is an element of construction modelling skeleton and cavities inside a bird that allows to reach average density of the imitator according to average density of a bird (0,93 г/см3).

Application of the bird imitator allows to simplify an experimental technique, to cut down expenses and time for exploratory design and actual tests.

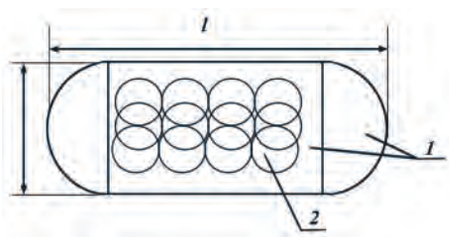

Fig. Bird imitator as a cylinder connected with hemispheres
1 – silicon, 2 - skeleton

Innovative Aspects and Main Advantages

In comparison with analogues it has several advantages:

- close to reality reproduction of an impact by bird to a structural component;
- simplicity of the technology and acceptable production cost;
- long working life under room temperature;
- applying non-polluting materials;
- compliance to hygiene and sanitary conditions and aesthetic norms;
- imitator's remnants are easily utilized.

Areas of Application

Aircraft industry of Ukraine, Russia and other countries of the world.

Development stage

The development is completed and ready to application, Ukrainian patent is obtained, and a positive decision of Russian patent grant is made.

Pilot batch of imitators is made and comparison actual tests are successfully conducted.

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Self-Contained Deep-Sea Lifting Gear

Description

The operation of the deep-sea self-contained lifting gear (APU) is based on blowing off an opening flexible shell with hydrogen generated by reaction of outboard water with the hydroreacting compound.

The gear consists of a hydrogen generator, hydroreacting compound charge (HCC) located inside the generator and a flexible blown off shell.

In the initial state, APU is fixed on the deck of a submersible vehicle (SV) on a special frame with a folded shell, and transported to a sunken object. APU has positive buoyancy, and is held in such a state on the frame with air-operated locks.

Outboard water flows during submersion via the open lower hatch in the generator to its chamber. In contacting with the lower HCC layers, the reaction with water generates hydrogen batches to compensate for increasing external pressure and maintain practically constant gear buoyancy.

APU is started by sending a hydro acoustic signal from the SV to open the air-operated locks that keep the flexible blown off shell in the folded condition. The shell is unfolded by generated hydrogen. In acquiring positive buoyancy, APU surfaces together with the object.

Innovative Aspects and Main Advantages

Using hydrogen as a lifting medium allows using the gear practically at any depths of the world Ocean.

An effective layout of design elements provides the APU with self-relief from external pressure.

The gear has minimal mass and size parameters, and ensures straightforward and safe operation.

Areas of Application

Lifting sunken objects (as well as extending guide ropes for big-tonnage objects).

Transporting equipment and constructions for deep-sea oil-and-gas pipelines to a specified depth.

Development of natural resources of the World Ocean (mining iron and manganese concretions).

Stage of Development

Completed pilot design project.

Two pilot units have been made.

Fig. 1. APU with opened flexible shell

Fig. 2. APU on deck of submersible vehicle

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Software Package for Analysing 3-D Non-Stationary Viscous Gas Flow Through a Stage of Axial Flow Turbomachine Taking into Account Blade Oscillations

Description

Aerodynamic, elastic and accelerative forces in turbomachines acting on blades can cause increased vibrations, which limit turbines'characteristics and serviceability. Realizing physics of non-stationary viscous flows and developing methods of forecasting aeroelastic characteristics of blade rows is very important for increasing economy, reliability and life of turbosets. Mathematical model, algorithm and software package for solving conjugate problems of aerodynamics and elastic oscillations are suggested. Aerodynamic model is presented by 3-D equations of Navie-Stocks describing non-stationary viscous flow through a stage of a turbomachine. Dynamic model applies a modal approach and 3-D finite element analysis.

Successive integration of aerodynamic equations and elastic oscillations with the use of march diagram of time allowed setting a problem of gas flow through a turbomachine stage correctly not dividing non-stationary phenomena caused by external flow irregularity and blade oscillations.

Innovative Aspects and Main Advantages

Application of software package allows increasing economy of turbine stage in 1-3% (due to selection of optimal shape of blades and flow pattern) and forecasting aeroelastic behavior and stress in blade rows. The development has world-wide priority.

Areas of Application

Power machine building, aircraft gas-turbine construction, gas-turbine equipment for gas-transfer stations. Would-be customers – design office and enterprises engaged in designing and producing of steam and gas-turbine equipment.

Stage of Development

Mathematical model, numerical method and algorithm of problem solving is developed. The development is now on debugging and program testing stage.

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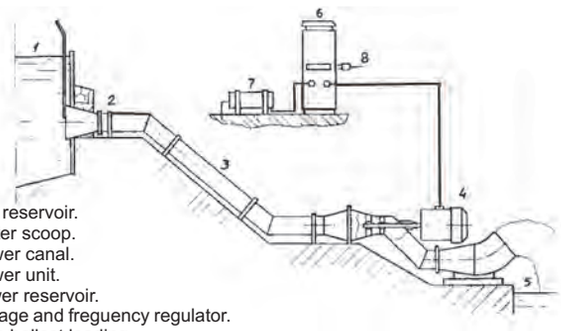
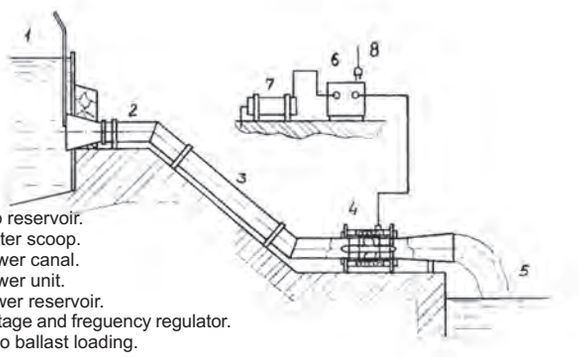
Straight-Flow Micro HPS with a Constant Magnet Generator

Description

It is intended for utilizing potential energy of small river waterways or industrial water systems with a net head from 3 to 8 meters and capacity from 3 to 12 kW with a water flow 0,13-0,23 m3/s. Such power unit is autonomous, ecologically pure energy source. It doesn't need a constant presence of attending personnel during its operation. The main elements of micro HPS: water motor, electric generator, electronic frequency and voltage regulator. The power unit is an axle free propeller straight flow turbine, on an impeller rim of which rare-earth constant magnets Nd-Fe-B are placed. Electronic frequency and voltage regulator is intended for producing 3-phase voltage Uф = 220 V, frequency 50-60 Hz..



1. Top reservoir.
2. Water scoop.
3. Power canal.
4. Power unit.
5. Lower reservoir.
6. Voltage and freguency regulator.
7. Auto ballast loading.
8. Consumers.



1. Top reservoir.
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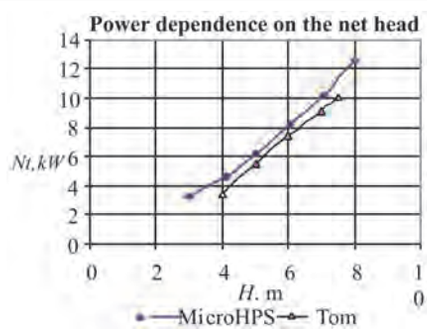
Innovative Aspects and Main Advantages

Comparison of the developed micro HPS characteristics and series-produced Tomik (public corporation "Turboatom", Kharkov) with close characteristics are cited in the table. Advantages of the developed model: mass is two times less and considerably miniaturized overall dimensions that provides thrice-repeated reduction of specific metal content. Efficiency diapason is 10-20% higher and generated power accordingly. Advantages stated in comparison with typical analogues will be saved and improved during power increase of micro HPS unit.

Comparison of micro HPS performance indicators

Key indicators	Micro HPS (IPMash)	Tom (OJSC Turboatom)
Net head, m	3.0-8.0	4.0-7.5
Power at controller terminals, kW	3.0-12.2	3.0-10.0
Discharge, l/s	130-230	130-240
Overall size, mm	430x900	1,600x400x685
Mass, kg	140	310
Specific weight, l/s/kW	18.9	24.0



Areas of Application

Potential places of application and consumers: hydro-power engineering facilities, water supply systems and drainage systems of industrial enterprises, big and individual farms. Installations of such type can be effectively used in distant from electric main areas, they are mobile and characterized with low transport expenses.

Stage of Development

Experimental model of micro HPS has been developed and produced. It passed bench tests at IPMash NAS of Ukraine (Kharkov). Nowadays environmental and fatigue tests are being carried out in Prielbrusye (Russia). Ukrainian patent is used in this development.

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Technology for Rapid Blocking of Emergency Sections of Oil and Gas Pipelines and a Mobile Complex for Implementation Thereof

Description

Due to natural or technogenic factors as well as a result of terrorist acts it may be necessary to rapidly block emergency sections of product pipelines.

When pumping oil (and oil products), and during pipe transportation of other energy carriers the pipes can rupture.

The technology is focused to increasing safety and reliability of operation of oil and petroleum product pipelines as well as for mitigating the economic and environmental damage due to accidents caused by pipe rupture, and to contain fires.

Innovative Aspects and Main Advantages

The technology is based on sealing off the delivery sections of the product pipeline by directional deformation of the shell provided its strength properties are maintained.

The mass and size of the mobile complex allows mounting it on an automobile chassis or onboard a helicopte. This makes it possible to deliver the complex rapidly to the accident zone. The complex deployment time is no more than 20 minutes. The equipment allows for sealed cut-off in pipeline systems with transportation pipe diameter within 1,200 mm.

Areas of Application

Oil pumping companies.

Stage of Development

Research has been conducted. The basic technological techniques and equipment components have been developed.

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Technology of Wasteless Water Treatment

Description

It is based on optimal combination of conventional (reagent) and new (physico-chemical) methods of water treatment. Subject to required water quality some processes developed at IPMash NAS of Ukraine are used: cavitation aeration, economically reagent coagulation, electro-membrane softening, membrane desalination, membraneous evaporation, magnetic activation, cavitation-radiation decontamination, electro-deionization, fractional crystallization, and also original instruments for their realization.

Innovative Aspects and Main Advantages

In the result of integrated water treatment by the offered technology, end products instead of waste are produced. The end products can be used in other industries.

Areas of Application

Wasteless treatment of mine waters, wasteless water treatment for thermal, nuclear, gas-turbine power plants, water treatment for food-processing industry, treatment of galvanic liquids and developing water circulating cycles of machine building enterprises.

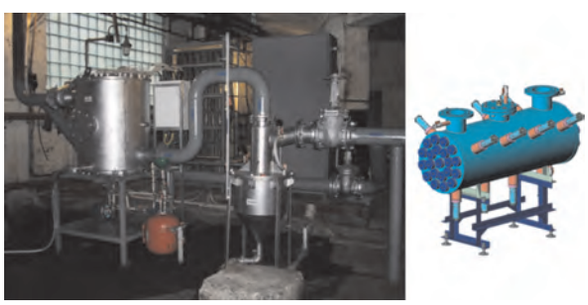
Stage of Development

Research engineering in optimization of applying the integrated technologies, exploratory design for developing reagentless water treatment in power engineering and closed cycles of galvanic manufactures have been conducted.

The project of integrated mine water demineralization has been implemented. (“P” stage).

Patenting the developed processes and instruments is carried out.

Electro-deionizator productivity 5m3/h



Cavitation-radiation decontamination installation

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Unmanned System of Vibro-Monitoring and Diagnostics of (USVD) a Turboset

Description

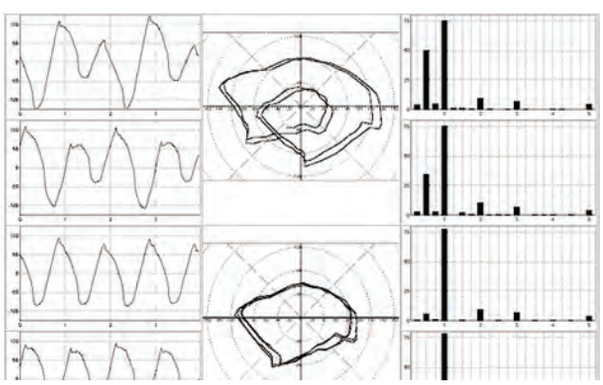
It is intended for prevention of contingencies and damages of a turboset and increasing reliability of its exploitation.

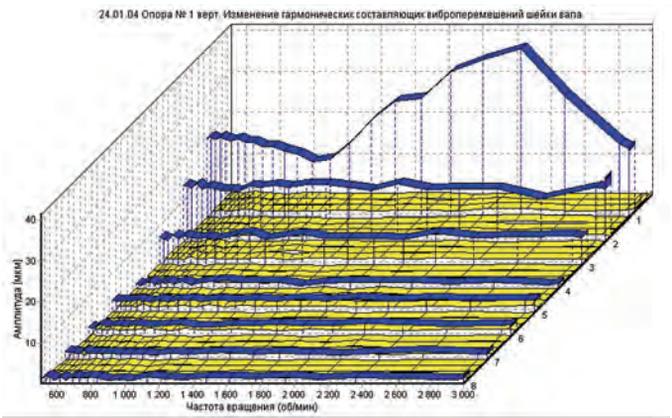
Concept description:

- Simultaneous measuring in all test points, evaluation period 80 mcs;
- permanent, parallel gaining and registration of VB parameters of rotors, supports and the main process-dependent parameters;
- normality vibration monitoring of rotors and supports;
- Prevention of contingencies;
- Vibration analysis: spectral, harmonic, correlated, static. Path and trend generation, harmonic locus;
- Expert judgement of developing the most dangerous defects during vibration increasing. The system can be used for vibration diagnostics of different rotor sets.

Innovative Aspects and Main Advantages

The proposed system is highly competitive with the world analogues by its technical and economic indices and 2-3 times cheaper.





Areas of Application

Power engineering and oil and gas industry.

Stage of Development

The system is developed and applied at 4 power units with an output 300MW (Kiev cogeneration plant-5, Kharkov cogeneration plant-5, Zaporozhskaya TPS).

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Space Research Institute NASU-NSAU

Technical Area Keywords: space, earth connection and space weather, space information systems and technologies, aerospace data processing methods, space material science research, devices for space research, control of space systems

General Information

ISRI was founded in 1996 and today includes main Institute in Kyiv (fundamental physics of near-Earth space, informational technologies in Earth Observation from Space, theory of control), Lviv Center of SRI (space and ground-based instrumentation, data handling systems), Kharkiv Center of SRI (algorithms for ground facilities, ballistics and tracking of Space Vehicles). SRI prepares and performs main national and international research projects in near Earth Space: VARIANT (onboard SICH-1), POTENTIAL (SICH-2), IONOSAT (under development); in Earth Observation: informational services in framework of GEO-UA program; Russian-Ukrainian Program for International Space Station. SRI represents Ukraine in main international Space organizations and working groups. (COSPAR, CEOS, GEO).

SRI is a center of excellence in the field of ionosphere exploration and space weather forecasting. SRI NASU-NSAU has a strong experience in solar-terrestrial physics. Original methods of dynamic systems control under uncertainty have been developed during several years.

Institute has 5 scientific departments, employs about 80 people, including 12 Dr.Sc. and around 20 Ph.D.

Institute's Focus

Main focus points of the Institute in basic research are:

- solar-terrestrial physics and space weather – space information systems and technologies, aerospace data processing methods – space material science;
- development of new instruments for space research;
- theory and methods of control for space systems. Significant roles in the Institute's applied activity are disasters monitoring and mitigation using modern data assimilation, data fusion and techniques.

Valuable Technology Offerings

SRI has a strong interest in joint development and commercialization of new technologies and services in the following areas:

- Geo-information technologies and services;
- Environmental monitoring and natural disaster management;
- Grid and distributed computing;
- Satellite data processing. Fundamental study of upper atmosphere and ionosphere wave activity;
- Investigations of ionosphere response on anthropogenic and natural hazards;

- Experiments on LEO satellites;
- Experiment “Variant” onboard Ukrainian remote sensing satellite Sich-1M launched in 2004;
- Preparation of new experiment “Potential” onboard Ukrainian remote sensing satellite Sich-2;
- Preparation of new mission IONOSAT onboard constellation of 3 LEO satellites;
- Space weather forecasting;
- Space instruments damage due to space weather impacts;
- Development of methods and devices for remote sensing of vegetation.

Scientific Cooperation and Technology Transfer

SRI NASU-NSAU extensively collaborates with the Group on Earth Observations (GEO), the Working Group on Information Systems and Services (WGISS) of the Committee on Earth Observation Satellites (CEOS), and participates in several international and national projects in collaboration with the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER), the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the International Federation of Red Cross (IFRC), University of Florida, Max-Planck institute and SPIE.

IONOSAT mission is included into Ukrainian National Space Program on 2008-2012, is also proposed for the First European Space Program, Space Weather Program and GMES. SRI NASU-NSAU maintains intensive research collaboration with leading international Institutions in the field of space physics: Sweden Institute for Space Physics, Stockholm, Sweden, Laboratoire de Physique et Chimie de l’Environnement (LPCE/CNRS), Orleans, France, Center for Space Research of Polish Academy of Sciences, Warsaw, Poland, Institute of Space Research of Bulgarian Academy of Sciences, Sofia, Bulgaria, SRI of Russian Academy of Sciences, Moscow, Russia; Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation of Russian Academy of Sciences, Troizk, Russia.

The Institute participated in a number of international projects funded by STCU, CRDF, as well as in inter-governmental programs of scientific cooperation.

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Development of Precision Intelligent Systems of Autonomous Navigation and Attitude Control of Space Vehicles under Uncertainty Conditions: Mathematical Methods, Software and Modeling Means

Description

In the work the actual problems concerned to creation the reliable software for high-precision control systems of the modern and perspective spacecrafts (SC) on the basis of new achievements in control theory are developed. It is created constructive and flexible mathematical tools and methods of control including algorithms and software with using the advanced information technology which are realized in the specialized computer system (SCS). This SCS is destined for intellectual support of the problems that should be solved when control systems of the contemporary and perspective SC are designed that allow significantly to reduce the material and time expenses for their working out.

Innovative Aspects and Main Advantages

- Accuracy increase of navigation and control systems by means of advanced algorithms of processing (filtration) of the information obtained from onboard measurement units;
- Keeping of the working capacity of SC control systems with respect to separate failures in the measurement data;
- Development of the methods for fault detection in measuring and executing tools and reconfiguration of the corresponding algorithms;
- Increase of SC functioning autonomy during the Earth observations via the expansion of a spectrum of problems which should be solved by onboard control system including in particular the forming of angular movement reference control and switching programs for sensing equipments under the general information on the areas and shooting regimes which is set by the ground control station;
- Development of the robust control algorithms which surely provide the stable solutions of SC attitude problems when essential difference of SC real dynamic properties from properties of the mathematical models used in control algorithms take place.

Areas of Application

Algorithms and software of precision reliable navigation and attitude control systems for promising multifunctional spacecrafts which are able to solve effectively a wide range of problems of investigation of Space and Solar system, as well as Earth monitoring. Complicated technological processes where reliable high-precision control is required.

Stage of Development

It is prepared the complex project of the new elaborations directed to creation of high-precision navigation and attitude control systems for various type of SC. Specialists and designers from Scientific and Production Enterprise HARTRON (leading firm of the former USSR which was involved in control systems development for srace-rocket technology including intercontinental ballistic missiles SS-18, SS-19) are among project developers. In present the first part of the mathematical tools and modeling complex have been created and have been used for EgyptSat 1 navigation and attitude control system design. This satellite was manufactured by Ukraine for Egypt and which shows the successful operation results.

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Intelligent Information Technologies for Geospatial Data Processing and Delivery

Description

Information technologies for geospatial remote sensing, modeling and sensor data processing have been developed. Common Grid-enabled framework for geospatial data acquisition, processing, delivery and advanced visualization have been developed and deployed in Space Research Institute of NASU-NSAU. Intelligent information technologies were delivered to production real-world applications of flood monitoring (neural networks), yield prediction (support vector machines), crop area estimation (regression and machine learning methods), crop classification (support vector machines, neural networks, state-of-the-art segmentation with machine learning algorithms) and others.

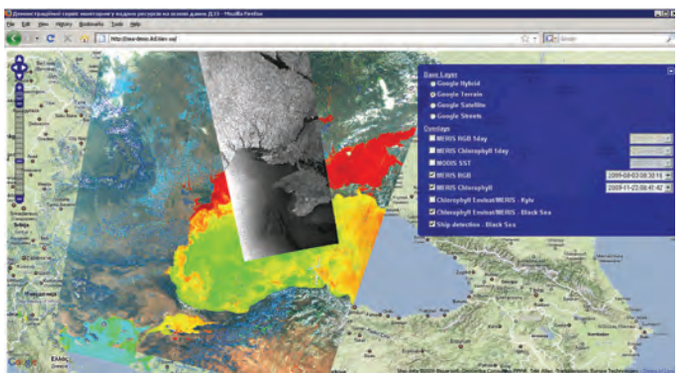
Innovative Aspects and Main Advantages

- Production-grade framework for geospatial data acquisition, processing, delivery and visualization;
- Information technologies for Grid infrastructure integration (Globus Toolkit 4, gLite 3.1, ARC 0.6+ middleware);
- Advanced geospatial data acquisition and preprocessing technologies (multi-tier geospatial data storage system, fault tolerant satellite data receiving technologies, metadata analysis technologies);
- Information technologies for Sensor Web integration;
- Intelligent methods for geospatial data processing;
- Advanced technologies for geospatial data delivery (OGC WMS/WCS integration, KML/KMZ publishing, SOS interfaces);
- Advanced distributed visualization technologies in Web, Grid and service-oriented environments.

Areas of Application

Proposed technologies are used in decision support systems for disaster management, environment monitoring and agro-ecological applications.

- Certification of coherent and non-coherent laser sources;
- Measurements of laser beam power characteristics in scientific and medical applications.



Stage of Development

Proposed information technologies are delivered in 10+ national and international completed and on-going research projects.

More details are available on http://inform.ikd.kiev.ua.

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Field Spectrometer for Remote Sensing of Vegetation State

Description

The field spectrometer consists of two blocks – optical and computing. The optical block is a two-cannel spectrometer with high resolution, adjusted to measurements under field conditions. Except for measuring and basic channels the device is equipped with a channel of visualization for supervision of a site which is measured. Results of measurements in a digital form are recorded on a flash card or can be transferred to the computing block for accumulation in a database. The device is supplied with detectors of temperature, irradiance and the GPS-receiver for determining of geographical coordinates of a site where measurements are carried out. All these service data are registered together with a measured spectrum. A developed software WINCHL has two channels for processing of the data transferred from optical block – user's (subsystem USWHL) and for scientific purpose.

Innovative Aspects and Main Advantages

- Chlorophyll and nitrogen estimation;
- Two-channels noise compensation;
- Validation and calibration of aerospace data;
- Vegetation indexes estimation;
- Robust models of plants state;
- Intelligent algorithms & software.

Areas of Application

Agriculture, validation, calibration, ecology and education.

Stage of Development

- spectral range – 520-800 nm;
- band-pass – 2-3 nm;
- field of vision – 16x160;
- time of measurement of one spectrum –0,1-1 s;
- level of own noise does not exceed 0,1 % from a scale of the device;
- range of measured concentrations of chlorophyll – 1,5-8,0 mg/dm2;
- voltage power – 6 V;
- capacity no more than 4,5 W;
- sizes – 310 x 235 x 200 mm;
- weight (without a support) – 8 kg.

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Ionosphere Exploration

Purposes

- Satellite data processing. Fundamental study of upper atmosphere and ionosphere wave activity (fig. 1)
- Investigations of ionosphere response on anthropogenic and natural hazards
- Experiments on LEO satellites:

1) Experiment “Variant” onboard Ukrainian remote sensing satellite Sich-1M launched in 2004 (fig. 2),
2) Preparation of new experiment “Potential” onboard Ukrainian remote sensing satellite Sich-2. Expected launch date in 2010;
3) Preparation of new mission IONOSAT onboard constellation of 3 LEO satellites (fig. 3). Expected launch in 2013;

IONOSAT mission is included into Ukrainian National Space Program on 2008-2012, is also proposed for the First European Space Program, Space Weather Program and GMES.

We maintain intensive research collaboration with leading international Institutions in field of space physics:

- Sweden Institute for Space Physics, Stockholm, Sweden
- Laboratoire de Physique et Chimie de l’Environnement (LPCE/CNRS), Orleans, France
- Center for Space Research of Polish Academy of Sciences, Warsaw, Poland,
- Institute of Space Research of Bulgarian Academy of Sciences, Sofia, Bulgaria,
- Institute of Space Research of Russian Academy of Sciences, Moscow, Russia,
- Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation of Russian Academy of Sciences, Troizk, Russia.

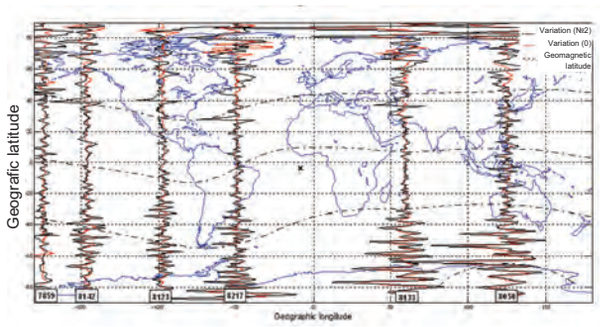

Fig. 1. Global distribution of atmosphere gravity waves according to Dynamics Explorer 2 data

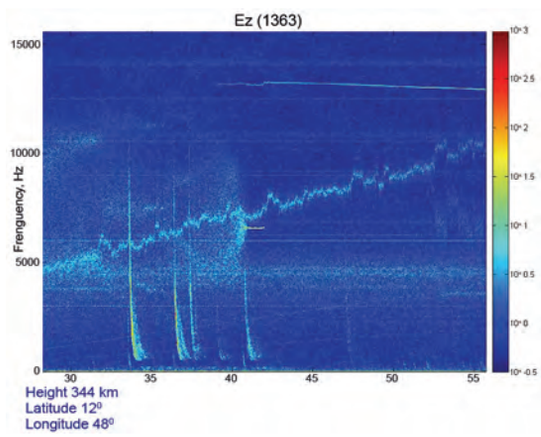

Fig. 2. VLF plasma emissions observed onboard Sich-1M satellite (experiment “Variant”).

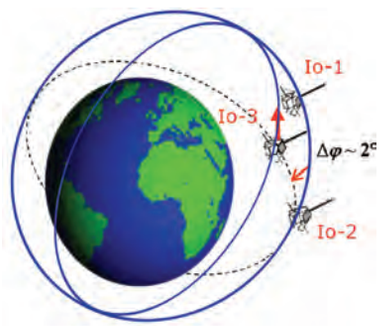

Fig 3. Satellite constellation proposed for IONOSAT mission

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Forecasting the Geomagnetic Activity

Description

We have developed the software for real-time forecasting of geomagnetic indices, which uses readily available data from ACE and a number of ground stations. We are able to predict a geomagnetic storm 2-3 hours before commencement with 94.1% correlation and very low false alarm rate. The typical elapsed time per forecast is a few seconds on an average PC. The proposed system can also be useful for investigating of physical phenomena related to interactions between the solar wind and the magnetosphere – it has already helped uncovering two new geoeffective parameters.

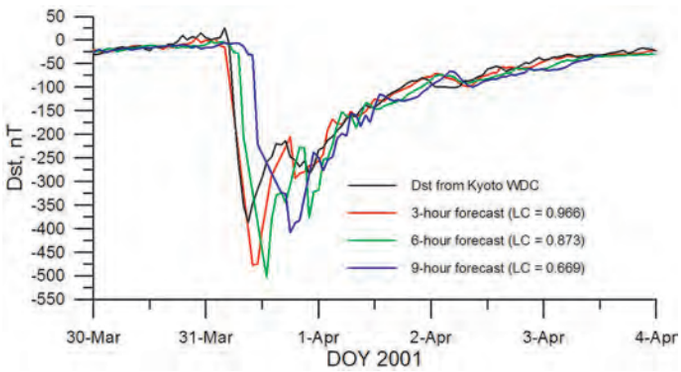

Fig. 1. A forecast example

Innovative Aspects and Main Advantages

- Real-time forecasting;
- Very precise (~95% correlation);
- Small time lag (<1 hour);
- Very fast operation (<5 sec/forecast);
- High stability of the results;
- Ability to construct phenomenological models of interaction between the solar wind and the terrestrial magnetosphere;
- Ability to analyze spectral characteristics of the magnetosphere.

Areas of Application

Space weather, solar-terrestrial physics.

The algorithms used in the developed software can be applied to forecast the behavior of any natural or technological system, which can be described with a nonlinear black box model.

Stage of Development

8 scholarly articles were published in peer-reviewed journals. The software successfully passed online tests in 2008.

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Usikov Institute of Radiophysics and Electronics

Technical Area Keywords: physics, sensors, microwave science and engineering

General Information

The Institute of Radiophysics and Electronics (IRE) was established in 1955 as a spin-off of the Kharkov Institute of Physics and Technology as a primary research institution in microwave science and engineering in Ukraine. The main objective of the newly founded Institute was research and development in the wide frequency range of electromagnetic wave spectrum, with a special emphasis on the millimeter (mm) and sub-millimeter (sub-mm) waves.

The structure of the Institute includes 19 departments (650 people, 220 of which are scientists), a Special Design Bureau (SKTB), and a Pilot Production facility for experimental and prototyping production of microwave and mm-wave devices. The facility works with IRE researchers on application development projects, but maintains certain independence within the Institute.

Institute's Focus

ISP is engaged in fundamental and applied research in the following areas:

- semiconductor materials science;
- interaction between electromagnetic radiation and matter;
- semiconductor optics, spectroscopy and photonics;
- physics of low-dimensional structures, micro- and nanoelectronics;
- optoelectronics and solar energetics;
- technologies and materials for sensors;
- infrared engineering and microwave electronics.

Valuable Technology Offerings

Tangible outputs include mm-wave klystrons, magnetrons, klynotrons, and orotrons (generators of diffraction radiation), as well as systems for high temperature plasma diagnostics, masers for radio astronomy, Doppler, noise and other radars, polarimeters, high-temperature sensors, super-compact testing ranges, and so on.

Concurrently with traditional fields of study, new areas of research were explored to include subsurface radiolocation (Ultra Wide Band / Short Pulse (UWB/SP) Radiolocation), optics of periodic media, Earth remote sensing from air- and space-born carriers, acoustic monitoring of sea bottom, use of microwave electronics for biomedical applications, etc.

Scientific Cooperation and Technology Transfer

IRE maintains active collaboration with a number of research institutions both in and outside of Ukraine. Close ties remain with the National Scientific Center “Kharkov Physical-Technical institute” (e.g., joint research on electronic-optical modules for vacuum systems), one of the founders of Scientific and Industrial Concern NAUKA, a project management organization facilitating technology transfer and commercialization through a number of programs, such as the bi-lateral Russian-Ukrainian Science and Technology Program “Nanophysics and Nanoelectronics”.

International cooperation includes joint research projects under European Union’s Framework programs. For example, IRE’s Modeling of Optoelectronic Components and Antennas group participates in two Networks of Excellence, Micro-Scale to Nano-Scale Photonic Structures for Optical Communications and Antenna Center of Excellence. Over 20 projects were funded by INTAS and STCU. Noteworthy is cooperation with the International Research Centre for Telecommunications and Radar, Delft University of Technology, the Netherlands, the International Center for Theoretical Physics in Trieste, Italy, and, especially, the Institute of Bio-and Nanosystems (IBN) of the Research Centre Jülich, Germany, where IRE scientists participate in the studies of transport and noise properties in advanced materials and heterostructures for the design of ultra low noise oscillators and sensors.

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Clynotrons – Microwave Electrovacuum Generators

Description

Clynotrons are low- and medium-power ra-diation continuous operation sources in the short-wave part of millimeter range.

Innovative Aspects and Main Advantages

Advantages: the clynotron effect being applied together with a high-performance system for generating dense ribbon electron sharply-shaped beam provides a substantial (by an order) increase in the output power in comparison to conventional BWO; a combined tuning of frequency within a wide band, i.e. up to several per cents from the central one.

Clynotrons can be realized to operate over the whole millimeter wave range, including submm, with the advanced output power of 30 W and higher in the 8-mm wave range and a few hundred mW in the submm wave range.

Analog: Development Wave Oscillator at 300 and 650 GHz, J.A.Dayton and et al., “IVEC/IVECS 2006”, April 25-27, 2006, Monterey, C, USA (f =285GHz, output power – 28,5 mW).

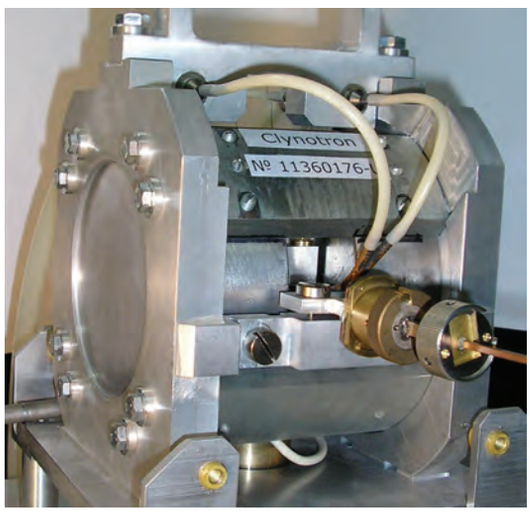
Areas of Application

Clynotrons can be applied in physical ex-periments, radio spectroscopy, near-field ra-dar, radio vision, etc.

Stage of Development

Tested, available for demonstration.

Images and Presentation



Clynotron of advanced output power for a shot wave of millimeter band

Clynotron characteristics

Anode voltage, kV	4,8
Anode current, mA	150
Output power at the wavelength 1 mm (not less), mWt	300
Stand-by time, hours	500
Dimensions, (without magnet), mm	Ø 50x30
Weight (without magnet), kg	0.3

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Device for the Irradiation of the Biological Liquids with the Electromagnetic Waves of the Millimetre Band

Description

The proposed device is qualified as re-search and medicinal devices in domain of the medical-biological equipments that are used for the irradiation biological liquids and another strongly absorbing liquids with the millimeter waves. The device en-ables one to irradiate the liquids in conditions of the minimum probability of the disorder of its sterility. The irradiation possibility of the maintenance personnel is decreased for the work with this device.

Innovative Aspects and Main Advantages

The device was made in the form of the cylindrical resonator with the axial grooves (turnings) in the end walls for the placement and fixing in it of the capacity with the irradiate liquid for example the syringe. The resonator and capacity sizes are connected by the specified relations.

Areas of Application

In research and medical investigations for the biological liquids irradiation for exam-ple, blood, blood plasma, physiologic sa-line, water and another strongly absorbing liquids.

Stage of Development

- Patented
- Tested, available for demonstration – field tested.

Images and Presentation

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Double-Beam Multi-Capsule Evaporator

Description

Double-Beam multi-capsule electron evaporator for simultaneous or serial of two or three materials with different properties for their uniform deposition in various film application technologies, especially in implantation stimulation.

Developed by Usikov's Institute of Radiophysics and Electronics NASU, Kharkiv, Ukraine with support from Science and Technology Center in Ukraine (project #2050)

Innovative Aspects and Main Advantages

Design specificity.

- The common for two electron counter-beams, principal quadrupole magnetic deviating system possessing focusing properties with the evaporated objects inside. Such design enables one to place the distributed vapor sources of the evaporated materials close to each other, as well as provides the normal incidence of the electron beams on the evaporation surface, stable focus spots sizes during 2D scanning (0.1÷200 Hz) and the return of the secondary and reflected electrons;
- Flexible design of the electron guns with variation of perveance (0.3÷2.1·10-6 A/V3/2);
- Cathodes made of ultra-pure single-crystal lanthanum hexabo ride having a high resistance toward ion bombardment, manufactured after a unique, in-house technology;

Highly cost-efficient design of the electron-beam cathode-heating units.

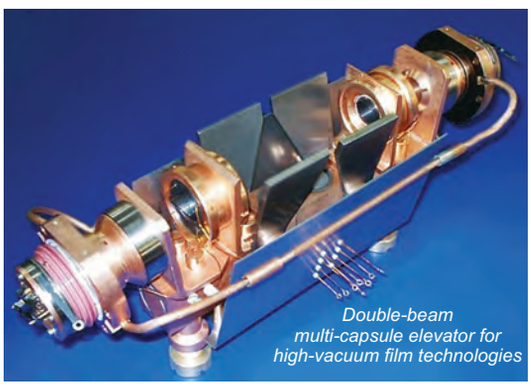
Areas of Application

The evaporator has been implemented in the ARGO-2 technological facility (NSC "KIPT") for ion-beam-assisted deposition of coatings with nanocristall struction.

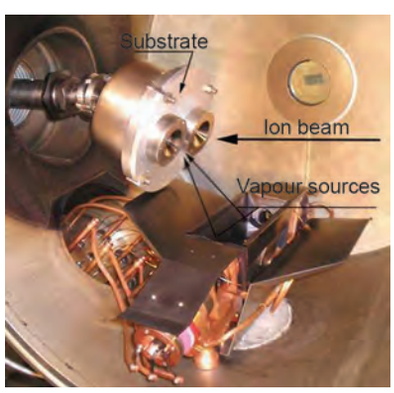
Stage of Development

Tested, available for demonstration.

Images and Presentation



Evaporator in the unit for producing film materials with nano-crystal structure



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EHF Dielectrometer

Description

The developed hardware complex consists of the reflectometer based on the four-probe measuring (slotted) line and the modified measuring cell. The reflectome-ter works at the frequency 39.5 GHz and measures the complex reflection coeffi-cient automatically in the band module value 0.05-0.8 (accuracy no worse than ±1,5%) and phase 0-360° (accuracy no worse than ±1,5%). For the loads with the reflection coefficient close to the cell with the sample the accuracy is ±0.4% and ±0.15° for the module and phase corre-spondently. The preliminary calculations showed that the measurement accuracy permits one to obtain the permittivity with the statistical confidence 2-3%. The ob-tainable accuracy characteristics of the de-vice confirm the replacement adequacy of the measuring line with the movable probe that was used in the devise previous ver-sion by the multi-probe analog. The meas-urement time of a microwave load is about 3 seconds. The power in the waveguide microwave transmission line is no more than 10 mW. It eliminates the sample heat-ing in the course of measurement. The last is very impotent for the investigation of the biological objects.

Innovative Aspects and Main Advantages

It permits one to take measurements of the permittivity complex value for the strongly absorbing substances with the statistical accuracy about 2-4 %.

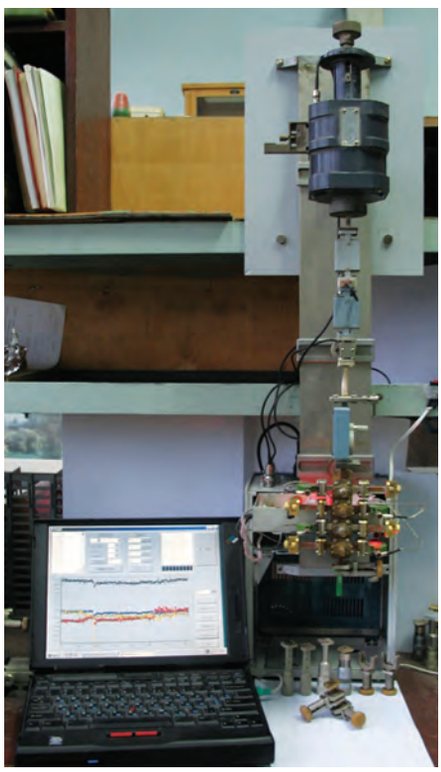
Areas of Application

Medical-biological investigations.

Stage of Development

Tested, available for demonstration – field tested.

Images and Presentation



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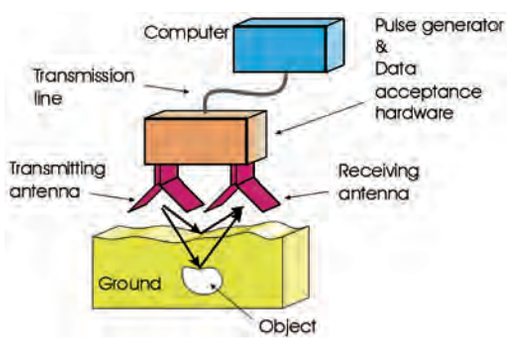
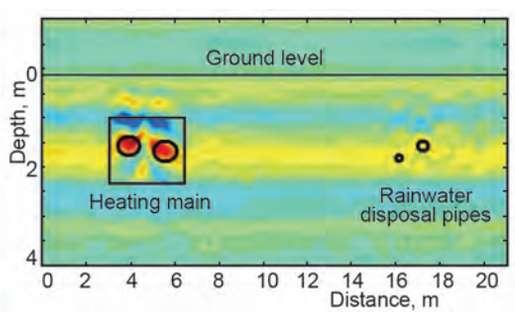
Ground Penetrating Radar "ODJAG"

Description

Ground-penetrating radar (GPR) is a geo-physical method that uses short (ultrawide-band) electromagnetic pulses to sound the subsurface. This is non-destructive radar method. Ultrawideband pulses provide high resolution as well as quite deep penetration. It allows detecting the re-flected signals from subsurface structures. GPR can be used in a variety of media, including rock, soil, ice, fresh water, pavements and struc-tures. It can detect objects, changes in ma-terial, and voids and cracks.





Innovative Aspects and Main Advantages

- Frequency independent high decoup-led transmitting-receiving antenna system;
- *GPR ProView*© data processing software;

New patented antenna system provides high decoupling (-103 db) between trans-mitting and receiving antenna. It makes the GPR power budget very high and creates the necessary condition to locate more ac-curate and deeper than other GPR at the same other conditions.

New patented method for the automatic lo-cal targets de-tection simultaneously with automatic propagation speed estimation provides higher accuracy of the target depth measurement.

Areas of Application

- Ultrawideband radiolocation;
- Search for underground utilities (me-tallic or non-metallic);
- Roads inspection.

Stage of Development

- Available for demonstration;
- Further improvement.

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Microwave Resonator

Description

The disk resonator has the increase selec-tion level of the azimuthal oscillations and high Q-factor (final result – one resonant response in the broad band).

Innovative Aspects and Main Advantages

The disk dielectric resonator with the os-cillations of the whispering gallery type in which for the rare spectrum the system of the metallic strips forming the diffraction grating was coated on the side surface.

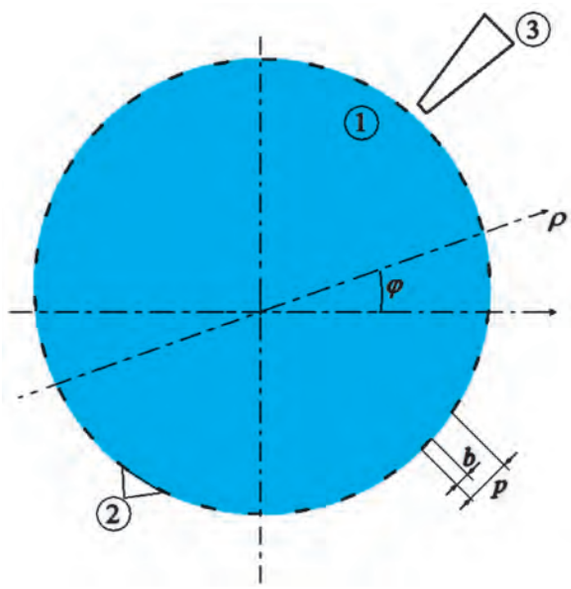
Areas of Application

One is used in microwave engineering for the oscillation selection for example as the resonance networks for the microwave os-cillators.

Stage of Development

Tested, available for demonstration – field tested.

Images and Presentation



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Portable Radar-Set for Rescuers

Description

This device is used for search and rescue operations in the areas of natural disasters or mancaused catastrophes. It facilitates to reveal and determine location of the people under wreckage after earthquakes, explosions, fires etc. it can be also used for detecting moving objects behind optically non-transparent obstacles. The principle of operation of this unit is based on recording the information signal phase shifts, which are stipulated by Doppler frequency bias. It occurs due to the interaction between the probing emanation and a stiff object.

Main performance characteristics:

Maximum distance to the obstacle	– 15 m
Detectable objects depth	– up to 5 m
Distance resolution ratio	– 0.7 m
Wave band – decimetric	
Self-contained power supply	
Weight (without power supply unit)	– 3 kg
Weight of the power supply unit	– 5 kg
Overall dimensions	400x150x140 mm3
Operating time without recharge	– not least than 8 hours.

Innovative Aspects and Main Advantages

The device allows quickly find out people after a mancaused catastrophes behind bricks or concrete barriers. The process of palpitation, breathing and motion of extremities is the distinctive sign of living man. It is possible to select these signs by the Doppler analysis of echo-signals of radar.

Areas of Application

- Rescue services for search and rescue operations in the areas of snow avalanche and other natural disasters or mancaused catastrophes;
- Counterterrorist (military or police) units for men detection in guard or restricted areas;
- Medicine service for remote measurement (non invasive) the process of palpitation, breathing.

Stage of Development

Tested, available for demonstration.

Images and Presentation

Fig.1 Portable Radar-Set for Rescuers

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Quasi-Optical Solid-State Oscillators

Description

The millimeter band QSO with the spheri-cal-echelette open oscillating system is the source of the high-stable electromagnetic oscillations. QSOs were developed at the fixed frequencies with the mechanical fre-quency control to 0.5 GHz. The oscillator has no need of the forced cooling. The ba-sic characteristics of the developed QSOs are set out in Table below. The oscillations frequency instability at a second is no more than 10-8 for the power source instability 10^{-4}.

Innovative Aspects and Main Advantages

The increase of the long-term stability of the frequency is achieved by the applica-tion of the high-Q quasi-optical resonators with the angle-echelette mirror that made of the special materials as well as by the using of the thermally stabilized hermetic chambers filled with the inert gas.

Type of device	Type of diode	F, GHz	P, mW
OQG-8	Gunn diode (GaAs)	30-40	110
OQG-3	Gunn diode (InP)	80-86	10
OQI-8	IMPATT diode	33-42	180
OQG-5	IMPATT diode	53-62	60
OQG-8T	Gunn diode (GaAs)	37,5	110
OQI-3	IMPATT diode	93-96	15
OQI-3A	IMPATT diode	115	15
OQNB	Gunn diode (ONB 12)	67	5

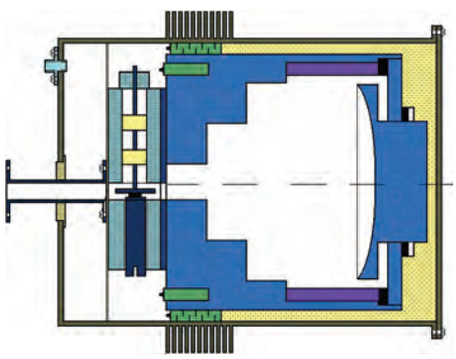
Areas of Application

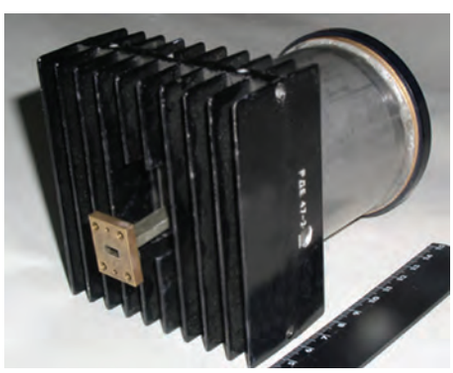
They can be used in the scientific aim, in spectroscopy, in microwave engineering for example as the low-noise heterodynes and pump oscillators for the parametric amplifiers.

Stage of Development

Tested, available for demonstration – field tested

Images and Presentation





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Radar Sensor of Dust

Description

- The Dust Sensor (sensor) is intended for inspec-tion of a volumetric distributed dust and based on double frequency radar. At present large amount of various sensors of dust (aerosols) provide measurements in wide range of particles dimen-sions with satisfactory accuracy. But practically all of them are based on contact methods which require getting of a sample.
- But often it is necessary to provide inspection of remote sources of dust, for example in chimneys or simply in air. Therefore we developed the dust sensor which based on double frequency radar and algorithm of signal processing that permit to find mass-loading, effective particles diameter and number of particles in unit volume.
- The surface appearance of the sensor prototype is shown on the figure. The prototype is based on two coherent solid state radars in 3 mm and 8 mm wavelengths, antennas of which are focused at the same volume.

Innovative Aspects and Main Advantages

- Innovation aspect is based on development of the original signal processing algorithm that per-mits to measure parameters of aerosols;
- Main advantage of the sensor is the ability to provide remote inspection of dust parameters in large volumes in contrast to existing devices that use the contact methods of measurements.

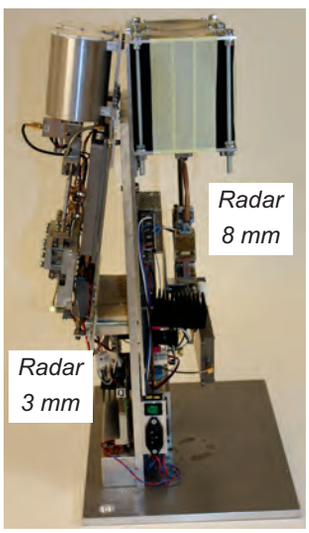
Areas of Application

- The sensor can be used everywhere to control technological processes that produce atmospheric pollutions, including thermoelectric power sta-tions, cement works, enterprises of mineral re-sources industry etc.

Stage of Development

The prototype of the sensor is in development phase – laboratory tested.

Images and Presentation



The surface appearance of the sensor prototype

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Radio Beam Sensor for Perimeter Intrusion Protection System

Description

The Radio Beam Sensor (sensor) is intended for generating of alarm signal when a person or vehi-cle crosses guarded perimeter. Transmitting unit radiates pencil beam -fig. 1 along the perimeter, on other end of which the receiving unit is situ-ated in a straight visibility. When any object (per-son, vehicle etc.) crosses the beam, the level of signal received decreases and sensor generates an alarm signal, which can be translated to any moni-toring system.

Innovative Aspects and Main Advantages

- *Innovation aspect* is connected with use of mil-limeter wave band for operation of the sensor;
- Main advantages of the sensor are the following:
- *Hidden of operation* because of sensor design – fig. 2 (it is impossible to determine a destination of the sensor and location of radio beam;
- *Capability to detect a creeping intruder* that permits to create practically irresistible electronic fence.
- *All-weather operation* regardless to fog, heavy rain or snowfall;
- *High noise immunity* regarding precipitations, birds and with respect to lightning, power optical sources and outer electromagnetic fields;
- *Low price* in comparison with other systems.

- *Performance specification*.
- Frequency range 35 GHz
- Max length of a perimeter section 300 m
- Beamwidth at a max length ≤ 1,0 m
- Rate of beam crossing 0,01-10 m/s
- Self-contained power supply with solar battery:

Areas of Application

The radio beam sensor can be used as a compo-nent of intrusion protection systems in large outer perimeters (oil and gas storages, airports, traffic centers, electric power stations (including nuclear power stations) and other protected areas.

Stage of Development

The prototype of the sensor is field tested and available for demonstration.

Images and Presentation

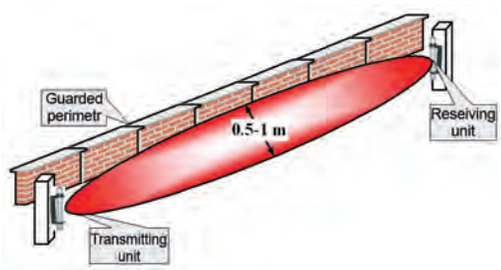

Fig. 1 Operation principle

Fig. 2 Design of the sensor prototype

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Remote Sensor of Vibrations

Description

The Remote Sensor of Vibrations (SENSOR) is based on coherent radar in millimeter wave band which illuminates the object under inspection -fig.1. The reflected signal is modulated by phase

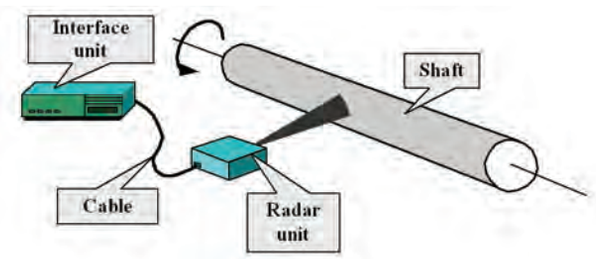

Fig. 1 Principle of the sensor operation

and amplitude due to the object vibrations. The scattered signals are priory processed in the inter-face unit and entered to the PC. To restore pa-rameters of vibration special algorithm for signal processing was developed that permits to measure parameters of vibration including time structure and spectrum.

Innovative Aspects and Main Advantages

Comparatively with optical and ultrasonic sensing, use of *radar sensing* provides vibration measurements on long distances, independently of surface roughness and presence of oil film. As well it does not require any calibration (potential accuracy of vibration measurement depends on measurement accuracy of radar frequency).

Areas of Application

Remote vibration measurements of *moving objects* (rotary shafts, turbines, engines), in *dangerous zones* (chemically active environment, high temperature, pressure, radioactivity, etc.) and for *remote objects* (high-rise buildings, bridges, platforms, etc).

Stage of Development

The prototype of the sensor is in development phase – laboratory tested.

Images and Presentation

Two types of the sensors were performed and tested: for near range operation – fig.2a and for remote sensing – fig.2b. The near range prototype consists of radar unit (to the left) and interface unit (to the right) that linked together by a cable.

a)

b)

Fig. 2 Prototype of the near range sensor – a) and for re-mote sensing – b)

Parameter	Near Range	Remote sensing
Frequency, GHz	35,5	35,2
Power radiated, mW	30	50
Receiver sensitivity, dBW	-75	-125
Distance, m	≤ 3	≤600
Frequency range, Hz	$10 \div 10^4$	$10^{-2} \div 10^3$
Accuracy (RMS), μm	7	80

The prototype for remote sensing contains co-herent radar with high-directivity antenna which are jointly fixed on free adjustable mounting.

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Stand for Quasi-Optical Researches SQR-0.14

Description

The Stand for quasi-optical researches SQR –110/1 (further referred to as the Stand) created in accordance with Partner project STCU P-103. It operates in short-wave part of the millimeter band of electromagnetic waves. The Stand is intended for the demonstration of the quasioptical (QO) measuring methods in THz frequency region and training of the university students and researchers specializing in radiophysics.

The SQR-0.14 is the device made on the basis of the hollow dielectric beamquide (HDB) with cir-cular cross-section of 20 mm diameter.

Working frequency - 0.14 THz.

Overall SQR-0.14 dimensions in assembled state are 100x40x50 cm.

Mass - no more than 40 kg (net), 55кг (gross).

Operating conditions:

- environment temperature from 10°C to 40°C;
- relative humid less 80% at the temperature +20±5°C;
- atmospheric pressure 750±30 mm mercury column.

Power supply: alternating current 220V/110V±10V, 50 Hz/60 Hz; direct current 24V±3V, 0.3A.

Innovative Aspects and Main Advantages

The Stand provides the following functions:

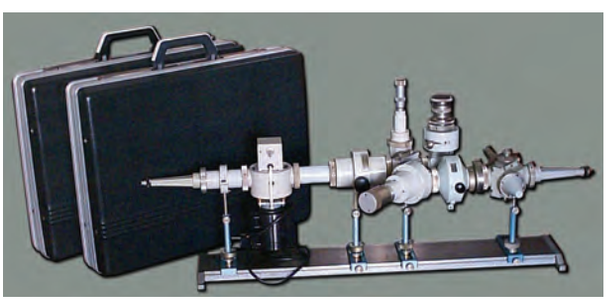
- experimental determination of reflection factor modulus and phase by the Michelson interferometer method;
- experimental determination of wavelength by the Michelson interferometer method;
- experimental determination of insertion at-tenuation (losses) by a substitution method;
- experimental determination of polarization diagram by rotary polarization-analyzer method;
- experimental determination of the depend-ence of mirror reflection factor modulus on the angle of incidence of wave at sample flat surface.

Areas of Application

The perspective fields of project development applications are: physics, radiophysics and elec-tronics of terahertz frequency range, spectros-copy, biomedicine, as well as university educa-tional laboratory.

Stage of Development

The Stand has been developed, manufactured, and delivered to the Partner - Department of Electrical Engineering Arizona State University, Consortium for Metrology of Semiconductor Nanodefects Multi-disciplinary Laboratory for Material-Wave Interactions Nanomechanics Program.



Appearance of the Stand SQR-0.14

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Stand for Quasi-Optical Researches SQR-110/1

Description

The Stand for quasi-optical researches SQR –110/1 (further referred to as the Stand) created in accordance with Partner project STCU P-278. It operates in short-wave part of the millimeter band of electromagnetic waves. The Stand is intended for the use as a part of electron paramagnetic re-sonance spectrometer (EPR) and nuclear magnetic resonance spectrometer (NMR) for scientific investigations in biology, biophysics and bio-chemistry. The Stand is realized on the basis of a metal- dielectric waveguide (MDW) providing extremely small loss per unit length of electromagnetic wave, quasi-optical radiomeasuring de-vices, and circuit elements made on the basis of MDW.

Innovative Aspects and Main Advantages

The Stand provides the following functions:

- effective transmission power pumping of li-nearly polarized electromagnetic wave from signal source to measuring resonator, located in helium cryostat;
- commutation of pumping signals sources;
- signal frequency measurement by quasi-optical absorbing wavemeter;
- adjustment of signal power level by means of quasi-optical direct reading polarization at-tenuators;
- effective transmission of reflected wave EPR signal-response and reference signal to detec-tor;
- compensation of influence of generator fre-quency fluctuation on Stand's performance.

Becides, the Stand's modifications for operation with the high power generators (gyrotrons) have been created. The Stand providing effective nu-clear dynamic polarization pumping when opera-tion wave is circular polarized is being developed.

Areas of Application

The perspective fields of project development applications are: physics, radiophysics and elec-tronics of terahertz frequency range, spectros-copy, biomedicine, as well as university educa-tional laboratory.

Stage of Development

The Stand has been developed, manufactured, and delivered to the Partner - Center for Bio-molecular Magnetic Resonance (BMRZ) J.W.Goetre University (Germany, Frankfurt am Main).

The Stand SQR-110/1 is a quasioptical part of EPR-NMR spectrometer with dynamic nuclear polarization pumping in terahertz frequency band

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Surveillance Sensor for Intrusion Protection Systems

Description

The Surveillance Sensor (sensor) is intended for generating of alarm signal when a person or vehicle entered the protected area. Radar scans the given area – fig. 1 and when any object (person, vehicle etc.) entered the area, level of signal reflected in-creased and the sensor generates an alarm signal, which can be translated to any monitoring system.

Innovative Aspects and Main Advantages

- Innovation aspect is connected with two features:
- Use of a solid state coherent radar in millimeter wave band;
- Development of the software to match a radar im-age and graphic map of the area protected;

- Main advantages of the sensor are the following:
- Pictorial rendition of the situation in the area protected on PC monitor due to matching of radar image and graphic map of the area
- Safety of operation for an attending personal, working at the area protected because of very small power radiated (more then 1000 times smaller then the overload capacity)
- All weather operation regardless to fog, heavy rain or snowfall
- High noise immunity regarding precipitations, birds and with respect to lightning, power optical sources and outer electromagnetic fields.

- Performance specification

• Frequency range	35 GHz
• Max diameter of the area protected	1000 m
• Azimuth beamwidth	≤ 2,2 deg
• Rate of an intruder	0,01-10 m/s
• Power supply	≤ 10 W

Areas of Application

The surveillance sensor can be used as a component of intrusion protection systems of large areas, including oil and gas storages, airports, traffic centers, electric power stations and other protected areas.

Stage of Development

The prototype of the sensor is in development phase - laboratory tested.

Fig. 1 Surveillance sensor

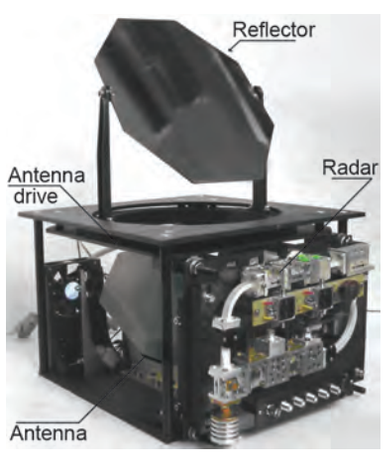

Fig. 2 Design of the surveillance sensor

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UHF Radio Wave Attenuation Factor Distance Dependence Database

Description

Almost each sea-going vessel is known to be equipped with navigation, communication and other radio engineering facilities that serve to secure the safety of navigation and are chiefly operated at UHF-wave band. The key parameter of a propagation path is the (radio) wave attenuation factor and its dis-tance dependence . A diversity of meteofactors influencing the radio signal attenuation over the oce-anic expanses and the lack of experimental data could be routinely acquired were the compelling reasons to develop the attenuation factor distance dependence database.

Innovative Aspects and Main Advantages

The database allows solving the following problems:

- to determine parameters of radar, navigational and another radio engineering systems developed to provide necessary coverage range in the World Ocean regions in question;
- to make coverage range diagnosis and forecast for existing and exploited radar, navigational and another radio engineering systems in the World Ocean regions in question, which improve shipping safety;
- to conduct continual monitoring of UHF wave propagation conditions in various regions of the World Ocean.

Areas of Application

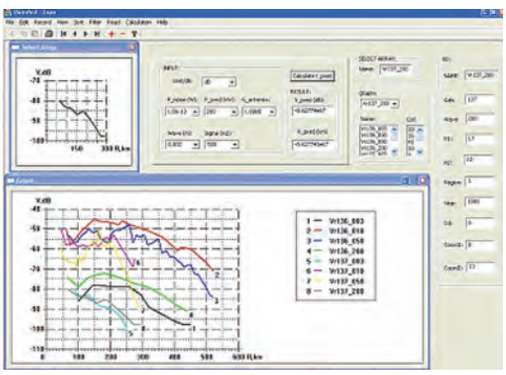
The distance dependences of the attenuation factor for the UHF waves may find their practical use in de-signing and developing the radio engineering facilities that are capable to operate over oceanic surfaces and in validating the existing theoretical radio wave propagation models.

Stage of Development

The database of radio wave attenuation factor dis-tance dependences for ranges in 20÷600 km was developed on the base of experimental data obtained in different regions of the Atlantic, Indian, Arctic and Pacific Oceans. The database itself con-sists from a set of experimental data arrays, organized as a database, and of application program package, allows one to use this database and to solve rationally the problems in question.

The database is ready for testing and demonstration.

Images and Presentation



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