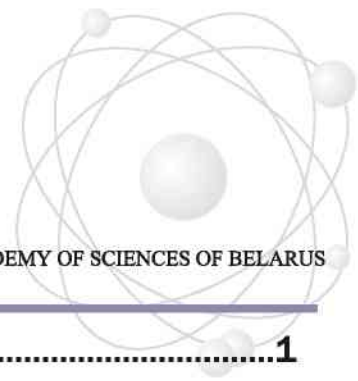


NATIONAL ACADEMY OF SCIENCES OF BELARUS

**SCIENTIFIC-PRACTICAL MATERIALS
RESEARCH CENTRE OF THE NATIONAL ACADEMY
OF SCIENCES OF BELARUS**



MINSK 2016



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Administration of the Scientific-Practical Materials Research Centre of NAS of Belarus

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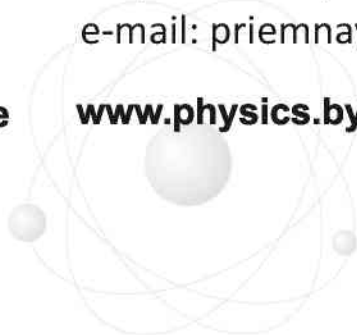
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GENERAL INFORMATION ABOUT ORGANIZATION

The State Research and Production Association “The Scientific and Practical Materials Research Center” has been established under the Decree of the President of the Republic of Belarus of 01.11.2007 № 554 by force of corporate reconstruction of the state research institution “The Institute of Solid State and Semiconductor Physics of NAS of Belarus”. The Research, Development and Production Facility consists of the following institutions: the state research institutions of the National Academy of Sciences of the Republic of Belarus – the V. A. Biely Metal-Polymer Research Institute, the Institute of Applied Physics, the Institute of Technical Acoustics, the Institute of Metal Technology, the Institute of Chemistry of New Materials, the Institute of Physics and Technology, as well as republican unitary enterprises – «Ferrit», RUF SKTB «Metal Polymer»

The main objective of «The Scientific and Practical Materials Research Center» is organization and realization of research and experimental work in the sphere of material physics and physicochemical material engineering, development and exploitation of novel competitive products in production. In accordance with the main objective priority directions of fundamental and applied researches, priority directions of scientific and technological activities of the Republic of Belarus of the Centre solves the following issues: the creation of new magnetic, ferroelectric, semiconducting, metallic, superconducting, ultrahard, optical materials in the form of crystals, ceramics, disordered systems, nanomaterials and nanostructures; the development of methods and technologies for the production of organic and inorganic materials, including composite material and products on their basis; the development of methods and equipment for nondestructive control and technical diagnostics of materials and products; the development of recommendations for use of scientific findings in practical terms, their support during the development in production; the ensuring of competitive ability of created technological solutions and of its commercial exploitation organization, including foreign market; trainings of academic staff members of top-qualification.

The Centre performs and coordinates research activities within the state complex target scientific and technical programme SSTEP “Materials and technologies” in 2011 – 2015, which includes the state scientific research programme SSRP “Functional and composite materials, nanomaterials”, SSRP “Electronic engineering and photonics”, the state scientific and technical programme SSTEP “Cost-effective use of resources, advanced materials and new technologies – 2015”, SSTEP «Optic-Tech». of the Centre also participates in a number of tasks included in SSRP and SSTEP “Materials and Technology”, research and development programs of the Union state, projects funded by the Belarusian Republican Foundation for Fundamental Research and another international funds. In 2016 – 2020 of the Centre will be the head implementing organization in the forming SSTEP “Material physics, novel materials and innovative technologies”.

The Centre provides a full innovative and production cycle: starting from the production of materials with the predetermined properties to the development and manufacturing of products for specific practical needs. Research and development projects are carried out not only in the interest of a number of ministries and departments of the Republic of Belarus (for example, in the interest of the Department of Industry, the Department of Housing, Building and Architecture, the Ministry of Municipal Affairs and Housing, the Ministry of Healthcare, the Ministry for Emergency Situations, the Ministry of Education, the Ministry of Finance), but also within the confines of extensive international cooperation with the countries of the Commonwealth of Independent States, the European Union, the USA, China, South Korea, Iran, Vietnam, Mongolia, Israel, the Republic of South Africa and etc.

Approximately 1300 people are employees of the “The Scientific and Practical Materials Research Center”. Annual total volume of work performed by its institutions is equal to \$US 30 MLN.

Laboratory of Solid State Physics

Head of the laboratory – Dr. Sc. Valery F. GREMENOK

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Basic Direction of R& D Activity: Fundamental Investi:

Chemical bonds in crystals, semiconductor thin-film materials and their properties.

Investigation of the real crystal structure characteristics, phase transitions and physical properties of stable and meta-stable phase's real crystal structure in ferroelectrics.

Applied Investigations:

-Development of semiconductor and ferroelectric materials in single crystal, thin film, and ceramic forms for electronic and optoelectronic applications.

-Complex study of composition, crystal structure defects, and impurity influence on physical properties of multi-component semiconductors and ferroelectrics including relaxor.

New Forming Directions of Investigations:

-Lattice dynamics and phase transitions in dielectric crystals with modulated structures.

-Influence of impurities, electron and gamma radiation on physical properties of ferroelectric materials.

-New lead-free oxide ferroelectric materials.

-Development of preparation technology of new generation semiconductor materials for photovoltaic solar energy converters based on multi-component chalcogenide compounds.

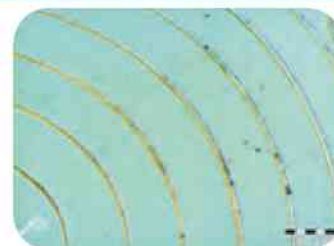
-Physical basics of nano-structuring thin-film semiconductor materials for optoelectronic and photovoltaic applications.

Laboratory of Magnetic Films Physics

Head of the laboratory – Dr. Sc., Corresponding Member

Valery M. FEDOSYUK

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Basic Direction of R& D Activity: Fundamental Investi:

Theoretical and experimental bases of magnetism in thin film materials, kinetic phenomena and surface effects in nanoscale magnetic structures, magnetism in amorphous alloys, intergranular interactions and magnetization reversal processes, formation of interface boundaries without epitaxial harmonization.

Obtaining of magnetoplasmons crystals (MPC) by a combined ion-beam sputtering method (broad beams of low-energy oxygen ions). Study of optical and magneto-optical effects in the MPC and control of their properties by external magnetic field.

Development of phenomenological models of interaction of electromagnetic radiation with multilayer and composite structures based on transition metals.

Applied Investigations:

Investigation of the formation conditions and physical properties of amorphous, nanocrystalline and composite films based on transition metals. That can be used for materials development for protection of microelectronic and radio electronic equipment against electromagnetic and ionizing radiation.

Development of ion-beam sputtering methods for thin-films deposition; technology superfinishing surface polishing of optical materials; development of large aperture discharge ion sources of original design with no limit on the period of operation for vacuum equipment dual ion-beam sputtering and deposition; lab plasma generators of SHF discharge.

The List of Legal Entities Included in to the Structure of the «Scientific-Practical Materials Research Centre of NAS of Belarus»

- 1** State Research Institution "Institute of Solid State and Semiconductor Physics of NAS of Belarus" (from February, 1, 2008 transformed to the "Scientific-Practical Materials Research Centre of NAS of Belarus", the head organization of the Centre)
- 2** State Research Institution "Physico-Technical Institute of NAS of Belarus"
- 3** State Research Institution "Institute of Applied Physics of NAS of Belarus"
- 4** State Research Institution "Institute of Chemistry of New Materials of NAS of Belarus"
- 5** State Research Institution "Institute of Applied Acoustics of NAS of Belarus"
- 6** State Research Institution "V.A. Bely Metal Polymer Research Institute of NAS of Belarus"
- 7** State Research Institution "Institute of Technology of Metals of NAS of Belarus"
- 8** Republican Production Unitary Enterprise "Ferrit"
- 9** Republican Unitary Enterprise "Special Constructor-Technical Bureau "Metal Polymer"

INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS OF NAS OF BELARUS

General Information about Institute

Creation Date – November, 5, 1963.

Founder of the Institute - Nikolay N. SIROTA, Academician, honoured worker of science and technics of the Republic of Belarus.

Namely N.N.Sirota has formed the main directions of research activities of the Institute, which are still relevant at present. He has created the world-famous Belarusian scientific research school in solid state physics and modern physical materials science.

The Main Scientific Research Directions of the Institute are: fundamental and applied problems of condensed state physics; creation of new magnetic, ferroelectric, semiconductor, superconductor and superhard materials. Highly qualified staff of the Institute of Solid State and Semiconductor Physics of NAS of Belarus comprises research fellows, and in this number there is one Academician and two Corresponding Members of the National Academy of Sciences of Belarus, Doctors of Science and PhD's. Academician B.B.Boiko (director of the Institute in 1975-1993), Corresponding Member E.M.Lobanov, Academician V.V. Klubovich (head of the Vitebsk branch of the Institute) have been working in the Institute. Academician N.M.Olekhovich (director of the Institute in 1993 - 2004), Corresponding Members F.P.Korshunov and I.O.Trojanchuk are working in the Institute now. The Council on defence of doctoral and candidate dissertations, and the Postgraduate studentship are functioning in the Institute.

The Institute carries out investigations with a broad international scientific collaboration with research centres of Russia, Ukraine, Germany, Great Britain, France, Sweden, Poland, USA, Japan, etc. It regularly performs international conferences on the problems of solid state physics and takes an active part in international exhibitions. At present the Institute is a leader in the field of the solid state physics and physical materials science in Belarus.

ADMINISTRATION

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STRUCTURE

- ◀ Laboratory of solid state physics
- ◀ Laboratory of magnetic films physics
- ◀ Laboratory of semiconductor physics
- ◀ Laboratory of solid state theory
- ◀ Laboratory of high pressure physics and synthesis of superhard materials
- ◀ Laboratory of refractory ceramics and nanomaterials
- ◀ Laboratory of radiation influences
- ◀ Laboratory of physics of magnetic materials
- ◀ Laboratory of non-metallic ferromagnetics
- ◀ Division of cryogenic research
- ◀ Laboratory of physics of superconducting materials
- ◀ Laboratory of electronic ceramics
- ◀ Laboratory of physical-chemical technologies
- ◀ Pilot production

Contacts

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New Forming Directions of Investigations:

Investigation of acoustic-electronic phenomena in the cubic boron nitride, nanoelectronics: acquisition of the cubic boron nitride crystals, intended for the creation of structures realizing effects of dimensional quantization.

R&D Production of the Laboratory:

Substrates for solid state electronics devices, polycrystalline cutting plates made of cubic boron nitride, diamond polycrystals, cutting plates based on composite materials made of diamond-cubic boron nitride (CBN) - hard alloy, industrial high pressure chamber, high-thermo-conducting of higher strength CBN powders, conical cup-shaped diamond wheels forms 12A2 with the angle of 45°, CBN micro-powders (MP CBN) of fraction (5/2) and CBN polycrystal powders (PP CBN) of wide range of grain size (50/40 2000/1600), high-strength cubic boron nitride powders with high form factor spatial and strength, composition superhard material (CSHM) based on diamond and CSHM based on CBN with diameter 5 mm and thickness 3 - 4 mm, high-strength diamond and cubic boron nitride powders with amorphous coatings, grinding device with CSHM insertions, diamond powders AC65 and higher with output of grain 125/100-250/200 no less than 40%, diamond powders AC15, AC32 of fractions 60-200 MCM with output of basic fraction grain up to 60%, composite material containing of diamond "Diamond - CBN - ultra dispersed diamond (UDD)", "Diamond - CBN", "Diamond-UDD".

Laboratory of Refractory Ceramics and Nanomaterials

Head of the laboratory – Ph.D. Vladimir S. URBANOVICH

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Basic Directions of R&D Activity:

Fundamental Investigations:

Research of structure formation and phase transformation processes in nanocrystal ceramic materials based on refractory compounds in conditions of high pressures and high temperatures, research of their physical-mechanical, electrical and thermophysical properties.

Applied Investigations:

Elaboration of new superhard nanocomposites with high thermal stability on the base of refractory nitrides, carbides and borides; development of highly heat-conductive ceramic materials on the base of aluminium nitride and other refractory compounds for electronic engineering devices; elaboration of heat-stable ceramics on the base of silicon nitride, development of the wear-stable ceramic materials on the base of aluminium oxides and zirconium for medical technology; elaboration of high-pressure devices and high-temperature devices for press installations with the loading of 5-25 MN, development of the controllers of sintering and synthesis modes at high pressures.

Topics of Investigations on Novel and Priority Trends:

Investigations of mechanisms of compaction of nanopowders of refractory compounds at high pressures directly in the loading and sintering modes, development of software and study of processes of sintering of refractory ceramics at high pressures with regulated concentration rate, development of scientific foundations for the processes of getting nanostructural materials based on refractory compounds with the use of high-energy processing technologies.

New Forming Directions of Investigations:

Study of the influence of composition, crystal structure and acquisition conditions on electrical-physical properties of ceramics from zirconium dioxide. Elaboration and investigation of new functional structures of the zirconium dioxide for creation of fuel elements.

R&D Production of the Laboratory:

High heat-conductive ceramic material "Alnit" on the base of aluminium nitride, sintering controller "KS-5".

Topics of Investigations on Novel and Priority Trends:

Development of formation technology of multilayer and composite coatings on the housing of microelectronics, radio-electronic and scientific equipment (inertial navigation systems, basic constructions etc.) for protection from wide range of electromagnetic and ionizing radiation.

Development of scientific bases for creation of thin film nanostructures with high magnetic parameters for microelectronics; investigations of magnetoresistive properties of multilayer films and nanostructures; determination of the nature of the giant magnetoresistance in inhomogeneous nanowires and alloys; preparation and study of the nanoscale magnetic structures in the anodic alumina oxide matrixes; nanoheterostructures synthesis of "ferroelectric/ferromagnetic", "metal/dielectric"; and formation of artificial materials on their basis (magnon; magnon-polariton 1D and 2D-crystal and materials with magnetoelectric effect).

New Forming Directions of Investigations:

Development and optimization of the technological processes of formation of the gradient multilayer film structures based on alternating layers "ferromagnetic-diamagnetic", "metal-dielectric" and investigations of their effectiveness of shielding from wide spectrum of electromagnetic radiation (including pulse radiation).

Research and development of the magnetic nanostructures based on multilayer, granular and nanocrystalline thin films for magnetic microelectronics. Study of the interaction of ion beams (10 eV-10 keV) of various gases including reactive (Ar, C, O and their combinations) with solid surfaces and thin films.

R&D Production of the Laboratory:

Technology of multilayer film shields formation on housing and blocks of radio-electronic and microelectronic devices for protection from the damaging influence of static and quasi-static magnetic fields, regular electromagnetic and pulsed radiation.

Technology of formation of radiation-resistant shields based on multilayer and composite materials for protection of integrated circuits from wide range of ionizing radiation.

Development and production of: contactless cold plasma coagulators (for use in human and veterinary medicine); generators of atomic hydrogen (for finish cleaning of small items by plasma etching in a vacuum) and large aperture discharge ion sources (for obtaining and modification of thin films in a vacuum by ion-beam sputtering).

Laboratory of Semiconductor physics

Head of Laboratory – Ph.D. Sergei A. GURETSKII

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Basic Direction of R&D Activity:

Fundamental Investi:

Development of theoretical bases of control of oxide materials crystallization from high-melt solution environments.

Applied Investigations:

Theoretical and experimental investigation of thermal, kinetic and dynamic parameters of the controlled crystallization of the oxide single crystals from solution-melt.

Study the relationship between the main parameters of crystallization and structure-sensitive physical properties of single crystals.

Investigation of the physical properties and the development of methods for growing single crystals for laser technology on the basis of A^2B^6 compounds doped with transition metals.

Development and modernization of the equipment growth installations and test equipment for the process of growing single crystals.

New Forming Directions of Investigations:

Development of theoretical basis and management technology of complexing in high-temperature



solution-melt during crystallization.

The development of thermaphysics and physicochemical conditions for obtaining of multilayer epitaxial single-crystal structures based on double tungstate and the study of their optical properties for use as active media in integrated optics devices.

Creation a conception and prototyping of multifunctional measurement telemetric systems with an open structure.

R&D Production of the Laboratory:

Active and nonlinear optical single crystals of double tungstate, KTP, BBO, A^2B^6 , etc. for the manufacture of components for laser technology.

The certified test and workshop equipment and equipment and precision positioning device for using in high-technology industries: temperature meter E401; temperature regulators E801; electric stepper controller E1501.

Laboratory of Solid State Theory

Head of the laboratory – Dr.Sc. Alexander P. SAIKO

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Basic Directions of R&D Activity:

Fundamental Investigations:

Theory of coherent phenomena, laser generation, photonic induction and echo, Rabi nutation, optical bistability; collective phenomena in low-dimensional systems at phase transitions of the first and the second order; phase transitions in solids with an unstable sub-lattice.

New Forming Directions of Investigations:

Theory of strongly correlated electron-electron system and electron-phonon systems; computer modeling of the growth of nanostructures and nanoclusters.

Laboratory of High Pressure Physics and Synthesis of Superhard Materials

Head of the laboratory – Ph.D. Oleg V. IGNATENKO

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Basic Directions of R&D Activity:

Fundamental Investigations:

Experimental investigations and determination of physical laws of formation of dense phases of boron nitride and carbon polycrystals in the conditions of high pressures; elaboration of physical foundations of acquisition of high-strength and heat-resistant single crystals of cubic boron nitride, diamond, polycrystals and composite materials on its base, investigations of a real structure of superhard materials, investigations of electrical-physical and optical properties of superhard materials.

Applied Investigations:

Elaboration of the methods of acquisition of composite materials of instrumental assignment on the base of cubic boron nitride and diamond, elaboration of some types of blade, abrasive and rock-breaking tools, equipped with superhard materials; production of tools on the base of boron nitride and diamond.

Topics of Investigations on Novel and Priority Trends:

Acquisition and investigation of physical properties of cubic boron nitride, designed for applications in solid state electronics; study of kinetics of spontaneous crystallization of high-strength powders of diamond and cubic boron nitride in Ni-Mn-C and B-N-Li systems and investigation of their real structure; study of the processes of formation of highly dense ceramics on the base of nitrides of silicon, aluminium, boron and composition materials on their base in conditions of high pressures effect; investigation of characteristics of real structure and physical properties of stable and metastable phases, study of compaction processes of powders with granularity of nanometer size in conditions of high pressures.



Laboratory of Radiation Influences

Head of the laboratory – Ph.D. Stanislav P. LASTOVSKY

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Basic Directions of R&D Activity:

Fundamental Investigations:

Experimental and theoretical investigations in the field of radiation solid state physics (silicon, germanium, silicon-germanium solid solutions, etc.).

Investigations of the changes of electrical-physical characteristics of semiconductor structures with p-n-junctions and metal-dielectric-semiconductor structures at the influence of various types of ionizing irradiation (**gamma irradiation, electronic irradiation, etc.**).

Applied Investigations:

Elaboration of physical foundations and methods of the use of penetrating radiation in the technology of fabrication of semiconductor materials and devices with improved characteristics. Elaboration of methods of forecasting and increase of radiation stability of discrete semiconductor devices and integrated circuits.

Topics of Investigations on Novel and Priority Trends:

Investigation and modelling of radiation effects in prospective bipolar integrated circuits and complementary metal-oxide semiconductor integrated circuits; development of method of supplying of their radiation stability at the use in on-board space equipment.

Development of methods of radiation technology of making of powerful fast-action diode structures and transistor structures.

New Forming Directions of Investigations:

Investigation of the influence of metastable radiation defects on parameters of silicon p-n-structures.

Study of the influence of structures on the base of metallic, multilayer and composition nanomaterials at the influence of ionizing irradiation.

Research of the radiation effects in metal-semiconductor structures based on epitaxial silicon.

R&D Production of the Laboratory:

Development of new methods of radiation technology of production of semiconductor device structures with improved characteristics, including power ones.

Elaboration of methods of supplying radiation hardness and making tests of special and double purpose.



Laboratory of Physics of Magnetic Materials

Head of the laboratory – Dr.Sc. Kazimir I. YANUSHKEVICH

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Basic Directions of R&D Activity:

Fundamental Investigations:

Synthesis of solid solutions on the base of compounds with magnetic ordering, investigation of crystal and magnetic structures, investigation of electrical, magnetic and thermoelectric properties of solid solutions in a wide temperature region, investigation of phase transitions of “magnetic order – magnetic disorder” and “metal-dielectric” type.

Applied Investigations:

Development of generators of magnetic pulses, development of technology of heating elements fabrication for household appliances.

Topics of Investigations on Novel and Priority Trends:

Synthesis of magnetic semiconductors in the state of polycrystal powders and thin films (in this number nanosized ones); building of magnetic state diagrams; studies of properties of R – BiFeO₃ (R = Gd, Nd, La) multiferroics, Ge – M (M=Fe, Co, Ni) – Te – Se magnetic semiconductors; investigations of magnetic ordering peculiarities and magnetic characteristics and determination of temperature regions of the stable existence



of magnetic properties of 3d-transition metals nanoparticles filling carbon nanotubes and creation of devices on their base; chalcogenides and pnictides of 3d-elements in the form of nanosized powders.

New Forming Directions of Investigations:

Development of the technology of acquisition of new magnetically-soft materials with saturation magnetic induction up to 2.2 T; studies of crystal structure and magnetic properties of nanostructured materials on the base of chalcogenides of transition metals for the use as matrices for microelectronics; investigations of magnetoresistance effect in chalcogenides of 3d-elements; synthesis of thin (in this number nanosized) layers of Nd–Fe–B.

R&D Production of the Laboratory:

Magnetic induction therapy device, highly efficient heating devices, inverter welding unit, set up for investigations of temperature dependences of specific magnetization and magnetic susceptibility in temperature range 77–1400 K and in conditions of continuous measurements mode (without a specimen rearrangement, change of heaters, etc.)

Laboratory of Non-Metallic Ferromagnetics

**Head of the laboratory – Dr.Sc., Corresponding Member
Igor O. TROYANCHUK**

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Basic Direction of R&D Activity:

Fundamental Investi:

- Investigation of the crystal and magnetic structure of complex oxides.
- Investigation of correlation between structural, electric and magnetic properties of complex oxides.

Applied Investigations:

- Development of new magnetic, piezoelectric and ferroelectric materials.

Topics of Investigations on Novel and Priority Trends:

- Colossal magnetoresistance effect in manganites, cobaltites and molybdates.
- Influence of orbital and charge ordering on magnetic and electric properties of complex oxides.

New Forming Directions of Investigations:

- Development of new magnetic and ferroelectric materials based on anion-deficient ceramics.

R&D Production of the Laboratory:

- Samples of new magnetically ordered materials based on transition metal oxides.
- Samples of nanostructured magnetoelectric and piezoelectric materials based on BiFeO₃

Division of Cryogenic Research

Head of the laboratory – Dr. Sc. Sergey E. DEMYANOV

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Basic Direction of R&D Activity:

Fundamental Investi:

Electronic structure and low-temperature processes of charge transfer in metals:

Quantum oscillation effects and connectivity of Fermi surface sheets of metals at magnetic breakdown; anisotropy of small-angle scattering of conduction electrons in strong magnetic fields; resistive properties of conducting media at a low-temperature plastic deformation.

Low-dimensional metal-insulator-semiconductor systems with swift heavy ion tracks:

Technique of their creation; investigations of their structural properties; electrical-physical and galvanomagnetic properties; development of research and technology principles for a design of novel electrical and electronic devices.

Multicomponent metal-oxide compounds:

Methods of their synthesis; processes of cation substitution and cation exchange in metal-oxide compounds

with a double perovskite structure; spin-dependent transport of electrons in an external magnetic field; influence of nonstoichiometry defects on magnetic and electric transport properties of high-temperature superconductors.

Optical and magneto-optical investigations of semiconductor materials:

Low-temperature (4.2 – 300 K) optical spectroscopy (reflection, absorption, luminescence, excitation spectra of luminescence) of semiconductor materials - Si, Ge, CdS, ZnO, InN, GaN, InGaN, Cu(In, Ga)Se₂, CuInS₂, etc.; determination of fundamental optical parameters and electronic band structure of semiconductor compounds; investigations of the influence of ionizing radiation (electrons, gamma rays, protons, etc.) on optical properties of semiconductors and wide band-gap oxides; research of the effect of magnetic fields up to 15 T on exciton states in semiconducting compounds with chalcopyrite structure - CuInSe₂, CuInS₂, CuGaSe₂ at 4.2 K.

Applied Investigations:

Production of cryogenic liquids (liquid helium, nitrogen) for: ensuring the needs of medical and scientific research institutions of the Republic of Belarus in liquid helium supply; cryoconservation of the allograft bank (biological prostheses of heart valves) for the cardiac surgery; provision of medical centers with liquid nitrogen for ophthalmological operations, cosmetology and cryotherapy; enabling scientific organizations to carry out low-temperature investigations.

Technical aspects of low-temperature investigations: rendering of technical and consultative assistance in manufacturing of low-temperature research installations; integration tests of electrical-physical and mechanical properties of conducting materials at low temperatures in strong magnetic fields; development and optimization of operating characteristics of cryogenic materials; development and creation of powerful cryogenic electromagnetic systems (superconducting and hyperconducting windings); development of technology and equipment for cryogenic freezing of food products and microbic biomass.

Devices created with a use of swift heavy ion track technology: flexible microelectronic and electrical elements; TEMPOS (Tunable Electronic Material with Pores in Oxide on Silicon) structures; development of nanostructured magnetic field sensors for rocket and space applications.

Novel materials and devices on the base of metal-oxide compounds: development of magnetically operated sensors based on nanoscale granular structures and multilayer structures; development of physical principles of the creation of new spintronic elements on the base of metal-oxide compounds; preparation of high-temperature superconducting materials.

Optical investigation methods: Development of non-destructive optical methods for the control of parameters of the photoconversion of solar energy and a quality of structure of semiconductor materials on all stages of their manufacturing process.

New emerging areas of research: investigations of nanosystems with carbon nanotubes in swift heavy ion tracks; development of scientific principles of creation of nanoelectronic devices based on systems with carbon nanotubes in dielectric layers on the silicon substrate; creation of new functional materials and structures based on anodized aluminum oxide; creation of plasmonic nanostructures for the identification of super low quantities of substances by means of SERS effect; optical spectroscopy of Si-Ge nanostructures with Ge quantum dots of dimensions ~ 2-10 nm are used to create light-emitting structures and photodetectors in the infrared spectral region; non-destructive spectroscopic analysis of the parameters of photovoltaic devices based on Cu(In,Ga)Se₂ chalcopyrite compounds; low-temperature microwave investigations of superconducting niobium cavities for linear electron accelerators.

Laboratory of Physics of Superconducting Materials

Head of the laboratory – Ph.D. Andrei G. SOLDATOV

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Basic Directions of R&D Activity:

Fundamental Investigations:

Investigation of physical-chemical parameters of a guided crystallization in new high-temperature solutions-melts, elaboration of electrical-chemical methods of single crystal growth, study of optical properties of magnetic-ordered and ferroelectric crystals at phase transitions, research of phenomena of superconductivity, long-range magnetic ordering and giant magneto-resistive effect in complex oxides.

Applied Investigations:

Development of technological processes of growth and organization of small-series production of single crystals of sapphire, alexandrite and ruby with morphological characteristic features, physical properties and colour characteristics, being maximally close to the natural precious stones.

New Forming Directions of Investigations:

Investigation of the phase-separation processes, study of physics of the processes of stripes and quasi-gap formation for the plotting of phase diagram of high-temperature superconductor and revealing of the high-temperature conduction mechanism, investigation of magnetically ordered crystals, multiferroics and thin film structures, being prospective for spintronic applications.

R&D Production of the Laboratory:

Synthetic single crystals (emeralds, rubies, sapphires, alexandrites).

Laboratory of Electronic Ceramics

Head of the laboratory – Liudmila A. BLIZNIUK

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Basic Direction of R&D Activity:

Fundamental Investi:

Research of composition, structure, microstructure and electrophysical properties of ceramic dielectric, piezoelectric and ferroelectric materials from structure and technology of receiving, development of new materials and products on their base.

Applied Investigations:

Elaboration and investigation of new dielectric materials, and the methods of receiving high-dense ceramic materials for electronic engineering.

Topics of Investigations on Novel and Priority Trends:

Development of dielectric materials with the given values of dielectric constant is conducted at preservation high values of Q-factor and thermostability on the base of the complex oxide systems. Elaboration and investigation of dielectric materials for electronic technique of SHF-range is conducted with the following parameters: $\epsilon = 6,5 \dots 150$, $\text{tg } \delta \leq 0,0005$, thermostable in wide temperature range ($-60 \dots +120$) °C.

Research on creation of piezo-ceramic materials based of $\text{PbZrO}_3\text{-PbTiO}_3$ system. Searching of lead-free piezo-material with high piezo-parameters is conducted.

The small-sized antennas providing simultaneous reception of signals from navigation systems GLONASS - GPS are developed and created. Development of rational technological parameters of synthesis of materials with the given properties, and manufacture of products based on them is carried out.

New Forming Directions of Investigations:

Development of ceramic materials with the improved or fundamentally new properties including operated by external electric and magnetic fields.

R&D Production of the Laboratory:

Ceramic multi-resonator small-sized cases for SHF-range filters, dielectric materials for SHF-range and dielectric

materials for SHF-range and dielectric resonators based on them, efficient at frequencies up to 20 GHz, ceramic substrates for the SHF engineering, piezo-materials and products based on them, ceramic elements of the antennas for systems of satellite navigation and the small-sized antennas providing simultaneous reception of signals from navigation systems GLONASS - GPS, ceramic rod insulators for feeding devices.

Laboratory of Physical-Chemical Technologies

Head of the laboratory – Ph.D. Vladimir P. NOVIKOV

tel.: +375 (17) 284 11 26, e-mail: novikov@physics.by



Basic Directions of R&D Activity:

Fundamental Investigations:

Chemistry and physics of metal-oxide superconductors and ferrites, structural phase transitions, electrical chemistry of solids, thermodynamics and crystal chemistry of the synthesis of powders, fibers and coatings by pyrolysis of metal-organic compounds, investigation of self-organization and self-assembling processes in micro- and nanoparticle systems.

Applied Investigations:

Development of chemical methods of the synthesis of powders of prospective metal-oxide materials with a lowered baking temperature and high homogeneity of chemical and phase composition, creation of protective, antifriction, hardwearing coatings on the base of diamond-like carbon on the metal surface by the electrical-chemical method, electrical synthesis of the coatings from bio-active ceramics on the base of hydroxyapatite on the surface of metallic implants for the orthopedics.

Topics of Investigations on Novel and Priority Trends:

Electrical-chemical synthesis of a diamond and a diamond-like carbon, creation and investigation of composite structures being ordered on nano- and micro-level.

New Forming Directions of Investigations:

Creation of a functional chemical encrustation of the surface of nanoparticles and application of these systems in biology and medicine.

Pilot production

Production Manager – Aleksey M. SHELKOVSKI

tel.: +375 (17) 284 11 55, e-mail: 2841155@tut.by

Basic Direction

Carrying out research and development work in the field of physical and physico-chemical materials science. Water treatment and water purification: technologies, filters, iron removal system. Sewerage and wastewater treatment: technologies, equipment for cleaning. Automation of technological processes.

PHYSICAL-TECHNICAL INSTITUTE

General Information about Institute

Creation Date - March 29, 1931.

Main directions of activity:

- Physics of strength and plasticity, scientific and technological basis for obtaining and processing of materials using laser, ion and electron beams, plasma flows, magnetic field and high pressure energies;
- Development of methods and technologies to obtain and process new multifunctional and specialized materials and coatings with improved properties;
- Creation of technologies and elements of unmanned aircrafts, payloads and unmanned aviation complexes for multifunctional purpose.

ADMINISTRATION

Director:

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e-mail: phti@belhost.by

Deputy director for scientific activity:

Corresponding Member, Dr.Sc. Aleksei V. BYELI

tel.: +375 (17) 265 07 98

Deputy director for scientific and innovation activity:

Ph.D. Anatoli I. MIKHLYUK

tel.: +375 (17) 267 42 75

Deputy director for scientific and manufacturing activity:

Yuriy A. LEANAVETS

tel.: +375 (17) 267 55 74

Deputy director for general issues:

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STRUCTURE

SCIENTIFIC RESEARCH CENTRE OF INDUCTION TECHNOLOGIES AND HEAT TREATMENT PROBLEMS

- ◀ Laboratory of high-speed methods of heat treatment of metals and alloys
- ◀ Laboratory of technologies and equipment for induction heating

SCIENTIFIC-MANUFACTURING CENTRE

"UNMANNED AVIATION COMPLEXES AND TECHNOLOGIES"

- ◀ Laboratory of aerodynamics and aircraft designing
- ◀ Laboratory of testing and quality control
- ◀ Sector of physical modelling and designing
- ◀ Manufacturing technological sector
- ◀ Sector of system designing and mathematical modelling
- ◀ Sector of software development
- ◀ Laboratory of standards and technical documentation development and R&D operative execution
- ◀ Sector of on-board aircraft systems and aggregates

SCIENTIFIC RESEARCH CENTRE OF ELECTRON-BEAM TECHNOLOGIES AND PLASMA PHYSICS

- ◀ Electrophysics laboratory
- ◀ PlasmaPhysicsLaboratory

SCIENTIFIC RESEARCH CENTRE OF DEFORMATION AND CASTING TECHNOLOGIES

- ◀ Laboratory of high pressures
- ◀ Laboratory of limiting deformation
- ◀ Laboratory of limiting deformation
- ◀ Laboratory of cross-wedge rolling
- ◀ Laboratory of cross-wedge rolling
- ◀ Designing technological sector
- ◀ Sector of technologies and equipment of magnetic pulse processing of materials
- ◀ Laboratory of special alloys and technologies

SCIENTIFIC MANUFACTURING CENTRE "TECHNOMAG"

DIVISION OF BEAM AND PLASMA TECHNOLOGIES

- ◀ Laboratory of High-Energy Processing Methods
- ◀ Laboratory of Laser Treatment of Materials
- ◀ Laboratory of vacuum-plasma coatings

DIVISION OF VOLUMETRIC HETEROGENEOUS SYSTEMS

- ◀ Laboratory of mechanic physics of heterogeneous systems forming
- ◀ Laboratory of surface interaction physics
- ◀ Laboratory of surface phenomenon physics

SCIENTIFIC RESEARCH CENTRE OF INDUCTION TECHNOLOGIES AND HEAT TREATMENT PROBLEMS

Head – Academician, Dr.Sc. Anatoli GORDIENKO

Structure:

1. *Laboratory of High-Speed Methods of Heat Treatment of Metals and Alloys*
2. *Laboratory of Technologies and Equipment for Induction Heating*

Laboratory of High-Speed Methods of Heat Treatment of Metals and Alloys

Head Laboratory – Ph.D., Associate Professor, Viktor V. IVASHKO

tel.: +375 (17) 267 52 50

The Basic Directions of R&D Activity:

Fundamental Investigation:

Research of the mechanism and kinetics of phase and structural transformations, correlation between structure and properties in metals and alloys under speed heating, processes of metal and composite breakage under static and dynamic influence.

Applied Investigations:

Development of technological processes of volumetric and surface strengthening of steel and titanium half finished product, parts of machines of agricultural purposes under high-energy influence with the use of induction, electrocontact and laser influence.

Topics of Investigations on Novel and Priority Trends:

Research and development of composite and functional and gradient materials for individual defenders and special-purpose technical armouring.

New Forming Directions of Investigations:

Research of structure, mechanic and technological properties of steel and alloys used in medicine as implants.

R&D Products of the Laboratory:

Technological process of electrothermal strengthening of flak jackets with III-V defence level (Russian State Standard 50744-95), technological process of surface thermal strengthening of steel elements for flak jackets with V defence level (Russian State Standard 50744-95), multi-layer armour panel for anti-splinter anti-bullet defence of special-purpose cars (Russian State Standard 50744-95), technological process of electrothermal strengthening of disks for harvester machines, technological process of combined knives strengthening for harvest equipment.

Laboratory of Technologies and Equipment for Induction Heating

Head Laboratory – Ph.D., Associate Professor Ivan I. VIAHERA

tel.: +375 (17) 267 41 55, e-mail: smto@tut.by

The Basic Directions of R&D Activity:

Fundamental Investigation:

Theoretic and experimental modelling of electromagnetic field high-energy flows impact on materials; research of the influence of high-frequency heating energy-force parameters on structure, phase composition, and metal properties; approbation and introduction of high-efficient technologies of high-frequency heating of parts and semi-finished parts for the following technological operations (deformation, heat treatment, soldering, melting, overlaying).

Development of scientific basis for technologies and equipment:

-induction volumetric heating;



-surface strengthening of materials using high-frequency rapid heating.

Applied Investigations:

Development and manufacture of high-frequency semiconductor modular generators with frequency within 2.4-60 kHz;

Development and manufacture of automated set of induction heating for heat treatment and deformation of metals and alloys;

Development and manufacture of supporting facilities for induction heating (quenching and matching transformers, inductors, cooling stations);

Development of induction heating technologies;

Development of induction thermal equipment control system based on up-to-date industrial controllers.

R&D Products and services of the Laboratory:

Induction heating sets for melting, heat treatment, metal heating for deformation (the Customs Union tariff number 8514 40 000 0)

Semiconductor frequency converters (the Customs Union tariff number 8504 40 900 9)

Manufacture of supporting facilities for induction heating (quenching and matching transformers, inductors, cooling stations)

Surface strengthening of parts and semi-finished parts using high-frequency currents

Repair, assembling, adjustment of induction heating equipment.

SCIENTIFIC-MANUFACTURING CENTRE "UNMANNED AVIATION COMPLEXES AND TECHNOLOGIES"

Head – Ph.D., Associate Professor Yury F. YATSYNA,
tel.: +375 (17) 263 67 61, fax: +375 (17) 268 85 12,
e-mail: yanvad003@gmail.com, maks.uav@gmail.com.



Structure:

- 1. Laboratory of aerodynamics and aircraft designing;**
- 2. Laboratory of testing and quality control;**
- 3. Sector of physical modelling and designing;**
- 4. Manufacturing technological sector;**
- 5. Sector of system designing and mathematical modelling;**
- 6. Sector of software development;**
- 7. Laboratory of standards and technical documentation development and R&D operative execution;**
- 8. Sector of on-board aircraft systems and aggregates.**

The Basic Directions of R&D Activity:

Fundamental Investigation:

Development of the general construction conception of unmanned aviation complexes (UAC), unmanned aircrafts (UA), optical systems, simulators, imitation modelling complexes and stands, UA take-off and landing systems, aviation complexes.

Applied Investigations:

Development and technological activity to create and modernize UAC and multifunctional UA as a whole and their separate components, organization of up-to-date high-tech manufacture, modification of typical UA construction, group of actions for their technical maintenance.

R&D Products (Works, Services):

UA, terrestrial control units, gyro-stabilized optical electronic systems, antenna-masted devices, hardware and software complexes, flight complexes, simulators, infrared radiators, services for technical training, after-sales (warranty) service for the manufactured products.

Laboratory of aerodynamics and aircraft designing

Head Laboratory – Rustam Ya. SINDARAU

The Basic Directions of R&D Activity:

Applied Investigations:

Development of superlight and strong composite materials; carrying out of aerodynamic and strengthening calculations of developed UA constructions; manufacture of UA, their assembly units, components and elements; participation in terrestrial and flight tests including construction strength testing; repair and finalization of UA after testing.

Laboratory of testing and quality control

Head Laboratory – Aliaksandr N. CHAICHYTS

The Basic Directions of R&D Activity:

Applied Investigations:

Elaboration of program and method soft testing, operation documentation of the products; carrying-out of acceptance and quality control of the products; carrying-out of terrestrial and flight testing of pilot UA samples and other products, training of a customer's specialists to operate and maintain UAC; exploitation of UAC in favour of customers; technical assistance and warranty service of UA and UAC; certification of manufacture and products.

Sector of physical modelling and designing

Head – Siarhei M. TOLKACH

The Basic Directions of R&D Activity:

Applied Investigations:

Development of design and operation documentation for assembly units and parts, UAC components and other products; design assistance in manufacture of products both in the institute's production place and in other enterprises (in cooperation); participation in acceptance of ready items.

Manufacturing technological sector

Head – Andrei P. ANISOVETS

The Basic Directions of R&D Activity:

Applied Investigations:

Development of technological documentation for assembly units, parts, components of UA and UA airframes; improvement of materials and machinery for R&D; incoming control of components and materials; execution of scheduled plans to manufacture UAC and infrared radiators; improvement of technology of manufacture and its efficiency; systematic monitoring of state, well-time execution of preventive maintenance, attestation, well-timed check, technical service and repair of technological and manufacturing equipment and accessories as well as means of measure; delivery of products to a customer and conducting of manufacturing controlling documentation; stocktaking and write-off of commodities and materials.

Sector of system designing and mathematical modelling

Head – Siarhei V. PRUCHKOUSKI

The Basic Directions of R&D Activity:

Applied Investigations:

Development of algorithms for different terrestrial automated systems of designing and control (including simulators and imitators), registration systems, flight, UAC data transmission; development of mathematical and information software for flight complexes operation, electronic simulators; development of requirements for UAC equipment in part of creation of united control contour; participation in terrestrial and flight tests in part of problems that can be solved by mathematical modelling.

Sector of software development

Head – Andrei B. KUPRYIANAU

The Basic Directions of R&D Activity:

Applied Investigations:

Development of software for different terrestrial automated designing and control systems (including simulators and imitators), registration systems, flight, UAC data transmission; development of software for flight complexes operation, for electronics imulators; development of software documentation for research, development and technological work; development of requirements for computing facilities of a terrestrial control unit; participation in terrestrial and flight tests in part of problems that can be solved using software.

Laboratory of standards and technical documentation development and R&D operative execution

Head Laboratory – Yauheni V. FILIAHIN

The Basic Directions of R&D Activity:

Applied Investigations:

A feasibility analysis of research, development and technological work; preparation and signing of R&D and commercial contracts; working out of report R&D and commercial documentation; execution of patent research; arrangement of purchases and supplies of materials and machinery for the SMC; the SMC records management, correspondence with other organizations; organization of the SMC participation in exhibitions, scientific-engineering conferences, marketing research, reception of foreign delegations.

Sector of on-board aircraft systems and aggregates

Head – Uladzimir N. RYLKOU

The Basic Directions of R&D Activity:

Applied Investigations:

Development and modernization of on-board UA systems and aggregates; testing, adjustment, programming and mounting of the indicated systems and aggregates on UA.

SCIENTIFIC RESEARCH CENTRE OF ELECTRON-BEAM TECHNOLOGIES AND PLASMA PHYSICS

Head – Dr.Sc., Associate Professor Ihar L. POBAL

tel.: +375 (17) 263 51 25, tel./fax: +375 (17) 263 59 20, e-mail: i.pobol@gmail.com

Structure

1. *Electrophysics laboratory*
2. *PlasmaPhysicsLaboratory*

Electrophysics laboratory

Head of Laboratory – Dr.Sc., Associate Professor Ihar L. POBAL

tel.: +375 (17) 263 51 25, tel./fax: +375 (17) 263 59 20,

e-mail: i.pobol@gmail.com

The Basic Directions of R&D Activity:

Fundamental Investigation:

Theoretic and experimental modelling of high-energy flows impact on materials; structure-phase state of steels, alloys and ceramic materials after their processing by flows of electrons, ions and plasma; development of new volumetric and thin-film materials of heterogeneous and gradient type to operate in extreme media; research of modified materials' behaviour at different conditions of outer impact in various media.

Development of scientific basis for technologies:

- electron-beam (EB) modification of metal materials surface;
- EB forming of permanent connection of homo- and heterogeneous materials;
- surface hardening of metals using methods of ion chemical heat treatment (ICHT) in glow discharge plasma – nitriding, carburizing and nitrocarburizing.

Applied Investigations:



- EB refining of materials with obtaining ingots of pure and superpure metals including refractory and chemically active ones;
- surface EB hardening (quenching of surface of items made of steels and cast irons, deposition of coatings with different properties on steels and alloys);
- manufacture of permanent connections of key parts using EB welding;
- active EB soldering of superhard materials (SHM) with basis to obtain edge tools;
- surface hardening using nitriding, carburizing and nitrocarburizing;
- electroerosionforming of working elements of dies, geometrically-complex and shaped tools;
- surfaceelectrosparkalloying.

Plasma physics laboratory

Head – Ph.D. Ihar P. SMYAGLIKOV

tel.: +375 (17) 265 86 96, e-mail: ips.imaf@gmail.com

The Basic Directions of R&D Activity:

Fundamental Investigation:

Physics and technology of thin films and coatings.

Theory, methods and devices for producing diamond-like, multi-component and multi-layer coatings.

Spectroscopic and probe diagnostics of heterogeneous plasma flows.

Development of new thin-film materials for technical and medical-biological applications.

Applied Investigations:

-Development of technological fundamentals for producing of new materials and coatings based on metals and carbon by vacuum plasma methods to improve the performance of machine parts and tools, medical equipment.

-Creation of the sensor element, sensor devices and systems for applications in engineering and medicine.

-Formation of radio-absorbing and bioprotective coatings on textile materials.

-Physical and chemical processes for electrolytic-plasma polishing and electrochemical oxidation of ferrous and non-ferrous metals.

R&D Products of the laboratory:

-Plasma arc generators of carbon and metal plasmas.

-Tool with wear-resistant multilayer coatings for working of metal, wood and plastics.

-Machine parts and mechanisms with wear-resistant and corrosion-resistant coatings based on refractory metals and carbon.

-Computer diagnostic complex "Diapast" for the diagnosis of diseases of the musculoskeletal system, choice and individual adjustment of orthopedic insoles, orthopedic correction monitoring.

-Wear-resistant and decorative alumina ceramic coatings for mechanical engineering, electronics and watch industries.

Rendering services for enterprises:

-deposition of hardening and protective coatings on parts and tools,

-electrolyte-plasma polishing of parts made of steels, titanium- and aluminium-based alloys,

-oxidation of titanium- and aluminium-based alloys.



SCIENTIFIC RESEARCH CENTRE OF DEFORMATION AND CASTING TECHNOLOGIES

Head – Dr.Sc., Associate Professor, Viachaslau A. TAMILA

tel.: +375 (44) 585 91 38, e-mail: stamila@rambler.ru

Structure:

1. Laboratory of high pressures

2. Laboratory of metal forming

3. Laboratory of limiting deformation

4. Laboratory of cross-wedge rolling

5. Designing technological sector

6. Sector of technologies and equipment of magnetic pulse processing of materials

7. Laboratory of special alloys and technologies

8. Laboratory of precise forging

Laboratory of high pressures

Head laboratory – Ph.D., Associate Professor Artur I. PAKROUSKI

tel.: +375 (17) 267 52 99, e-mail: buksi@tut.by, arturu@tut.by, pakrouski@mail.ru



The Basic Directions of R&D Activity:

Fundamental Investigation:

-physics of strength and plasticity at high-speed deformation of solids under shock loads and electromagnetic fields;

-research of an influence of highly intensive powerful impacts on behaviour of solids and change of their physical mechanical properties; interaction of metal plate with a hard barrier; determination of interconnection between energy-force parameters and technological capabilities of pulse methods of thin-sheet materials forming;

-theoretical and experimental research of structure forming, physical mechanical, operating characteristics of difficult-to-form heterogeneous materials as cast irons at hot plastic deformation and practical realization of technological developments at obtaining of actual items;

-theoretical and technological bases for creation of new materials: aluminium-, copper-, iron- and niobium-based alloys and composites for machine parts, mechanisms and special equipment.

Applied Investigations:

Versatile sheet-metal forming technology for producing a wide range of items from sheet metal (aluminum, steel, titanium, copper, brass) up to 3 mm thick.

Brief description of the technology.

Sheet-metal forming is performed by a high-pressure pulse, which is created by an impact of rapidly moving striker on an enclosed volume of a liquid or elastic medium that fills the working chamber of a press. The process is characterized by a short duration of the pressure pulse, 300 to 600 s, and the absence of a punch; the function of the latter is performed by a transmitting medium (liquid or polyurethane). The source of energy that is stored in the pressure accumulator of a press is the pressurized air from the compressed-air network of the workshop. We offer several specialized presses for sheet forming of a variety of materials.

The technology has a number of special features that make it different from common pressure forming:

-Quick readjustment (preproduction term for a new item is 1-2 months);

-Low metal consumption for die tooling and, correspondingly, low cost of the latter (by 3-5 times as compared with traditional dies);

-A possibility for producing small batches of articles (50 and more) while for the common sheet forming technology the minimal batch is 5000 pieces;

-High uniformity of the applied load;

-High efficiency for difficult-to-deform metals and alloys.

The technology has been tested and used in engineering industry, aerospace and military industry, shipbuilding and some others.

R&D Products of the laboratory:

Versatile sheet-metal forming technology for producing a wide range of items from sheet metal (aluminum, steel, titanium, copper, brass) up to 3 mm thick

Laboratory of special alloys and technologies

Head laboratory – Ph.D., Associate Professor Larisa R. DUDETSKAYA

tel.: +375 (17) 263 58 38, e-mail: fmmlab@tut.by

The Basic Directions of R&D Activity:

Fundamental Investigation:

Theoretical basis of structure for manganese-iron-based alloys depending on composition, crystallization conditions, heat and for impacts.

Applied Investigations:

Development and commissioning of new sparingly-alloyed iron-carbon alloys with specific properties, casting and casting-deformation technologies of their processing.

R&D Products of the laboratory:

Steel composition and manufacture technology of tractor "Belarus-1221" transmission gear wheel. Pilot industrial consignment of tractor "Belarus-1221" gearbox gear wheels made of steel 20XГНМБ. Technical specification TY BY 100185302.291-2014 for carburizing steel 20XГНМБ.

Patent BY 18268 C1 2014.06.30. Steel.

Steel composition and a technology to manufacture die inserting out of steel 5XHM waste products. Patent for useful model №6812 – Die set for hot forming. Technical specification TY BY 100185302.292-2014 2014 for die casting steel 5XHMБЛ

Patent BY 18273 C1 2014.06.30. Casting die steel.

Technological processes of electroslag remelting (ESR) of P6M5 and 5XHM instrumental steels waste. A pilot ESR equipment with interactive control has been adopted and commissioned for Minsk Plant of Special Tools and Production Equipment. Technical specification TY BY 100185302.311-2014. Instrumental steels of electroslag remelting.

Pilot technological processes of smelting in electric arc furnace ДППТУ-6 of high-chromium and grey cast irons, carbon and acid-resisting steels. Technical specification TY BY 100185302.165-2008 "Ingots of high-chromium cast iron ЧХ22Г". Technological process of obtaining a sparingly alloyed wear-resistant alloy with improved heat resistance and technological processes of smelting a cast iron and a steel have been adopted for PLC "Babrujsk Machine-Building Plant".

Laboratory of Cross-wedge Rolling

Head laboratory – Ph.D. Alexandr N. DAVIDOVICH

tel.: +375 (17) 264 53 73

The Basic Directions of R&D Activity:

Applied Investigation:

Research of structure and mechanical properties of metals subjected to special types of pressure processing. Topics of Investigations on Novel and Priority Trends:

Development of technology and equipment of thermoplastic processing of the working bodies of agricultural techniques.

New Forming Directions of Investigations:

Hardening of articles by mar forming method.

R&D Products of the Laboratory:

Machine for cold forming of spiral tubes in self-compensative heating systems, cross-wedge rolling and forging (patent RB 4213), planetary division of billets, production technology of anode balls, three-roller cross rolling mill.

Laboratory of Ultimate Deformability

Head – Ph.D. Hanna A. ZHUKOVA

tel.: +375 (17) 263 49 69

e-mail: hannahukova@mail.ru, lab-pd.fti@mail.ru

The Basic Directions of R&D Activity:

Fundamental Investigation:

-development of the classical theory of cross-wedge rolling that specifies principles of plastic flow of metal in connection with stresses in the deformation zone and on the contact with the tool;

-metal failure at plastic forming.

Applied Investigation:

- development of methods of prediction of quality characteristics and formation of structure and properties of items obtained by cross-wedge rolling; technological basis of cross-wedge rolling;
- development of combined technologies based on metal forming processes including use of close tolerance stamping;
- development of equipment and tools for implementation of cross-wedge rolling and combined technological processes;
- computer simulation of metal forming processes;
- development of automated complexes that provide implementation of almost waste-free technologies (the coefficient of metal utilization is 0.95-0.98), which excludes application of finishing operations of mechanical treatment; production of finished items with new operational properties.

R&D Products of the Laboratory:

Cross-wedge rolling (the patent of the Republic of Belarus No.298)

Laboratory of Metal Forming

Head laboratory – Dr.Sc., Associate Professor Viachaslau A. TAMILA

тел.: +375 (44) 585 91 38, e-mail: stamila@rambler.ru



The Basic Directions of R&D Activity:

Fundamental Investigation:

Theoretic and experimental research of combined method of forming, surface and volume modification of structure of metals and alloys using metalforming methods;

research of the course of deformation processes intensified by high-energy impacts (electromagnetic, ultrasound and others); research of principles of forming of ultrahighly dispersed structure and physical mechanisms of technological inheritance at outer energy impacts.

Applied Investigation:

Development of construction of equipment, tools and technological accessories for plasticforming, new technological processes of manufacturing competitive items using metalforming methods; development and research of new high-tech methods for manufacturing products that ensure rational distribution of reserve plasticity for life cycle stages and high operation resource of machine key parts working under extreme conditions; development of constructions and devices for accelerating objects with regulated acceleration and exit speed; commissioning for the Belarusian enterprises of new highly efficient technologies of press-forging and rolling manufacture, technologies and equipment for manufacturing and strengthening elastic elements of automobile and agricultural machinery.

R&D Products of the Laboratory:

Technologies and equipment for manufacturing and strengthening elastic elements of automobile and agricultural machinery; technologies and equipment of cross-screw rolling.

SECTOR OF EQUIPMENT TECHNOLOGY OF MAGNETIC PULSE MATERIALS PROCESSING

Head – Yury I. KRIVANOS

tel.: +375 (17) 263 59 74

The Basic Directions of R&D Activity:

Fundamental Investigation:

Investigation of the regularities of high-speed plastic flow and destruction of structural materials under the influence of strong pulsed magnetic fields.

Applied Investigation:

Investigation of the processes of magneto-impulse sheet stamping, getting one-piece compounds, including dissimilar materials, pressing-sintering of metal-powders.

Topics of Investigations on Novel and Priority Trends:

Electro-hydro-impulse processing of materials, including its use when building of pile bands foundations in construction.



New Forming Directions of Investigations:

R&D processes of magneto-impulse processing of composite materials getting for automotive, aviation, space technology, in foundries to produce alloys with high performance.

R&D Products of the Sector:

Magneto-impulse press (MIP).

DESIGNING TECHNOLOGICAL SECTOR**Head – Mikhail M. SIDARAU**

tel.: +375 (17) 268 88 93, e-mail: ms3535@yandex.ru

The Basic Directions of R&D Activity:**Fundamental Investigation:**

Research of the theory of longitudinal, cross and screw rolling, rolling-off and other metalforming processes, research of regularities of metal plastic forming.

Applied Investigation:

Technological basis for longitudinal, cross and screw rolling, rolling-off and other metalforming processes; development of technological processes, equipment constructions, tools and technological accessories, automation means for plastic forming and manufacturing parts that are used in different spheres of agriculture and industry.

New Forming Directions of Investigations:

Research of strength properties of manufactured construction elements, technological processes of metal forming to determine energy-force parameters and possibility to manufacture using different technological processes by virtual modelling

methods. Research of fatigue life of different products and constructions.

R&D Products of the Sector:

Technologies, equipment, mechanization means for manufacture of different elements of automobile and agricultural machinery; technologies and equipment of longitudinal, cross and screw rolling, rolling-off, die accessory.

Laboratory of precise forging**Head laboratory – Ph.D. Alexandr Yu. IZABELA**

tel.: +375(29)263 64 69, e-mail: aizobello@tut.by

The Basic Directions of R&D Activity:**Fundamental Investigation:**

Research of the influence of forming thermomechanical parameters on microstructure and properties.

Applied Investigation:

Development of technologies of forging and pressing of items using different materials

SCIENTIFIC MANUFACTURING CENTRE “TECHNOMAG”**Head – Victor N. DIK**

tel./fax: +375 (17) 263 64 74, e-mail: technomag@tut.by

The Basic Directions of R&D Activity:**Applied Investigations:**

Research and development projects on creation, organization of manufacture, modernization and utilization of collective and individual special protection means and components for it, special equipment and technologies for collective and individual protection means production, development of material and technical base for accomplishing of tests, researches and development for special purposes.

Production activity:

Preparation for serial production and manufacturing of high-tech parts of special purposes and wide consumption, development and realization of technical documentation, regulating the creation,

production and exploitation and utilization of individual protection means and componentries for it, special equipment and technologies for its production.

R&D Products of the centre:

Flak jacket of "Coral" type, flak jacket of "Diamond" type, flak jacket of "Ruby" type, flak jacket of "Atraum" type, flakjacketof "TMG"type, staff machine of permanent volume «МШ-6317-ПО-КШ».

DIVISION OF BEAM AND PLASMA TECHNOLOGIES

Head – Corresponding Member, Dr.Sc. Aleksei V. BYELI

tel.: +375 (17) 265 07 98, e-mail: vmo@tut.by

Structure:

- 1. Laboratory of High-Energy Processing Methods**
- 2. Laboratory of Laser Treatment of Materials**
- 3. Laboratory of vacuum-plasma coatings**

Laboratory of High-Energy Processing Methods

Head – Dr.Sc. Uladzimir A. KUKAREKA

tel.: +375 (17) 263 86 19

The Basic Directions of R&D Activity:

Fundamental Investigation:

Research of physics processes of ion beams interaction with high density and surface metal layers, alloys and ceramic materials.

Applied Investigation:

Creation of scientific bases of technological processes of constructional materials processing with the use of high density ion beams.

Topics of Investigations on Novel and Priority Trends:

Gaining of nano-structured surface layers in metals and alloys using ion-beam processing method.

New Forming Directions of Investigations:

Research of physical and mechanical properties of steels and alloys with expressed gradient of structural and phase parameters which form due to strong-current ion alloying.

R&D Products of the Laboratory:

Lon-beam processing of metals and alloys, metallization of roll materials on the polymer and paper base, equipment complex for tribotechnical tests of materials and friction nodes in extreme conditions of environment, adhesion measurement system and thin materials durability.

Laboratory of Laser Treatment of Materials

Head – Dr.Sc. Valeriy S. GOLUBEV

tel.: +375 (17) 263 51 23, e-mail: gvs_fti@mail.ru

The Basic Directions of R&D Activity:

Fundamental Investigation:

Development of the scientific basis for manufacture of composite layers using the methods of laser modification of the surfaces of Fe, Ti and Al-based metal materials.

Applied Investigation:

Development of up-to-date high-efficient technologies of surface treatment of materials using powerful flows of laser and plasma impact; laser overlaying, cutting and welding.

R&D Products of the Laboratory:

Laser modification for working surfaces of cutting and fragmenting knives of agricultural machinery, technology and equipment for laser hardening rapidlywearingpartsofa steering box, laser restoration of working surfaces of the key parts of power equipment.



Laboratory of vacuum-plasma coatings

Head laboratory – Ph.D. Sviatlana D. LATUSHKINA

tel.: +375 (17) 237 06 05

The Basic Directions of R&D Activity:

Fundamental Investigation:

Development of theoretical and technological foundations of forming coatings using vacuum-plasma methods with regulated level of physical and mechanical properties

Study of interaction regularities of hetero-phase plasma streams with the surface of a solid body with the aim of creating high-performance technology modifications.

Applied Investigation:

Development of technological principles and the creation of highly efficient technologies of vacuum-plasma deposition of protective and decorative, wear-, heat- and corrosion-resistant coatings on products of a broad class of materials

Development of maintenance (components of equipment, composition of multicomponent targets, etc.), implementation of new approaches in the condensates formation.

Topics of Investigations on Novel and Priority Trends:

Investigation of formation regularities of nano-structured materials in the multilayer film performance, based on refractory compounds of transition metals and their deposition technology development in order to obtain coatings for various applications.

New Forming Directions of Investigations:

Technology development of ultra-small-grain nano-structural targets and cathodes with the equichannel angular pressing method for the vacuum deposition of functional coatings (protective and decorative, hardening, optical, etc.).

R&D Products of the Laboratory:

Deposition technology of multi-component, multilayer and protective-decorative coatings.

DIVISION OF VOLUMETRIC HETEROGENEOUS SYSTEMS

Head – Dr.Sc., Associate Professor Alexandr V. ALIFANAU

tel.: +375 (17) 263 49 71, e-mail: phti@belhost.by

Structure:

- 1. Laboratory of mechanic physics of heterogeneous systems forming*
- 2. Laboratory of surface interaction physics*
- 3. Laboratory of surface phenomenon physics*

Laboratory of Mechanic Physics of Heterogeneous Systems Forming

Head – Ph.D. Anna M. MILIUKOVA

tel.: +375 (17) 263 65 52, e-mail: annart@mail.ru, alifanov_aav@mail.ru

The Basic Directions of R&D Activity:

Fundamental Investigation:

Scientific basis of controlling the structure and properties of instrumental steels using the combined methods of plastic deformation, magnetic pulse and ion-plasma processing to strengthen metal- and wood-working and other tools.

Applied Investigation:

Development of magnetic pulse sets, flat and cylindrical inductors with various electrophysical characteristics.

Development of high-efficient technological processes to strengthen metal- and wood-working and other tools using the combined high-energy methods (magnetic pulse impact, ion-plasma spraying and nitriding, gas-thermal and induction overlaying welding).

LABORATORY OF MICROCRYSTALLINE AND AMORPHOUS MATERIALS

Head Laboratory – Dr.Sc., Associate Professor Alexandr T. VALOCHKA

tel.: +375 (17) 26 67 62, e-mail: volochkoat@mail.ru

The Basic Directions of R&D Activity:

Fundamental Investigation:

Research of peculiarities, mechanisms and kinetics of forming of composite materials with microcrystalline, quasicrystalline and amorphous structures.

Applied Investigation:

Creation of special purpose materials and technologies of their manufacture.

- high-strength and antifriction aluminium materials with solid lubrication particles;
- addition alloys, modifiers for processing of melts based on aluminium, iron and others;
- heat-resistant and heat-proof ceramic materials (heat-resistant ceramics, heat insulating and technical ceramics);
- protective heat-resistant coatings made using self-propagating high-temperature synthesis;
- electromagnetic radiation shielding multilayer protective coatings;
- wear-resistant, heat-resistant coatings and casting cathodes for their manufacture;
- addition alloys in system Si-metal and items manufactured with their use for electronic machinery.

The laboratory has:

- vacuum melting induction furnaces, directional crystallization furnaces in protective gases medium. Low-tonnage manufacture has been arranged to recycle precious metals and alloys, to manufacture cathodes (targets) on the base of superpure alloys, alloys based on intermetallic, medical purpose materials and others;
- vacuum sets to deposit coatings of different functions, a shop has been arranged to deposit them for different industries;
- research devices to determine elemental analysis, annealing in vacuum medium, sets to determine mechanical, antifriction and operation properties.

Topics of Investigations on Novel and Priority Trends:

Development of nanostructured materials distinguishing by improved physical chemical, mechanical and operational characteristics, manufactured with the use of addition alloys, modifiers, high-energy impact methods.

New Forming Directions of Investigations:

Research of theoretical and experimental regularities of synthesis of new phases in system aluminium matrix – nanostructured forms of carbon. Structure forming of alloys on the base of iron with different forms of carbon obtained using nanostructured modifying addition alloys.

R&D Products of the Laboratory:

A set to recycle aluminium chips and slag; addition alloys and bearings made of aluminium-graphite materials; alloy cathodes and targets for vacuum machinery, protective heat-resistant coatings; modifiers, addition alloys to process alloys.

LABORATORY OF APPLIED MECHANICS

Head laboratory – Ph.D. Svyataslau M. KRASNEUSKI

tel.: +375(17) 267 43 85, e-mail: krasneuski@mail.ru

The Basic Directions of R&D Activity:

Fundamental Investigation:

Identify of patterns and mechanisms of degradation of service properties of long-running steel structures (vessels, piping, etc.) based on the nonlinear mechanics of accumulation of scattered damage.

Applied Investigation:

Investigation of mechanical properties (strength, fracture toughness, work formation and fissures spread) of pipe and boiler steels under long-term (20 years and over) influence on them of quasi-static and cyclic

elastic stress fields.

Development of scientific foundations and techniques for determining the reliability and residual life of main gas, oil and pipe product, petro-chemical equipment.

The laboratory is making methods elaboration to determine the residual life and recommendations for repair and maintenance of steel structures responsible appointments, including the main gas, oil and pipe- product, compressor, gas distribution, automatic gas-filling stations, vehicles and convoys of chemical and petro-chemical production.

LABORATORY OF THIN FILM PHYSICS AND EQUILIBRIUM SYSTEMS

Head – D.Sc., Professor Maryia I. MARKEVICH

tel.: +375 (17) 263 64 72, e-mail: a.chaplanov@gmail.com

The Basic Directions of R&D Activity:

Fundamental Investigation:

The development of physical foundations of materials science of thin films, thin film systems and coatings

The study of structural and phase transformations occurring in thin-film materials under steady and impulse annealing.

The study of structural and phase transformations occurring in materials under the influence of photon and ion-plasma beams.

Applied Investigation:

Creation and development of thin film materials by the method of stationary and pulsed annealing to solve the problems of micro- and nanoelectronics.

The development of contact systems for the active elements of LSI and VLSI with submicron dimensions.

LABORATORY OF NANOMATERIALS AND ION-PLASMA PROCESSES

Head laboratory – Dr.Sc., Mikalai M. CHEKAN

tel.: +375 (17) 211 83 71, e-mail: pec@bas-net.by

The Basic Directions of R&D Activity:

Fundamental Investigation:

Physical processes of formation of thin films and coatings from cathode-arc discharge plasma; physical materials science of diamond-like carbon and ceramic wear-resistant coatings; mechanical and tribological properties of coatings.

Applied Investigations:

Development of scientific basis for the technologies using physical deposition in vacuum to obtain wear-resistant, tribological and biocompatible coatings on metal-working tools, machine and mechanism parts, medical implants.

R&D Products of the Laboratory:

wear-resistant coatings of diamond-like carbon on hard-alloy tools, plunger pair of high pressure pumps, casting moulds (signs) to make items of plastics, thread guides of weaver loom for fiberglass, anti-glare light-absorbing coatings on body parts optical detectors of space module, biocompatible coatings on orthopedic implants, protective-decorative coatings for watches;

strengthening heat-resistant coatings of TiAlN-Si₃N₄ system for tools made of stainless steels;

wear-resistant coatings ZrCN-DLC for blanking die punches, die moulds, form rollers, broaching bits;

anti-adhesion coatings CrN-CrC for casting moulds of non-ferrous metals.

ENGINEERING TECHNOLOGICAL DIVISION

Head – Uladzimir A. PRAZHENNIK

tel.: +375 (17) 263 59 03

The list of works and services:

Production of various technological and non-standard equipment: stamp rigging, the lines of cross-wedge rolling, induction heating systems, installation of magnetic-pulse stamping, cylindered woodworking machines, other means of mechanization;

Heat treatment of structural and tool steels, including high-speed ones;

Galvanic coatings: chemical oxidation, zinc coating, anodic oxidation.

INSTITUTE OF APPLIED PHYSICS OF NAS OF BELARUS

General Information about Institute

Foundation date – March 1980

The main scientific direction of the Institute – development of physics foundations, new methods and means for non-destructive testing of industrial products and technical diagnostics. Institute of Applied Physics of the National academy of sciences of Belarus is the only one in the country specializing in the physics of non-destructive testing and technical diagnostics.

Today it is a highly qualified team, which employs about 100 employees, including 1 Corresponding Member, 11 Doctors and 20 PhD's.

Applied researches of the institute include a wide range of scientific and engineering problems that have multidisciplinary base, and developed modern methods and means of non-destructive testing and technical diagnostics are used in power generation, metallurgy, automobile, tractor and agricultural machinery, motor- construction, welding production , civil engineering, electronics, petrochemical, rail and road transport, pipeline, bridge, aircraft, repair services, utilities, medicine, sport, criminalistics etc.

ADMINISTRATION

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Academic secretary

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STRUCTURE

- ◀ Laboratory of metal physics
- ◀ Laboratory of radio tomography
- ◀ Laboratory of contact dynamic methods of testing
- ◀ Laboratory of magnet methods of testing
- ◀ Laboratory of capillary phenomena
- ◀ Laboratory of physics of electromagnetic losses
- ◀ Laboratory of computerized diagnostics
- ◀ Construction-technological division

Laboratory of Metal Physics

Head of the Laboratory – Dr.Sc. Alexander A. LUHVICH

tel.: +375 (17) 284 23 07, e-mail: lab1@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

Researches of electrical and magnetic properties in relation to the structure of materials, surface characteristics and transitional layers.

Researches of the processes of magnetization, remagnetization the ferromagnetic materials with taking into account their nonlinear properties.

Applied research:

Studies on the development on the basis of magnetic and thermal measurements of methods and means of non-destructive testing of physical-chemical properties of materials and thickness of coatings, surface and transition layers.

The development of physical foundations for creation of electromagnetic methods and means of non-

destructive testing and technical diagnostics.

R&D Products of the Laboratory:

- Magnetic thickness gauge for thickness control of non-magnetic coatings on ferromagnetic basis, nickel coatings on non-magnetic base, nickel coatings on ferromagnetic steel;
- Instruments for magnetic induction measuring, and the residual magnetization;
- Thermoelectric devices for chemical composition and structure of metallic materials control, coating thickness, surface and transition layers;
- Electromagnetic devices to control the hardness of steel units after the surface hardening;
- Electromagnetic devices for deformation monitoring of ferromagnetic materials; eddy current defectoscope, magnetic defectoscope for the control of ropes.



Laboratory of radio tomography

Head of the Laboratory – Ph.D. Alexander O. NAUMOV

tel.: +375 (17) 284 24 38, e-mail: alekspk@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

- Development of the statistical theory for dynamic image reconstruction in the X-ray tomography; development of the theory and principles of construction of systems with controlled structure.
- Study of reconstruction methods of the internal structure of non-metallic objects based on solutions of inverse problems of diffraction of ultra-wideband microwave signals.

Applied research:

- Development of methods, algorithms and software for dynamic image reconstruction in the process tomography.
- Research and development of radio-wave methods of detecting hidden subsurface objects;
- Development of digital signal processing for subsurface radar.

R&D Products of the Laboratory:

- Microwave thickness gauge of dielectric coatings on metals;
- Portable instrument measuring the radio-transparency of antenna radomes of aircraft radars;
- Subsurface radars to visualize the internal structure of building structures (identification and visualization of flaws in walls, floors etc.



Laboratory of Contact Dynamic Methods of Testing

Head of the Laboratory – Dr.Sc. Alexander P. KREN

tel.: +375(17) 284 24 38, e-mail:alekspk@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

- Theoretical and experimental study of rheological behavior of materials under dynamic contact loading.
- Development of methods and means for estimation of physical and mechanical characteristics of articles by non-destructive testing of properties of metals and alloys, viscoelastic materials (low-module poly-

mers, rubbers, plastics), as well as construction materials (concrete, asphalt, bitumen), graphite and 4d structure carbon materials.

Applied research:

- Investigation of material properties under static and dynamic loading; determination of the relationships between static and dynamic characteristics of materials;
- Metrology research and development of verification techniques for equipment for static and dynamic loading.

R&D Products of the Laboratory:

- Portable digital tester for metallic materials, equipment for measurement of mechanical characteristics of metallic materials;
- Diagnostics of a state of metal products with removal of the influence of roughness and stiffness of structures;
- Measurement of viscoelastic properties of polymeric materials and rubber products, measurement of concrete strength.



Laboratory of Magnetic Methods of Testing

Head of the Laboratory – Ph.D. Alexander A. OSIPOV,
tel.: +375 (17) 284 18 55, e-mail: osipov@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

- Processes of ferromagnetics magnetization, including with non-uniform structure, in homogeneous and inhomogeneous and quasi-static and pulsed magnetic fields, the relationship between magnetic parameters and mechanical properties of ferromagnetic materials;

Applied research:

- Development of new methods to control mechanical properties and quality of heat treatment of ferromagnetic materials and products, of optimizing parameters of pulse magnetization systems with a given amplitude and temporal characteristics, of the synthesis of magnetic fields with given spatial and temporal distribution;
- Development of principles of measuring magnetic fields and magnetic characteristics of ferromagnetic materials and products;
- Development of techniques for metrological provision of the magnetic control means.

R&D Products of the Laboratory:

- Pulsed magnetic analyzers of structure, mechanical properties and quality of heat treatment of ferromagnetic materials and products;
- Pulsed flow controllers of structure and mechanical properties of rolled steel, moving in the flow of production at speeds of up to 25 m/s;
- The installation for measuring the magnetic properties of ferromagnetic materials.



Laboratory of Capillary Phenomena

Head of the Laboratory – Ph.D. Alexander L. MAYOROV

tel.: +375 (17) 284 20 02, e-mail: mayorov@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

- Investigation of ultrasonic (elastic) wave propagation in materials;
- Study of physical phenomena and processes at the "liquid - solid state" boundary, underlying in the base of penetrant testing methods.

Applied research:

- Research and development of new methods and means of ultrasonic flaw detection, structurescopy, measure of hardened layers depth;
- Development of new methods and means for penetrate testing, ways to increase the sensitivity and reliability of penetrate testing.

R&D Products of the Laboratory:

- Automated installation for ultrasonic non-destructive testing of adhesion of non-resistant insert with the main material of pistons of internal combustion engines;
- Automated installation for ultrasonic non-destructive of defects of diesel engines sleeve;
- Methods and equipment for ultrasonic testing of welded joints obtained by different methods (friction welding, explosion welding, magnet-pulse welding, etc.);
- Sets of ultrasonic transducers with a magnetic contact fluid; methods and apparatus for automatic ultrasonic testing by subsurface waves;
- Ultrasound indicators of castings structure from high-strength cast iron;
- High-sensitive materials for fluorescent and dyer penetrant testing;
- Computerized systems for the sensitivity evaluating of product families and t results of penetrant testing using methods of image processing methods;
- Test panels for penetrant testing and magnetic-powder flaw detection.



Laboratory of Physics of Electromagnetic Losses

Head of the Laboratory – Dr.Sc. Ivan I. BRANOVITSKY

tel.: +375 (17) 284 15 77, e-mail: branovitsky@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

Energy dissipation in ferromagnetics under their magnetization, the dynamics of the processes and identification of sources.

Applied research:

- The study of electromagnetic processes in the systems of transformation and the conversion of electrical energy;
- Development of methods and means of non-destructive testing and diagnostics of their technical condition.

R&D Products of the Laboratory:

Devices for measuring the magnetic properties of electrical steels; instruments for non-destructive testing

and technical diagnostics of energetic equipment including:

- power transformers;
- electrical machines constant current;
- wide range of electrical coils;
- isolation of high-voltage equipment through the contactless measurement of current leakage.



Laboratory of Computerized Diagnostics

Head of the Laboratory – Dr.Sc. Valery L. VENGRINOVICH

tel.: +375 (17) 284 23 44, e-mail: veng@iaph.bas-net.by

The Basic Directions of R&D Activity:

Basic research:

Development of the theoretical framework for limited views and limited projections x-ray tomography; Development of the theoretical foundation for the quantitative magnetic, Barkhausen noise and electromagnetic testing of surface layers including inverse methods of reconstruction the surface properties.

Applied research:

- Magnetic noise method and technique for stress and strain accurate measurement, microstructure and steel properties quantitative evaluation;
- Development of algorithms and software for limited data tomography;
- New structure health monitoring systems for multi purpose applications.

R&D Products of the Laboratory:

- Barkhausen noise sensors and analyzers for stress and stress measurement as well as microstructure and properties non destructive evaluation;
- Techniques, algorithms and software for image reconstruction within industrial x-ray and other types of tomography;
- Complete structure health monitoring systems: development (licensed) and installation turnkey for buildings, civil engineering structures, bridges, pressure vessels, etc.



Construction-technological Division

Head of the Division – Valery L. TSUKERMAN

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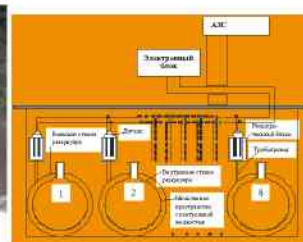
The Basic Directions of R&D Activity:

- Experimental and pilot samples of instruments, sensors and sensor based systems design, development, installation and setting into operation.

-Engineering and design department encloses the self-supporting research sector for automated information systems, established in 2007 and headed by Shalatonin V.A.

R&D Products of the Division:

Multichannel explosion-proof control sensors and systems for oil and oil-like goods tanks (leakage detector), industrial monitoring systems, automated control systems for vibro-diagnostics of electromechanical systems, equipment for measuring of the liquid products level in the tanks, hardware-software complexes for oil goods marketing on the gas stations, measuring instruments of petroleum products in tanks, etc.



INSTITUTE OF CHEMISTRY OF NEW MATERIALS OF NAS OF BELARUS

General Information about Institute

Creation date – October 22, 1998

Major directions of the institute scientific activities:

-creation of thin film (including nanostructured) organic materials for various purposes;
-development of new composite materials with desired properties based on timber and petrochemical products and technology for their production.

There is one hundred staff members currently working at IChNM NAS of Belarus, including : 1 academician, 4 doctors of science, 22 Ph.Ds, 1 person has the scientific title «professor»; 2 – «docent»; 3 – «senior scientific researcher»; 74 researchers, including 34 people who are less than 35 years old.

ADMINISTRATION

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STRUCTURE

DEPARTMENT OF PHYSICO-CHEMISTRY OF THIN FILM MATERIALS

◀Laboratory of micro- and nanostructured systems

◀Laboratory of biopolymer encapsulated structures

◀Laboratory of optical anisotropic films (pilot

◀Laboratory «Materials and technologies of LC-devices»

DEPARTMENT OF ORGANIC COMPOSITE

◀Laboratory of poly-conjugated organic compounds (experimental plot)

◀Laboratory of polymer Bio-Active Substances (experimental plot)

◀Laboratory of forest- and oil chemistry products (experimental plot)

DEPARTMENT OF PHYSICO-CHEMISTRY OF THIN FILM MATERIALS

Head of the Department – Academician, Dr.Sc, Honored Scientist of the Republic of Belarus

Vladimir E. AGABEKOV

tel.: +375 (17) 263 19 23, e-mail: agabekov@ichnm.basnet.by, ichnm@ichnm.basnet.by

The Department consists of research laboratories:

- 1. Of micro- and nanostructured systems;***
- 2. Of biopolymer encapsulated structures;***
- 3. Of optical anisotropic films;***

4. «Materials and technologies of LC-devices» (dual subordination with Ministry of Industry).

Main directions of research scientific work:

Fundamental research:

- establishment of correlation between chemical structure of organic compounds and formation mechanisms, physico-chemical properties of mono- and multilayers on their basis;
- study of formation regularities and specificity of chemical reactions in "two-dimensional" and multilayer organic systems;
- formation of thin-film organic materials with the controllable molecular structure.

Applied research:

development and creation of knowledge-intensive (including import-substituting) thin-film and nanostructured materials and components with various functionalities.

The Laboratory of micro- and nanostructured systems

Head of the Laboratory – Ph.D. Viktoriya I. KULIKOVSKAYA

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Directions of research:

- physico-chemistry of surfaces and surface phenomena on interphase boundary, bioengineering;
- creation and study of physico-chemical regularities of formation of nano-sized structural sensor elements and microstructured net polymeric films; development of protective coatings for friction units and micro-electromechanical systems;
- formation of super hydrophobic surfaces, microstructured polymeric coatings by methods of "soft" lithography;
- study of regularities and physico-chemical parameters of mono- and multilayers formation by layer-by-layer self-assembly of biopolyelectrolytes;
- creation of biopolymer carriers for bioactive substances (nano - and microparticles, microcapsules, liposomes);
- development of the methods for local modification of solid surface to give them a set of specified properties (hydrophilicity/hydrophobicity, roughness, etc.).

Main achievements and R&D products:

- the method of horizontal precipitation of monomolecular films and the automatic device LB-103 for formation of mono - and multimolecular coatings;
- the device LT-201 for modification of solid substrate and flexible polymeric base by ultrathin Langmuir-Blodgett (LB) films and by method of layer-by-layer self-assembly;
- "roll-to-roll" technology for formation of LB-films on the basis of amphiphilic dyes, lipids, fluorescent and magnetic particles;
- formation of protective and lubricant coatings for microelectromechanical systems on the basis of fat acids and diketones;
- formation of microstructured net thin films from high-molecular compounds by "self-assembly" of water microdroplets.

The Laboratory of biopolymer capsulated structures

Deputy Head of the Laboratory – Academician, Dr.Sc., Professor Vladimir E. AGABEKOV

tel.: +375 (17) 263 19 23, e-mail: agabekov@ichnm.basnet.by

Directions of research:

- formation of nanocapsules, nanoparticles, nanocomposites and microspheres, functionalization of their surfaces;
- development of new micro- and nanosized structures as systems for local delivery of bioactive compounds;
- synthesis and study of the controllable chemical transformations of 2-amino-pyrimidine derivatives, their usage for obtaining of new bioactive compounds;
- development of technologies for synthesis of various heterocyclic products.



Main achievements and R&D products:

- methods of ultrasonic synthesis of nanomaterials including nanoparticles of hydroxyapatite, magnetite, iron, gold, silver and semiconductor metal oxides;
- method for synthesis of azobenzoic acid disodium salt– import-saving light stabilizer for polyoxadiazole fiber «Arselon».

The Laboratory of optical anisotropic films

Head of the Laboratory – Ph.D. Nadezhda A. IVANOVA

tel.: +375 (17) 237 68 07, e-mail: nadezh_iva@mail.ru

**Directions of scientific research:**

The creation of oriented polymeric films containing dichroic or diffusely scattering agents, study of patterns of their formation, physico-chemical characteristics to produce polarizers for different regions of spectrum with an expanded viewing angle.

Studying of optical anisotropy, light fastness and thermal conductivity of polyvinyl alcohol (PVA) films with dichroic dyes and nanoparticles of various nature in order to establish the factors that increase the quality of the polarizers compensating phase and diffusely-scattering films, their resistance to operating conditions.

Development of technological process of manufacturing of film and optical polarizers, compensating phase and scattering films for LCD-display, control devices of latent image, polarization light filters for optoelectronic devices of special purposes and others.

Main achievements and developments:

Polaroid films for optoelectronics of skipped, translucent, reflecting types, including extended spectral (for visible and near UV- и IR- regions of spectrum) and temperature ranges of exploitation; achromatic circular polarizers; carrying- reflective polarizers of new generation with improved optical characteristics (transmission above 50%).

Glues of various purposes, intended for gluing polymeric films; for formation of sticky adhesive layer providing adhesion of the polarizer with the surface of the LCD indicator; gluing of reflective coating to the polaroid and paper labels to the glass, polymer and metal.

Diffusion-scattering compensating phase films with expanded viewing angle; achromatic phase retarders based on bi-axis-oriented films by ZIV (Mogilev) production and PVA (IChNM NASB) for compensation of phase delay in the LCD-displays, devices of control of latent image and polarization 3D-glasses.

The Laboratory “Materials and technologies of LCD-devices”

Head of the Laboratory – Ph.D. Alexander A. MURAVSKII

tel.: +375 (17) 237 67 88, e-mail: alexander.muravsky@ichnm.basnet.by

Directions of scientific research:

-development of new technologies for the production of anisotropic organic materials and creation of electronic devices on their basis: diodes, liquid crystals (LCD), etc.;

-LCD technologies (alignment materials, LCD-lens, LCD-indicators, R&D materials, chiral additives, phase retarders, and others): molecular design of new material on the basis of quantum-chemical calculations; development of methods of obtaining and synthesis of substances; research of the properties of obtained materials; calculation of devices, the creation of the elements of structure of the devices and technology of their production;

-scientific accompaniment of production of means of information display, design and manufacture of new equipment based on LCD-technology.

Main achievements and developments:

Creation of controlled LCD lenses: fully compatible with existing LCD technology; possible forms of LCD lenses - cylindrical /parabolic (spherical); low-voltage control (5); thickness - less than 2 mm, lens diameter 0,1÷2 mm, switchable focal length - in the range of less than 40 ÷ ∞sm.

Quarterwave phase films: wide spectral range 500-620 nm on the level of phase delay of $\lambda/4 \pm 10$ nm, unifor-

mity over the area better than 5%, based on large-tonnage domestic raw materials, are used to manufacture of "achromatic" right- and left-circular polarizers, polarizing 3D and Dual-Play glasses (technology RealD). Photocurable orientant LCD: improving of brightness of LCD-devices in 1-2%, reduction in energy consumption in 10 times for the operation of creation of alignment layer, reducing the percentage of defectives of process.

Characterization of organic fluorescent semiconductor materials: creation of equipment complex and software for new level of measurements allowed to increase luminescence intensity of red luminescence inks based on them more than in 2 times.

THE DEPARTMENT OF ORGANIC COMPOSITE MATERIALS

Acting Head of department – Ph.D. Anatolij P. YUVCHENKO,
tel.: +375 (17) 267 13 11, e-mail: mixa@ichnm.basnet.by

The department consists of scientific research laboratories:

- 1. Polyconjugated organic compounds;*
- 2. Polymeric bioactive substances;*
- 3. Forest- and petrochemical products (dual subordination with BGTU).*

Main directions of research:

Fundamental research:

- creation of new organic materials having electroluminescent properties, orientable (including photo-) luminophores and dyes, organic semiconductors, polymers, bioactive compounds;
- synthesis and molecular assembly of functional organic compounds on the surface of the substrate to modify synthetic and natural polymers and give them biocidal, hydrophilic and (or) hydrophobic properties;
- development of scientific bases of creation and technologies of production of domestic import-substituting low-tonnage chemical products of various purposes on the basis of timber- and petrochemical raw materials.

Applied research:

development and creation of high-tech (including import substituting) materials and components of various applications.

The Laboratory of polyconjugated organic compounds

Head of the Laboratory – Laureate of State Prize in the field of science and technology (1996), Ph.D. Vyacheslav K. OLKHOVIK
tel.: +375 (17) 237 67 17, e-mail: slavol@ichnm.basnet.by



Directions of scientific researches:

Synthesis of new polyconjugated aromatic and heteroaromatic compounds, studying their physicochemical properties.

Development of technologies for obtaining new materials for organic electronics, devices of displaying information and backlight: emission, organic electron- and hole-conducting materials for fabrication of OLED-devices, also RFID- marks.

Creation of new organic materials having electroluminescent properties; photoorientable luminophores and dyes, organic semiconductors, polymers, biologically active compounds.

Development of effective technologies for producing high-purity semiproducts, pharmaceutical substances and plant protection products, luminophores, pigments and dyes based on them for different types of typographic printing.

Main achievements and developments:

The methods of synthesis of new polyconjugated organic compounds based on biphenyl, carbazole and dibenzothiophene emitting in blue, green and red regions of electromagnetic spectrum and having electroluminescent properties. Organic light emitting diodes (OLED) of blue, green and red emission, which can be used in microelectronics industry for creation of new devices of displaying information and the pack-

light were developed.

New technology of obtaining stable different-ligand complexes of europium (III) and security typographic paints (for dry, wet offset, thermosetting flexographic paint) on their basis which are introduced in the RUE «Cryptotech».

Manufacturing technology of current conductive paints for silk-screening with low sheet resistance – 20-35 MOhm/square, for manufacturing of antennas of radiofrequency identification devices (RFID-marks) by silk-screening.

The technology of continuous selective demetallization of aluminum layer on the polymer roll film, which allows to obtain patterned metallic image of high-resolution on given stencil. The development was introduced at "Minsk Printing Factory" in the production of protection elements for securities.

The technology for obtaining new irregular copolymer of polyphenylene-1,3,4-oxadiazole and fiber based on it with high fire- and heat resistance. The fibers based on new copolymers for the production of heat-resistant filters, protective clothing and accessories, hardening of rubber products, composite plastic and other. Assimilation at OJSC «Svetlogorskikhimvolokno».

The technology of obtaining active substance of the original domestic plant growth promoter «Epin» and preparation of anti-cholesterinemic action – “Dekrekhol” (with IBOCh NASB).

The Laboratory of polymeric bioactive substances

Head of the Laboratory – Laureate of State Prize of the BSSR in the field of science and technology (1984), Dr.Sc., Vladimir A. TARASEVICH
tel.: +375 (17) 237 67 89, e-mail: tar@ichnm.basnet.by

Directions of scientific research:

Synthesis and molecular assembly of functional organic compounds on the surface of the substrate to modify synthetic and natural polymers and give them biocidal, hydrophilic and (or) hydrophobic properties;

Synthesis of polymeric chelating ligands, research of complexing properties and obtaining poly-functional materials on their basis.

Main achievements and developments:

development of complex disinfectants for sanitizing of food enterprises and medical institutions, creation of the technology for their manufacture;

development of new heat-resistant materials based on thermosetting and porous graphite materials and carbon fibers;

recycling of wastes and by-products of industrial enterprises of the Republic of Belarus.



The Laboratory of forest- and oil chemistry products

Acting Head of the Laboratory – Ph.D., Anatolij P. YUVCHENKO
tel.: +375 (17) 267 13 11, e-mail: mixa@ichnm.basnet.by

Directions of scientific research:

Development of scientific bases of creation and technologies of obtaining domestic import-substituting low-tonnage chemicals of various types on the basis of wood- and oil raw materials.

Preparation and properties of nitrogen-containing derivatives of diene adducts of rosin in the process of modifying of polymeric and elastomeric compositions.

Development of new catalytic systems for the reactions of isomerization, polymerization, disproportionating of the turpentine, rosin and secondary terpenoid products.

Creation and study of the properties of bifunctional nanocatalysts of deep hydrothermal processing of mixture of heavy oil residues, alternative and renewable raw materials to produce hydrocarbons for motor fuels and raw materials for the synthesis of low-tonnage chemical products.

Main achievements and developments:

Complex hydroconversion of heavy oil residues in a mixture of renewable plant raw material.

Catalyst system for α -pinene isomerization into camphene and dipentene, represents modified natural alu-

minosilicate from deposits "Steel" (Belarus).

Optically-active additives for chiral LCD materials (UE "Display", Minsk)..

New secondary terpenoid products with complex of valuable properties based on pine gum and products of its processing - turpentine and rosin. Additives to the industrial polymers, which improve technological, adhesive and mechanical properties of polymeric composite materials.

INSTITUTE OF TECHNICAL ACOUSTICS OF NAS OF BELARUS

General Information about Institute

Founded – September 25, 1975

Main research areas: physics of concentrated energy flux on condensed media; development of methods and technologies for production of different functional and special-purpose materials.

The Institute employs 91 people, including 1 academician, 1 corresponding member, 2 Doctors of Science, and 9 PhD specialists.

Postgraduate course in the field of: 05.02.07 – Technology and equipment for mechanical and physical-technical processing; 01.04.07 – Condensed matter physics; 05.16.05 – Metal forming.

Doctoral programme in the field of: 05.02.07 – Technology and equipment for mechanical and physical-technical processing; 01.04.07 – Condensed matter physics; 05.16.05 – Metal forming.

ADMINISTRATION

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STRUCTURE

◀ Laboratory of Metal Physics

◀ Laboratory of Nonlinear Materials

◀ Joint laboratory with Vitebsk State Technological University: Perspective Materials and Technologies

◀ Department of Innovation and Regional Development

◀ Department of Marketing and International Relations

◀ Department of Electrical Measurements

Laboratory of Metal Physics

Head of Laboratory – Dr.Sc., Corresponding Member Vasili V. RUBANIK

tel.: +375 (212) 55 63 89, e-mail: ita@vitebsk.by

Main activities:

-study of concentrated energy flux on condensed matter and physical processes;

-ultrasonic intensification of technological processes;

-coatings of given composition produced by gas dynamic spraying;

-development and obtaining coatings of different functional purpose using ion- plasma sputtering method;

-study of thermomechanical behavior of shape memory alloys under ultrasonic influence.

Production and Services:

technology and equipment for ultrasonic welding of thermoplastic polymers: polystyrene, polycarbonate, polypropylene, LDPE, HDPE, PMMA, PVC, ABC-plastics and other thermoplastics;

-ultrasonic crimping apparatus;

-ultrasonic embossing machine;

-apparatus for ultrasonic welding of polymer tube of blood transfusion system;

- dental casting alloys;
- technology and equipment for ultrasonic dispersion and emulsion;
- die finishing machine;
- abrasive cord.

Laboratory of Nonlinear Materials

Head of Laboratory – Dr.Sc. Viktor N. SHUT

tel.: +375 (212) 55 35 18, e-mail: shut@vitebsk.by

Main activities:

- study and development of advanced materials (TGS single crystals, magnetoelectric structures, piezocomposites, electrically conductive composites and others);
- study of phase transitions, internal fields and self-polarization effects in materials with composition gradient;
- study of grain boundary barriers and electrical properties of semiconductor ceramics;
- study of electrically active defects in high-resistive wide-gap materials wide-gap materials;
- multiple-frequency laser probing of heated gas mixtures.

Production and Services:

- testing equipment for active dielectrics and semiconductors;
- multi-channel portable precision temperature gauges;
- aircraft maintenance equipment.

Joint laboratory for Perspective Materials and Technologies (Institute of Technical Acoustics & Vitebsk State Technological University)

Head of Laboratory – Dr.Sc., Corresponding member Vasili V. RUBANIK

tel.: +375 (212) 55 63 89, e-mail: ita@vitebsk.by

Main activities:

- study of martensitic inelasticity and heat transfer processes in alloys which undergo thermoelastic phase transformations under ultrasonic influence;
- phase transformations in shape memory materials (TiNi, etc.) under ultrasonic influence;
- study of physical and mechanical properties of powder materials under ultrasonic influence: mechanoactivation, pressing, etc.

Production and Services:

- TiNi valve actuator;
- colorectal stents;
- orthodontic archwires.

Department of Innovation and Regional Development

Head of Department – Ph.D. Yuri V. TSARENKO

tel.: +375 (212) 55 62 78, e-mail: labpt@vitebsk.by.

Main activities:

- methodical and organizational support of the Regional Scientific-Technical Program “Innovation Development of the Vitebsk Region”;
- preliminary examination of innovative projects for the Regional Scientific-Technical Program;
- information exchange network between scientific institutes and organizations.

Production and Services:

- capacitive type fuel sensors;
- automated energy accounting systems;
- automated system for oil product accounting;
- a branch office of the Republican Centre for Technology Transfer operates.

Department of Marketing and International Relations

Head of Department – Irina V. NIKIFORAVA

tel.: +375 (212) 55 62 78, e-mail: iakustika@mail.ru

Main activities:

Market research;

Advertising;

International and national exhibitions;

International project support services.

Department of Electrical Measurements

Head of Department – Pavel A. CHERNOV

tel.: +375 (212) 55 75 24, e-mail: ita@vitebsk.by

Main activities:

-installation and maintenance of fire detection and fire alarm systems (License: issued by Ministry of Emergency Situations of the Republic of Belarus);

-electrical measurements (Certificate of Accreditation BY).

V.A. BELYI METAL-POLYMER RESEARCH INSTITUTE OF NAS OF BELARUS

General Information about Institute

Creation date – 1969.

Academician V. A. Belyi has launched the first in Belarus academic laboratory of the mechanics of polymers further grown into a Department of the mechanics of polymers (1964) and reorganized in 1969 in the Metal-Polymer Research Institute (MPRI).

The Institute is engaged in fundamental and applied investigations within the scope of the two main assigned trends: 1. Interphase phenomenon in polymer systems, physico-chemical bases of developing composites materials on the base of organic and inorganic polymers; 2. Physics, chemistry and mechanics of surface, analysis of contact interactions, friction, wear and lubrication in engineering and biological systems. There are about 140 employees on the Institute's staff, among which 1 Academician and 2 Corresponding Member of the National Academy of Sciences of Belarus, about 40 workers with D.Sci. and Ph.D. degrees.

The institute publishes two journals: International scientific journal "Friction and Wear" and International scientific and technical journal "Polymer Materials and Technologies" in Russian. It runs Post-graduate and senior doctorate courses, a Council on granting Doctor and Candidate (Ph.D.) of Sciences degrees in specialties: Physics of condensed state, Materials science (engineering) and Tribology. There are two Multiple-access centers: Belarus Center of probe microscopy and Center of tribological testing and certification of composite materials and lubricants.

High-rank Prizes and awards obtained by the scientists of MPRI NASB: State Prize of BSSR in science and technology (1972), Prize of All-Union Komsomol in science and technology (1973, 1982), Prize of Belarus Komsomol in science and technology (1975, 1986), State Prize of BSSR in technology (1978), Prize of BSSR Council of Ministers (1981), Prize of the Academy of Sciences of Belarus (1993, 2007, 2008, 2011), Prize of the Government of Russian Federation in science and technology (2004), Prize of the Academician V. A. Koptuyug (2011).

Academics V. A. Belyi (the first director of the institute in 1969-1979), A. I. Sviridenok (director of the institute in 1979-1991) and S. A. Chizhik, Corresponding Members B. I. Kupchinov and A. V. Rogachev have been working in the institute. Academician N. K. Myshkin (director of the institute since 2002), Corresponding Members S. S. Pesetskii and Yu. M. Pleskachevskii (director of the institute in 1991-2002) are working in the institute now.

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STRUCTURE

◀DEPARTMENT №1 “Composite materials and recycling of polymers”
◀DEPARTMENT №2 “Physics and mechanics of composite systems”
◀DEPARTMENT №3 “Frictional material Science”

◀DEPARTMENT №4 “Friction, lubrication and operating proof of materials”
◀DEPARTMENT №5 “Technology of polymer composites”

DEPARTMENT № 1 “Composite materials and recycling of polymers”

Head of department – Dr.Sc., Professor Victor M. SHAPOVALOV

Fundamental investigations:

- physico-chemical processes and interfacial phenomena during processing and formation of composite materials based on artificial and natural polymers;
- control of physico-chemical properties of bitumen-mineral materials;
- electrical polarization of polymers, metal-polymer electrets.

Applied investigations:

- development of the composite materials by using technologies of polymer recycling;
- development of the polymer composites based on thermospread graphite, ultra- and nanodispersed fillers;
- hydrofobic gel compositions based on modified alkali silicates;
- modification of polymer fibers, extrusion technologies of polymer fiber materials.

Developments:

- products made out of materials based on secondary polymers;
- hybrid organosilicate nanocomposite;
- modifying additives for asphalt and concrete mixtures to improve durability of road paving;
- extruded continuous goods of wood plastics;
- fibrous polymer materials for filtering gases and liquids;
- modified polyester fibers with special properties.

Services:

- analysis of technological properties of composite materials;
- analysis of electrophysical and electretical properties of polymers and composites.



DEPARTMENT № 2 “Physics and mechanics of composite systems”

Head of department – Ph.D. Leonid F. IVANOV

Department includes:

Laboratory “Mechanics of composites and biopolymers”. Head of Laboratory - Sergei V. Shil'ko, Ph.D., associate professor, Laureate of the Prize of Academician V.A. Koptug.

Fundamental investigations:

- interaction of laser radiation and polymers in vacuum;
- properties of high-temperature plasma in a medium of complex organic compounds;
- formation regularities of thin polymer films;
- physics and mechanics of metal-polymer contact;
- mesomechanics of composites;
- the principles of creation of adaptive and smart materials;
- biomechanics.



Applied investigations:

- laser technology and equipment of PTFE processing, PTFE-based composites;
- technology of polymer coatings with specific properties;
- plasma-chemical technology and equipment for obtaining nanocoatings on fibers;
- methods of investigation and computation of strength of technical and medical polymer hardware.

Developments:

- composite materials of "Fluvis" group ("Vakofluvis", "Superfluvis");
- modified carbon fibers "Belum";
- fibrous-porous PTFE material "Griftext";
- filtering elements "Grif" and "Grif-T";
- installations "Grif" used in processing precious stones and metals in boiling acids;
- technology of surgical threads with poly-p-xylylene coatings;
- heart valve and ear bone prostheses.

Software products:

- "Bel" - Design of joints of the boundary element methods;
- "BIODIS V2.2", "Spas" - Diagnostics of hemodynamics of blood circulatory system;
- "Dimont" - Computation of hydrodynamic parameters for oil pipeline;
- "Dinas" - Identity establishing of pump characteristics;
- "Citygidro" - Simulation of urban water-supply.

Services:

- static and dynamic testing of polymer materials (State Standard, ASTM, DIN) for tension, compression, bending, contact, indentation, rheological properties;
- analysis of static strength and stress-strain behavior of products obtained from polymer composites;
- development of software for strength analysis of composites and biomechanical diagnostics.

DEPARTMENT NO. 3 "FRICTIONAL MATERIALS SCIENCE"

Head of Department – Ph.D. Vladimir P. SERGIENKO

Department includes:

Sector "Vibroacoustics of materials and friction units." Head of Sector - Sergej N. Bucharov, Ph.D.

**Fundamental investigations:**

- frictional materials science, methods of monitoring structure of composite materials and shaping processes of items;
- modeling of vibration-absorbing structures of composite materials for tribojoints; investigation of vibroacoustic phenomena at nonstationary conditions of friction;
- modeling of heat generation at nonstationary friction, development of numerical methods for determining the temperature fields in the frictional interaction of solids in the oil environment;
- modeling of laminated sound-absorbing structures; development of sound-absorbing materials based on native components.

Developments:

- materials and manufacturing methods of frictional materials, pads for brake units, clutches and transmissions;
- materials and manufacturing methods of friction discs for multidisc oil-cooled brakes and transmissions of hydromechanical gearboxes, clutches, couplings, power take-off shafts of vehicles;
- friction composites based on fluoroplastics and techniques of their molding into parts for stationary friction joints used in engineering equipment for manufacture of metal cord, chemical fibers and textile;
- sound-absorbing and damping composites based on natural and polymer fibers;
- high-strength composites and methods of processing thermosetting plastics into items by forward extrusion;
- formulas of compositions and technology of reconditioning surface and volume defects of metal equip-

equipment;

-engineering methods of calculating thermal loading of friction pairs.

Applied investigations:

-eco-friendly heat-resistant friction material for stationary and nonstationary friction;

-materials and technologies for recovering volume and surface defects of metal parts, technological equipment and pipelines;

-optimization of techniques of noise and vibration absorbing materials used in engineering and construction;

- thermal design of brakes and friction units.

Services:

-acoustic tests of sound-absorbing and sound-insulation materials (experimental determination of the acoustic characteristics of sound-absorbing media; selection of antinoise materials and structures, their testing on the noise spectrum and characteristics of sound field);

-vibration tests and diagnostics (determination of the dynamic elasticity modulus and loss factor of sound and vibration absorbing materials by resonant amplitudes, the vibration strength test of products; vibrodiagnostics of parts and machinery by noncontact Laser Doppler Vibrometry);

-measurement of noise using sound intensimeter (noise measurement, sound intensity, sound power source level, identification of noise sources, definition of acoustic performance of buildings and rooms).

DEPARTMENT № 4 “Friction, lubrication and operating proof of materials”

Head of Department – Academician of NASB, Doctor of Technical Sciences, Professor, Laureate of the Premium of Lenin's Komsomol, Premium of the Government of Russian Federation in science and engineering and Premiums of Academy of Sciences of Belarus Nikolai K. MYSHKIN

Department includes:

Laboratory “Triboanalysis”. Head of Laboratory – Ph.D. Laboratory “Environmental, irradiation and wear resistance of materials”. Head of Laboratory – Vladimir P. SELKIN

Laboratory “Tribophysics of lubricants”. Head of Laboratory – Sergey F. ERMAKOV, Dr.Sc., Prof. Aleksey V. KUPREEV



Fundamental investigations:

- friction, wear and lubrication, mechanics of discrete friction contact;

-contact adhesion and intermolecular interaction of tribosurfaces;

-morphology of friction surfaces and wear particles in triboanalysis problems;

-ageing of polymer materials under ionizing radiation;

-cavitation, erosion and hydroabrasive wear of materials in moving streams of liquids (oil, water, corrosive liquids);

-tribophysics of liquid crystals and lubricating materials on their base.

Applied investigations:

-tribotesting methods, certification of metal-polymer friction pairs, lubricants and coolants;

-methods for on-line diagnostics of lubricated friction joints, condition monitoring of lubricants, morphological analysis of wear debris and friction surface;

-condition monitoring of interfacial and friction surfaces (optical, electronic and atomic-force microscopy);

-stability prediction of physical-mechanical properties of polymer composite under environmental effects.

Developments:

-atomic-force microscope NANOTOP-207;

-universal microtribometer MTU-2KT;

-contact adhesion meter ADM-03;

-pendulum tribometer;

-sealing elements, anticorrosion, antifriction, wear resistant and cavitation-proof coatings operating in

- corrosive liquids;
- filters for drinking and service water;
- technologies of radiation modification of polymer materials, film dose-meters for measurements of ionizing radiation;
- methods of polymer parts welding (pipes, fittings);
- lubricants based on intervening products of oil processing and liquid-crystalline compounds;
- “Diasynol” medicine for treating human joints.

Services:

- tribotesting of polymer composites (Standards ISO/DIS 7148-2);
- friction and wear investigations of materials and coatings (ball-on-plate, conformal block on ring, cylinder-plate and pin-on-disk tests);
- surface investigations by optical, electron and atomic-force microscopy;
- testing of lubricants, coolants and additives, estimation of anticorrosion properties;
- environmental, physical-mechanical and electrical properties of polymer materials, paint and lacquer coatings;
- prediction of properties of polymer materials and coatings in different operating climatic conditions;
- estimation of quality and operating characteristics of filters systems.

DEPARTMENT № 5 “Technology of polymer composites”

Head of department – Dr.Sc., Professor, Laureate of the Premium of Lenin's Komsoml in science and engineering, Premium of Academy of Sciences of Belarus Stepan S. PESETSKII



The Department includes:

Sector 5.1. “Technology and processing of polymer composite materials”.

Head of Sector – Ph.D. Vasily N. KOVAL

Sector 5.2. “Reaction extrusion”. **Head of Sector – Ph.D. Yuri M. KRIVOGUZ**
 associate professor, Laureate of the Premium of Academy of Sciences of Belarus

Sector 5.3. “Interfacial phenomena in polymer composites”. **Head of Sector – Ph.D. Vladimir N. ADERIKHA**

Fundamental investigations:

- foundations of chemical technology and materials science of polymer composites;
- interfacial phenomena at formation and operation of polymer materials and their products;
- physicochemical structure and properties of thermoplastic polymer materials;
- foundations and technology of functionalized polymers, copolymer olefins and their blends;
- physico-chemistry and mechanics of contact interaction, service life prediction of constructions and tribojoints.

Applied investigations:

- technology of engineering plastics based on thermoplastics, including glass-reinforced ones, fireproof, blended, polymer-polymer, filled composites and etc.;
- manufacturing and processing technology of polymer materials (reaction extrusion, extrusion- molding and other);
- additives to polymer composite materials; antipyrine agents, compatibilizers, impact viscosity modifiers, adhesives, etc.;
- concentrates of nano- and hybrid fillers;
- composite materials based on polytetrafluoroethylene for friction units and seals.

Developments:

- oil-proof composites based on polyamide matrix processing by extrusion technologies;
- fiber-filled multifunctional thermoplastics (high-modular, fireproof, aimed for processing by extrusion);
- impact-resistant and super-shockproof structural materials resistant to cracking and atmospheric affects based on thermoplastic mixtures and alloys;

- components of upper railroad structure (dampers for highways and heavy traffic roads);
- plastic braids for hoses of high pressure and wiring;
- relaxometer for studying relaxation properties of polymer materials at temperatures from -150°C to $+300^{\circ}\text{C}$.

Services:

- analysis of chemical composition, physico-chemical structure and properties of polymer materials;
- development of computing procedures and software for computer-aded design of composite components and molding facilities for their manufacture.

INSTITUTE OF TECHNOLOGY OF METALS OF NAS OF BELARUS

General Information about Institute

Creation date – October 6, 1970

Main scientific directions of the Institute—development of theoretical bases of management processes of metal and alloys structure and properties at their crystallization and solidification, thermal physics and hydrodynamics of special casting types, creation of new materials and resource-saving technological processes of their obtaining, treatment and strengthening.

The institute staff numbers 98 people, 33 of them are research fellows, 16 have scientific degree (1 Academician, 4 Doctors of Science, 12 Ph.D's) and over 20 engineers.

ADMINISTRATION

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STRUCTURE

DIVISION OF CONTACT PHENOMENA:

◀ Laboratory of crystallization kinetics

◀ Laboratory of alloys modification

◀ Laboratory of surface phenomena

◀ Laboratory of continuously-iterative casting

◀ Laboratory of contact heat exchange

◀ Metal and alloy testing laboratory

◀ Department of innovations and scientific-technical developments



iterative casting for treatment of waste products of copper and aluminium alloys into ingots with fine-grained structure and for hereditary modification of alloys.

- Working out of jet crystallizers with advanced cooling capacity for steels, cast irons, copper and aluminium alloys casting.
- Working out of high-production technological process of production of ingots from aluminium-silicon alloys with application of hereditary modification of jet crystallizers and devices of submerged-jet secondary cooling.

New Forming Directions of Investigations:

- Application of laser and fiber-optical technology for creation of universal contactless device for metal temperature measurement in the range of 10042000°C.
- Working out of technology of casting of hollow billets from silumins with superfine structure without application of admixture modifiers.
- Working out of universal structure- disperse, ecologically safe silumin alloys for steels, cast irons, silumin and copper alloys modification.
- Working out of technology of casting of billets of thixotropic and deformable silumins for thixoforming and billeting of machinery parts.

R&D Products of the Laboratory:

Quenching solidification casting method, microstructure of casting 45 mm in diameter of AISil8Cu1.5x3000 alloy, microstructure of casting 45 mm in diameter of AISil8Cu1.5 after the normalization at the temperature of 500 °C during 4 hours, x2000, jet crystallizers and device of submerged-jet secondary cooling of castings, worm wheels from antifriction silumin, billets of internal combustion engines pistons with improved structural heredity, sleeves from deformable silumins, billets from aluminium and silicon alloys with nano-structure eutectic silicon.

Laboratory of surface phenomena

Head of the Laboratory – Ph.D., Professor Choy Ki YOUNG

tel.: +375 (222) 27 83 27, e-mail: info@itm.by

Basic Directions of R&D Activity:

Fundamental Investigations:

Working out of models for consolidation and crystallization processes at casting of metals and alloys; crystals growth modeling on the base of phase field model; research of technological and theoretical bases of process of die casting of silumin alloys; working out of methods of crystal growth modeling; methods of grade estimation of linear systems which form image; research of image forming and working out of methods of image reconstruction on the basis of solution of Fredholm equation of first kind.

Applied Investigations:

Modeling of thermalphysic processes of continuous casting of metals and alloys; working out and research of numerical and analog methods of simulation of processes of die casting of silumin alloys; research of technologies of anticorrosive and strengthening coatings for metals; working out of restore algorithms of images for objectives of remote observation and non-destructive control; working out of calculation and measurement methods of image characteristics of optic-electronic systems; research of informational criteria and determination of modulation transfer function of linear systems.

R&D Products of the Laboratory: Analogue simulation of die casting processes; technology of computer modelling and designing of bearing elements of automobile jib cranes.

Laboratory of continuously-iterative casting

Head of the Laboratory – Ph.D. Vladimir F. BEVZA

tel.: +375 (222) 28 01 53, e-mail: info@itm.by

Basic Directions of R&D Activity:

Fundamental Investigations:



Laboratory of crystallization kinetics

Head of the Laboratory – Academician, Professor Evgeniy I. MARUKOVICH

Basic Directions of R&D Activity:

Fundamental Investigations: Working out of theoretical bases of control of structure and properties forming process at their crystallization and solidification.

Thermal physics and hydrodynamics of special casting types.

Applied Investigations:

Theoretical and experimental researches of thermal, kinetics and dynamic parameters of forming processes of cast articles.

Physics and chemistry of metallurgic processes and external influences on crystallizing melt.

Mathematical description of processes of consolidation and cooling of casting.

Study of processes of solidification of metals and alloys in the conditions of intensive one-side heat sink at presence of constant overheating before the front crystallization.

Research of regularities of contact heat exchange of metal mould with solidifying casting at continuous casting.

-Study of processes of consolidation of castings in metal moulds in the conditions of regulated heat sink.

R&D Products of the Laboratory:

Technology and equipment for continuous horizontal casting; technology and equipment for electroslag remelting; technologies of electroslag centrifugal casting; of electroslag chill casting; of electroslag casting into water-cooled mold; crushers of steel cuttings; bimetal castings for worm wheel billets of the main lifts drive; casting for responsible purposes for manufacturing of chain links of bucket elevator; castings from tool steels which are made for knives manufacturing for thermo-strengthen armature felling; castings produced from alloyed steel; bimetal bushings and disks “steel-copper alloy”; centrifugal cast billets of copper alloys.



Laboratory of alloys modification

Head of the Laboratory – Ph.D. Vladimir Yu. STETSENKO

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Basic Directions of R&D Activity:

Fundamental Investigations:

- Development of theoretical bases of modification of cast irons, steels and silumines microstructure.

- Research of processes of nano and micro-crystallization in metals and alloys.

- Research of hydrodynamic boundary layers of cooler near the external surface of crystallizer jacket at its various modes of jet cooling.

- Development of numeric-analytical methods of equation solution of boundary layer and castings solidification conformably to hydro-dynamic and heat processes of casting in the jet crystallizer.

Applied Investigations:

-Working out of technology of obtaining of continuous cylindrical billets from silumins with nano-structured eutectic silicon, which have high mechanical, technological and tribotechnical properties.

-Working out of jet crystallizers and devices with submerged-jet systems of ingot cooling, allowing to raise more than twice productivity of casting process and obtain billets with superfine structure without application of ecologically unsafe and expensive admixture modifiers.

-Working out of technology of quenching solidification casting, which allows to obtain ingots with inverted structurally-superfine microstructure.

-Working out of antifriction silumins, which exceed antifriction bronzes in friction wear-resistance.

Topics of Investigations on Novel and Priority Trends:

-Working out of technology of hereditary silumins modification, allowing to improve structural heredity of alloys and raise billets properties without application of admixture modifiers.

- Working out of theoretical and technological bases of high-production processes of continuous and



Working out of theoretical bases of castings obtaining in the conditions of intensive one-side heat sink, allowing to calculate the casting technology and to bond the parameters of technological process of formation of casting and properties of finished product;
working out of original methodologies of calculation of solidification and cooling of castings taking into account surface temperature change, thermophysical properties of the material, superheating heat of the melt, direction of heat sink and real boundary conditions;
research and reveal of major regularities in the field of thermal physics of processes of metals and alloys solidification in thin-walled water-cooled metallic and combined moulds.

Applied Investigations:

Working out of main principles of realization of casting process by the method of wall crystallization, providing obtaining of billets of details for responsible purposes with increased physical-mechanical and operating characteristics.

Working out of calculation methods of kinetics of metal solidification, temperature fields and mode of deformation of casting and crystallizer in the pouring process.

Working out of designing bases of special casting equipment, constant and consumable production accessory for realization of obtaining process of hollow billets without application of core by the method of wall crystallization.

Research of influence of character of transition hydrodynamic processes in the system “ pouring cup-crystallizer” on castings quality and casting process stability. Reveal of regularities of influence of thermal, technological and metallurgical parameters on castings formation in the conditions of directional solidification and constant overheat of melt on the solidification front.

Topics of Investigations on Novel and Priority Trends:

-Working out of theoretical bases and technological methods of control of process of structure formation in cast iron castings during intensive radial heat sink in metallic water-cooled mould.

- Research of influence of thermo-deformational interaction of solidifying casting and crystallizer at its iterative one-side thermal loading on casting consolidation and structure formation conditions.

- Research of the main relations between technological parameters of casting, particularities of mechanism of formation of structure and properties of cast articles in the conditions of directional solidification and controllable heat sink on different stages of castings formation.

New Forming Directions of Investigations:

-Working out of creation conception of new scheme of casting of hollow billets without core use providing considerable increase of billets property and stability of casting process.

- Research of particularities influence of crystal composition and structure of cast iron on fracture conditions of material in operation process.

- Research of influence of composition, particularities of crystal structure and microstructure on wear-resistance and antiwelding properties of cast irons.

- Research of influence of obtaining and thermal treatment conditions of cast iron billets on structure and antifriction properties of material.

- Research of influence of composition and obtaining conditions of billets from special cast iron on wear-resistance in the conditions of dry friction and abrasive- dynamic wear.

R&D Products of the Sector:

- Continuously-iterative casting by directional solidification, plant for continuously-iterative casting by directional solidification, cylinder sleeve from special grey cast iron, seal rings from high-duty cast iron (import substitution), punches, draw plates from white high-chromium cast iron, piston rings from special grey cast iron (import substitution).

Laboratory of contact heat exchange

Head of the Laboratory – Ph.D. Valery M. ILUSHENKO

tel: +375 (222) 28 07 08, e-mail: info@itm.by

Basic Directions of R&D Activity:

Fundamental Investigations:

Study of regularities and particularities of contact heat exchange of the metal mould with casting during



continuous and chill casting; study of heat exchange in chills and continuous casting machines for production of flat cast billets; creation of scientific bases of obtaining of wear-resistant materials on the base of complex-alloyed cast irons for cast details which work in conditions of rheological influence of plastic ceramic masses with high contents of abrasive and shock-abrasive wear.

Applied Investigations: Research of regularities of castings formation at continuous casting of tapes and strips in roll, pass-through crystallizers and chills; working out of new technological processes of continuous casting of tapes, strips, panels, accumulator grids, working out of technological processes of chill casting of zinc billets at rolling from production waste, creation of new metal materials with strictly aligned microstructure.

Topics of Investigations on Novel and Priority Trends:

- Working out of theory, technique and technologies of resource-saving casting processes; creation of new multi-functional and specialized materials; research of thermophysics and hydrodynamics of special casting types; creation of new resource - and power saving technological processes of obtaining of castings from nonferrous metals and alloys.

New Forming Directions of Investigations: Creation of casting technology for obtaining of zinc anode material with 100-% ratio of use at galvanic process.

R&D Products of the Laboratory: Technological process of continuous casting of reinforced copper chloride tape for water-activable current sources, technological process and equipment for obtaining of zinc anodes for galvanic productions, technological process of continuous casting of lead accumulator grid for spiral batteries, cast details from multi-component cast irons with oriented carbide phase.

Metal and alloy testing laboratory

Head of the Laboratory – Nikolay I. GILKOV

tel: +375 (222) 28 06 37, e-mail: info@itm.by



Directions of R&D Activity:

Element spectral analysis of metals and alloys; determination of chemistry of metals and alloys, pressed powders and wire by the method of atomic emission spectroscopy; metallographic examination of structure; testing of physical and mechanical properties.

glass containers, equipment for application of polymeric power coatings, sections of dispatcher panels with a set of mnemonic circuits intended for on-line information display of all levels of electric supply, setups for building refuse disposal. Manufacture of off-standard metal structures; filtering elements for fine purification of diesel oil; cleaning of air and solutions for water wells; aerators for cleaning wastewater; sorbents for collecting oil and oil products; thermoplastic polymer components (from recycled materials including); pipes from polyethylene, key cases for non-departmental guard; polyethylene hose film, packets and so on.; deposition of polymer powder paints on metal components.

RF RUF "FERRIT" General Information

Creation date – October, 1991

Director – Ph.D. Victor N. SHAMBALEV

Belarus, 220072, Minsk, P. Brovki Str., 19 a
tel.: +375 (17) 284 13 21, +375 (17) 284 11 65
e-mail: info@ferrit.by, www.ferrit.by

Main directions of activity:

At present "Ferrit" has one of the leading positions in the countries of CIS and Eastern Europe in the field of production of constant magnets, ferrites and parts on their base. During that period, thousands tons of constant magnets and ferrites, hundreds of models of magnet separators and cuffs, transformers, wire-wrap and inductive parts have been sold and supplied for enterprises of special industry fields of Belarus, Ukraine, Russia, Poland, Lithuania, Latvia, Estonia, Moldova, countries of the Middle East. Overall volume of produced products exceeds 2 millions US dollars.

Unique scientific R&D's, high construction and technological level, collaboration with leading scientific-research organizations of Belarus, as well as use of novel materials and technologies enable the RUF "Ferrit" to compete with world leading enterprises of similar products and equipment.

R&D Production of "Ferrit":

Ferrites, permanent magnets, magnet separators, radio-electronic parts conform to technical demands, scales and economic criteria of the RUF "Ferrite" partners. The experience, accumulated during the time of work of the Company in combination with orientation on the advanced world technologies and constructor solutions, helps the factory to offer the wide range of magnet separators and metal detectors which help to solve the problem of raw materials enrichment, reveal and extract of metallic insertions in the raw materials and final products of customers. For the designing of magnetic systems scientists and specialists of the RUF "Ferrite" are using mathematical modeling with an application of new software, both for the calculation of requirements to permanent magnets syntheses and for analysis of required magnet field configurations.

Studies of magnet separation processes are carried out in physic-technological laboratory; in design-engineering bureau new models of radio-electronic products are developed, quality control of production is made in a certified laboratory.

RUF SKTB "METAL POLYMER" General Information

Creation date – 1968

Director – Sergei G. KUDYAN

Belarus, 246007, Gomel, Fedyuninsky Str., 4
fax: +375 (232) 57-14-18, e-mail: mpolimer@yandex.ru
www.sktb.by

Fields of activities: development of technologies and production of the following equipment

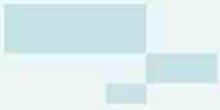
- for sorting and recycling secondary polymeric materials;
- grading and recycling glass waste;
- disposal of building wastes;
- manufacture of non-woven fibrous-porous materials and polymer filtering materials;
- painting of metallic components of any shape or configuration by polymeric powder materials.

Equipment: complete set of metal-working equipment.

Products and services:

Equipment for sorting solid domestic wastes, baling presses, crushing machines, sharpening devices, equipment for washing secondary polymeric materials, agglomerators, driers, molding machines, granula-

tors, production lines for polymeric pipes. Fiber shredders, film-hose aggregates, equipment for manufacture of non-woven fibrous-porous materials and polymer filtering elements, lines for breaking glass containers, equipment for application of polymeric power coatings, sections of dispatcher panels with a set of mnemonic circuits intended for on-line information display of all levels of electric supply, setups for building refuse disposal. Manufacture of off-standard metal structures; filtering elements for fine purification of diesel oil; cleaning of air and solutions for water wells; aerators for cleaning wastewater; sorbents for collecting oil and oil products; thermoplastic polymer components (from recycled materials including); pipes from polyethylene, key cases for non-departmental guard; polyethylene hose film, packets and so on.; deposition of polymer powder paints on metal components.

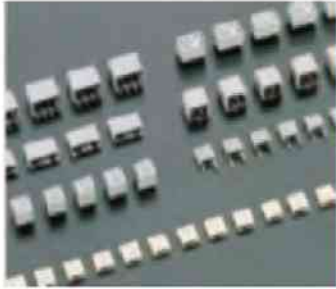


DEVELOPMENTS

of the Scientific-Practical Materials Research Centre
of the National Academy of Sciences of Belarus

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ULTRASONIC RECEIVERS IRRADIATORS FOR THE PRIMARY CONVERTER OF THE EXPENSE OF A LIQUID



Designed for the functioning in the composition of the initial transducer for the volume measurement of water, vapour and oil products. Operating frequency: 0,5, 1,0, 2,0, 4,0 MHz. Operating temperature of the measured liquid - (+2 ÷ 250) °C. Coefficient of the transfer from irradiator to the receiver through the operating liquid is not less than 0,5.

PIEZOELECTRIC CERAMIC IRRADIATORS FOR THE ULTRASOUND WASHING COMPLEXES AND THE DEGREASING SYSTEMS



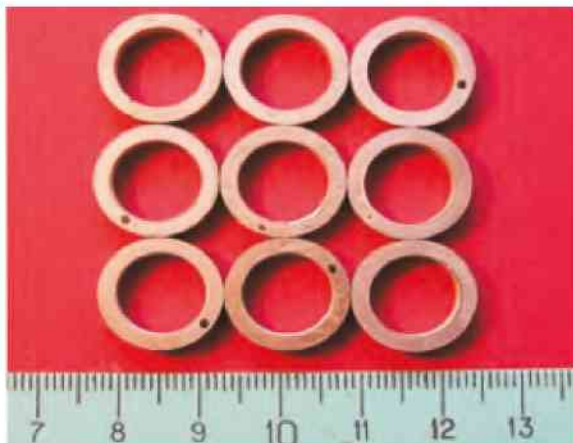
Designed for the use in the composition of the ultrasonic washing complexes and the degreasing systems. Generation frequency - $44,0 \pm 4,4$ kHz. Operating temperatures region - $(-10 \div 90)$ °C. Dimensions of piezoelectric ceramic rings: 40 x 8 x 6 mm. Dimensions of the irradiator: \varnothing 40,0 mm, length - 40 mm.

PIEZOELECTRIC CERAMIC IRRADIATORS AND RECEIVERS FOR THE ULTRASONIC FLOW-METERS OF LIQUIDS AND HEAT-COUNTERS



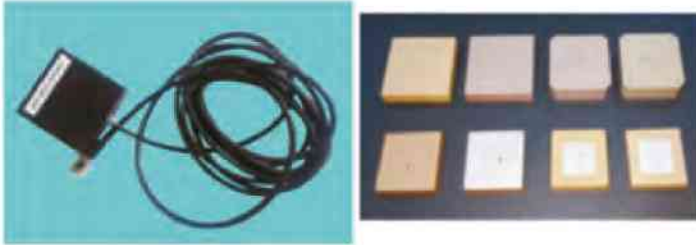
Piezoelectric ceramic irradiators and receivers are designed for the use in the composition of ultrasonic flow-meters and heat counters. Operating frequencies - (200...3000) kHz, diameters - (10...50) mm. Loss of the operating frequency in the temperature range (5... 150) °C is no bigger than 0,5%.

PIEZOELECTRIC CERAMIC COILS FOR THE MODULATION SYSTEM OF LASER GYROSCOPE



Piezoelectric ceramic coils are designed for the modulation system of laser gyroscope. The coils have following specifications: external diameter - 15,5 mm, internal diameter - 11,2 mm, radial resonance frequency 73 kHz, axial resonance frequency 396 kHz, mechanical Q-factor (Q_m) - (50 ÷ 120), ultimate operating temperature (T) - (430 ± 2) K, deviation of the main resonance frequency at heating of piezo-element up to 373 K not larger than 0,6%.

SMALL-SCALE CERAMIC AERIALS FOR THE SATELLITE NAVIGATION SYSTEMS



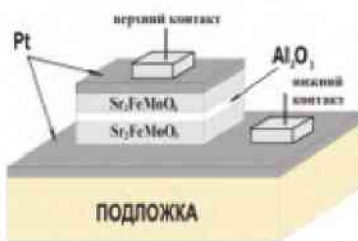
▶ Small-size broadband antennas and ceramic antenna elements are intended for systems of satellite navigation (GLONASS-GPS). For manufacture of ceramic elements of antennas thermostable dielectric materials with the relative inductivity $7 \div 41$ are used.

CERAMIC ROD INSULATORS FOR FEEDING DEVICES



▶ Ceramic rod insulators for suspension and tension of the antenna networks and external feeders working in the decameter, hectometer and kilometer rangesthat can withstand explosive effortover 4,5 tons.

MAGNETICALLY-SENSITIVE MULTILAYERED STRUCTURES ON THE BASE OF METAL-OXIDE COMPOUNDS



▶ Fields of application:
Magnetic field sensors; highly sensitive information reading heads; spintronic devices.

Unique features:

High Curie temperature (~ 420 K) provides a possibility of room temperature application of strontium ferromolybdate - based devices at room temperatures. The nature of Sr_2FeMoO_6 band structure leads to a practically complete spin polarization of charge carriers.

TECHNOLOGY OF THE PRODUCTION OF MULTILAYER ELECTRICAL-MAGNETIC SCREENS ON THE BASE OF ELECTROLYTIC DEPOSITED MAGNETICALLY-SOFT AND COPPER LAYERS



▶ The achieved results:
The samples of multi-layer electrical-magnetic screens with thickness of 250-300 um are produced. By their screening efficiency they are exceeding the singlelayer samples and can be compared with the laminated multiplayer screens on the base of the best magnetically-soft materials (81 H MA, AMAG176).

Advantages:

1. Low cost;
2. Electrical-chemical method of application makes it possible to put jointless screens on complicated surfaces;
3. Complicated technological equipment is not required for the application;
4. High technological effectiveness and constructive properties;
5. Low-temperature (up to 60 °C) deposition regimes.

MAGNETIC MATERIALS



- ▶ Magnetic materials on the base of ferrites:
 - magnetically-soft high-frequency Ni-Zn ferrites;
 - magnetically-soft highly-permeable Mn-Zn ferrites;
 - SHF ferrites;
 - magnetically-hard strontium ferrites and barium ferrites;
- Constant magnets on the base of NiFeB
- Radio-absorbing and protective materials and coatings based on ferrites.
- Noise-suppressing filters.
- Magnetic systems:
 - Magnetic separators for the cleaning for the enterprises of food, glass and ceramic industries.
 - Magnetic systems for rotors of valve motors and stators of electrical machines.
 - Magnetic clutches, reduction gear boxes and brakes.
 - Magnetic plates. Magnetic systems of various sensors, flow rate meters and indicators.
 - Special magnetic systems for absorbing of radio-frequency field signals in a wide frequency range.
 - Devices of magnetic treatment of water for the prevention of scale formation in the water-heating boilers of low and medium power. Wire-wrap goods:
 - Transformers, inductance coils, inductors.
 - Mini- and micro-magnets with high consumption characteristics.
 - Magnet layers.

FERRITES-GARNETS ($Re_3Fe_5O_{12}$)



- ▶ Single crystals of ferrite-garnet (FG) – $Re_3Fe_5O_{12}$ (Re is a rare-earth cation or Y) are widely used as magneto-optical materials in the UHF engineering, optoelectronics, magnetic recording technique, etc. Scientists of the Institute actively develop the method of controlled growing of various inorganic single crystals with the solution-melt method. Adaptation of this method for the acquisition of the FG crystals will make it possible to synthesize yttrium iron garnet with optical losses not worse than 0,2 dB on the wavelength $\lambda - 1,55 \mu m$, with ferromagnetic resonance line width of (0,5 – 1,0)Oe and high structure perfection. It will become possible to.

THE CERAMIC MATERIAL «ALNIT» WITH HIGH THERMAL CONDUCTIVITY BASED ON ALUMINUM NITRIDE

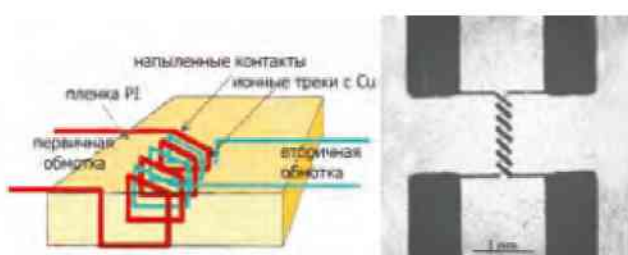


Application area:
Obtained ceramics based on aluminum nitride can be used as substrates and enclosures hybrid integrated circuits and other electronic devices, equipment, as well as targets for forming thin films, and a thin film structure used in optoelectronics. The method for producing eliminates any binders and additives, activating the sintering process. The method is protected by patents of Russia and Belarus. The material has a trademark «Alnit».

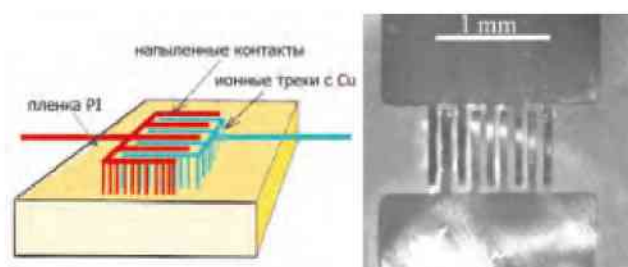
Specifications:

- Density: 99–100% of theoretical density
- Thermal conductivity: 135–185 W/(m·K)
- Electrical resistivity: 10^{11} – 10^{13} m·cm
- Microhardness: 16,5–18 GPa
- Roughness: $\leq 0,6 \mu\text{m}$
- Dissipation factor, $\text{tg}\delta$: 0,0005–0,01
- Dielectric constant, ϵ : 8,5–12
- Diameter: 10–26 mm, thickness: 0,5–5 mm.

USE OF TECHNOLOGY OF TRACKS OF FAST HEAVY IONS FOR CREATION MICRO- AND NANO-ELECTRONIC DEVICES



the prototype of micro-transformer



the prototype of micro-condenser

The technology of tracks of fast heavy ions (SHI) is offered for creation micro- and nano-electronic devices on the basis of polymeric films (in cooperation with Khan–Maytner-Institute, Berlin, Germany). Within the limits of the given research the first prototypes of micro-magnets, micro-transformers and micro-condensers on the basis of films polyimides (PI) with the pickled ionic tracks which have been filled by pure metals by means of technology of contactless sedimentation (ELD) through special masks are created.

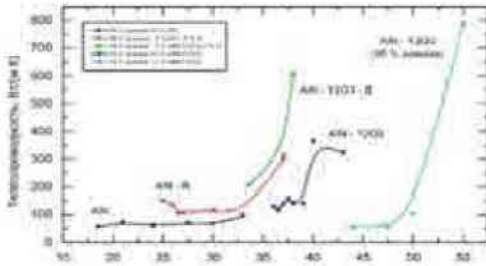
The micro-magnet prototype possesses good quality of an order ~ 7 at working frequencies about 0,5 GHz, and the parameter of communication of the micro-transformer makes about 90 %. The micro-condenser prototype is characterised by capacity of an order almost independent of frequency 0,5–0,6 pF at frequencies to 1G Hz. Possible application of the given devices on the basis of ionic tracks includes navigating systems of cars, space vehicles and new systems of a data.

HIGH PRESSURE AND HIGH TEMPERATURE APPARATUS WITH MADESTEEI–HARD ALLOYS MATRICES



The apparatus is intended for the sintering of refractory ceramics in the form of discs with a diameter up to 50 mm at pressures up to 2,5 GPa and temperatures up to 1700° C with an exposure up to 2 min using a presses DO 043 and DO 044 with a force of 20–25 MH.

MATERIAL WMI HIGH THERMAL CONDUCTIVITY BASED ON ALUMINUM NITRIDE AND DIAMOND



- Obtained ceramics based on aluminum nitride and diamond maybe used in electronic devices as a heat-removing and functional elements. A method for producing is patented in the Republic of Belarus.
- Specifications:
 - Density: 99–100% of theoretical density
 - Thermal conductivity: 520–800 W/(m·K)
 - Electrical resistivity: 10¹¹–10¹² Ohm·cm.

THE HIGH PRESSURE AND HIGH TEMPERATURE APPARATUS WITH HARD ALLOY-BASED MATRICES BC-021



- Is intended for experiments on sintering refractory ceramics at pressures up to 4 GPa and temperatures up to 2200° C using a press unit with a force of 5 MN. The sintering time is to 20 minutes. Apparatus allows to obtain ceramic samples with a diameter up to 10 mm and a height up to 5 mm.

THE HIGH PRESSURE AND HIGH TEMPERATURE APPARATUS WITH HARD ALLOY-BASED MATRICES BC-021 BC-021A



- Is intended for sintering refractory ceramics in the form of discs with a diameter up to 12 mm at temperatures up to 1800° C and pressures up to 5 GPa, using a press units DO 137 A and DO 138 with a force of 5–6,3 MN. Sintering time is up to 3–5 min.

HIGH PRESSURE AND HIGH TEMPERATURE APPARATUS WITH STEEL MATRICES



- Is intended for sintering ceramic samples with a diameter up to 30 mm and 2 mm in height at pressures up to 1 GPa and temperatures up to 1500° C using press units DO 137 A and DO 138 with a force of 5–6,3 MN. The container is made of material with high thermal stability.

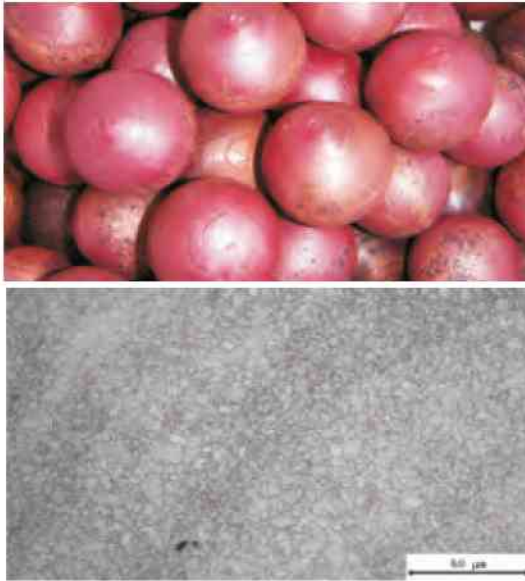
MATERIAL WMI HIGH THERMAL CONDUCTIVITY BASED ON ALUMINUM NITRIDE AND DIAMOND



- Specifications:
 - Pressure.....up to 4 Gpa
 - Temperature.....up to 1700–1800° C
 - Sintering time.....up to 3 min
 - Diameter of samples.....22–26 mm
 - Height of samples.....up to 5 mm
- The press units DO 043, DO 044 with a force of 20–25 MN.

1.2. PHYSICAL AND TECHNICAL INSTITUTE

PRODUCTION TECHNOLOGY OF ANODE SPHERES



▶ Manufacture of anode spheres from copper for electronic industry on the new technology combining methods "ECAP" and cross-wedge rolling.

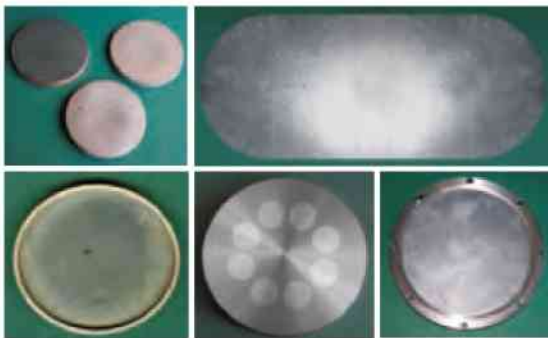
Advantages:

- The technology has no analogues in the world;
- High accuracy of the sizes: a deviation from a spherical surface of the form no more $\pm 0,1\text{mm}$;
- Maintenance of a demanded chemical compound of anode copper;
- Maintenance of demanded structural uniformity of anode copper and the size of grain spheres have the primary size of grain of 5 micron;
- Simultaneous rolling is not less than 4 spheres;
- High firmness of flat rolling tool.

Field of application:

Intended for electronic industry.

MULTI-COMPONENT MATERIALS FOR MANUFACTURING OF FILM ELEMENTS BIS AND TARGETS FROM THEM



▶ Appointment: manufacturing of film current-carrying and resistive elements of integrated microcircuits by a method magnetron dispersions.

Field of application: microelectronics.

Manufacturing method: gas-plasma sputtering, pressing and sintering, moulding, machining.

Overall dimensions: $\emptyset(46-225) \times (6-24)$ mm;

$114 \times 264 \times (2-15)$ mm.

Advantages - factor of stability of electric properties of thin films is no more than 0,01; specific resistance of resistive films - $0,5-1,5 \text{ k}\Omega/\text{TKR}$ of resistive films $1-10^4 \text{ K}^{-1}$.

MANUFACTURING AND RESTORATION OF CATHODES, TARGETS OF HIGH CLEANLINESS



▶ Appointment:

Cathodes, targets, the details of industrial equipment sprayed on installations arc, magnetron deposition of coverings.

Technical characteristics:

Manufacturing techniques are based on electron beam fusion of chemically active, refractory metals in vacuum that allows to exclude pollution of melted metal. The technology of usual and high-speed diffusive welding is used and moulding in the conditions of vacuum.

Advantages:

-The equipment of small capacity (ten kilowatts) is used; -Sources of pollution of melted metal are excluded;

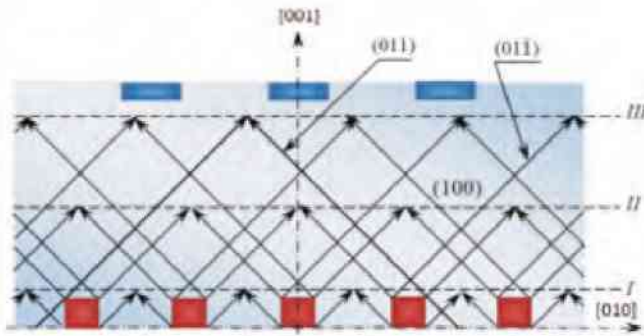
-Controllable structure of a received material;

- Possibility of realisation of restoration of the worn out cathodes, targets.

Field of application:

Manufacture of microelectronics, integrated microcircuits.

THE INGOT CUTTING OF MONO-CRYSTAL SILICON ON PLATES AND LASER GETTERING IMPURITY IN SEMICONDUCTOR STRUCTURES



► Manufacturing of silicon plates for integrated microcircuits; removal fast-diffusing impurity from active areas of Integrated microcircuits.

Field of application:

Microelectronics.

Developed tools:

The cutting tool and recommendations with the account crystallographic factors for silicon plates of orientation (001) and (111) on:

-mode of ingot cutting of monocrystal silicon on plates;

mode of laser gettering fast-diff using impurity.

Advantages:

-methods of cutting allow to receive more uniform distribution and considerable decrease in depth of the broken layers to surfaces of cut off plates, to improve geometrical parameters - to reduce a deflection and to eliminate a surface micro-waviness;

-gettering methods of impurity allow to form gettering the high-capacity areas excluding an exit of dispositions on a working surface of plates, to raise an exit of suitable semiconductor structures.

WEAR-RESISTANT CARBON DIAMOND-LIKE COVERINGS FOR CUTTING OF HARD-ALLOY MICRO TOOL



► The microtool for manufacture of printed-circuit boards of microelectronics and products of exact mechanics.

Technical and economic indicators:

Coverings are put on micro drills in vacuum by a method of sedimentation of the accelerated pulse carbon plasma.

1. Thickness, micron - 0,5÷1;

2. Hardness, ГПа - 30-60;

3. Absence of sticking of fragments of a processed material;

4. Improvements of quality of micro apertures and milled paths;

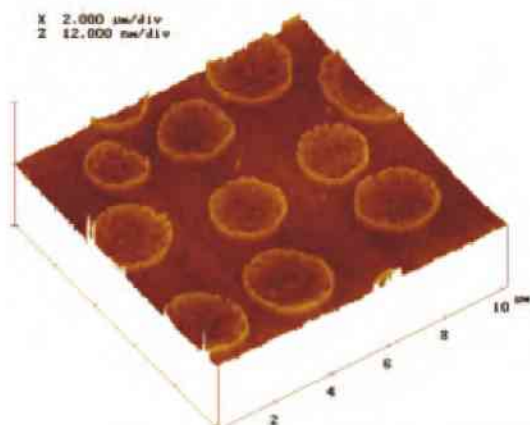
Increase of term of operation in 2,5 times.

1.3. INSTITUTE OF CHEMISTRY OF NEW MATERIALS

INSTALLATION FOR DEPOSITION OF MONOMOLECULAR FILMS ON A SURFACE OF FIRM SAMPLES



Соединение с персональным ПК через USB-порт



Joint working out with ALC "Microtestmashines". The device is intended for deposition of monomolecular films on a surface of film samples (substrates) by a technique of Lengmjura-Blodzhett (LB) or for formation of multimoecular films with use of a level-by-level technique. LT-103 It is specially developed for realisation of a method of horizontal sedimentation (HS) which, unlike traditional vertical L-B method, allows to receive high-homogeneous monomolecular films.

Advantages:

Installation allows putting a qualitative monomolecular film on various surfaces with use of a huge spectrum of PAV (both in firm, and in a liquid state) irrespective of polarity of trailer group of molecules. Sedimentation process is thus characterised by extreme simplicity and high speed. For example, the surface of a standard silicon plate (100 mm) can be completely modified by method HS within 3-5 minutes.

Technical characteristics:

Free surface of a bath: 400 cm², a working surface - 315 cm².

Deepening for immersing: depth to 75 mm, diameter of 60 mm. Liquid volume: 1000-1050 cm³.

Quantity of barriers: one.

The sensor of superficial pressure on the basis of a method of Vilgelmi. Vertical position of the sensor is regulated.

The independent variant is used as densimeter. Laser-beam system of measurement of a deviation dynamo metering consoles. High sensitivity is not worse 0,05 mN/m. the Two-level scheme of fine tuning of sensitivity. Stability is not worse 0,25 mN/h.

The mechanism for immersing: a course of 85 mm. Vertical position of the module of the mechanism is regulated.

The mechanism module can be used independently for substrate immersing in a liquid both under control of the computer (programmed), and by means of the electronic block.

Speed of sedimentation: from 0,002 to 2 mm/min. Sedimentation parameters: quantity of courses (cycles), delays in the top and bottom positions without restrictions. Modes of continuous and step sedimentation. Connection with the operating personal computer through a serial port (COM/RS 232).

Types of applied films: X - Z - Y-types L-B films, Horizontal sedimentation. Hand control is possible.

The temperature sensor: measurement of temperature of a liquid in a bath and ambient temperatures.

Transfer-cooperation forms: conclusion of contracts on delivery.

MODULE OF LEVEL-BY-LEVEL SEDIMENTATION



The short description of R&D:

Joint working out with ALC "Microtest-mashines". Installation is intended for formation from a solution on a firm surface self-organize monolayers, or multi molecular structures (polyelectrolytes, or their combinations with proteins, inorganic nanoparticles etc.) a method of level-by-level sedimentation. The module can work as independently, and in combination with Longmuir installation.

Advantages:

Automation of processes of drawing allows to standardize a technique of updating of a surface.

- Technical characteristics:
1. The substrate area: not less than 25 cm².
 2. Quantity of capacities (psc.): 21.
 3. Quantity of cycles of drawing: not limited.
 4. Speed of giving of capacities: from 44 to 80 mm/min.
 5. Immersing of the modified sample for set time in a solution.
 6. Speed of lifting/ lowering of the sample 0,01–75 mm/min.

Field of application:

Installation can be used In the cases, which demand surfaces updating (passiving and coatings, researches of processes of self-organising of substance on metal surfaces, formation of sensor coverings, interference and polarising optical filters, etc.).

Transfer-cooperation forms: conclusion of contracts on delivery.

COMPOSITE MATERIALS «PANANT» FOR PLASTIC CARDS OF DIFFERENT FUNCTION



Short description of R&D:

Composite materials (CM) of a series «PANANT» are developed (together with IMMS of V. A. Bely of NAS of Belarus) on the basis of the polymeric raw materials which are made In Belarus, and Intended for manufacturing by a method of moulding under the pressure of the bases of plastic cards (BPS) of different function.

Technical characteristics:

Granules white or coloured; possess the improved consumer properties: high mechanical durability, impact strength, high level of a limit of fluidity at a stretching. It can be made at the enterprises receiving polymeric materials and processing them In products of different function.

Advantages:

New CM differ with the improved complex of consumer properties: high adaptability to manufacture at processing, atmosphere-resistance, stability of mechanical properties and colours, and cheaper, than the one used now for manufacturing BPS import ABS plastic. systems of the account of working hours, etc., containing the pasted electronic modules "CHIPS".

Transfer-cooperation forms: conclusion of contracts on delivery.

1.4. INSTITUTE OF TECHNICAL ACOUSTICS

TECHNOLOGY OF ION-PLASMA APPLICATION OF COVERINGS



Made for drawing of protectively-decorative and strengthening coverings from refractory metals and alloys on carbonaceous, corrosion-proof and fast-cutting steels, firm alloys, cermet, plastic, glass and so forth. Characteristics of coverings:

- Coverings with demanded colourscale;
- Strengthening coverings 60–70 units;
- Multilayered coverings.

AUTOMATED COMPLEX FOR TESTS OF THERMISTORS



It is intended for carrying out of tests for service life and rejection thermistors of type of RTS-A working in structure of semi-regulated devices of economic sources of lighting.

Developed for manufacture of "Monolit-radiokeram", RUF 'The Vitebsk factory of radio components "MONOLITH".

MAGNETOELECTRIC COMPOSITE MATERIALS



Intended for designing of elements of radio electronics, magnet-sensitive gauges, contactless switching devices.

Volume composites:

Technical characteristics:

Magnetolectric factor in the field of low frequencies – 210 mV/(cm Э), in the field of a resonance – 150 V/(cm Э).

Layered composites:

Technical characteristics:

Magnetolectric factor in the field of low frequencies-1 V/(cm Э), in the field of a resonance -120 V/(cm Э).

The Maximum intensity of the electric field generated by samples at the pulsing magnetic field, reaches 30 kV/m.

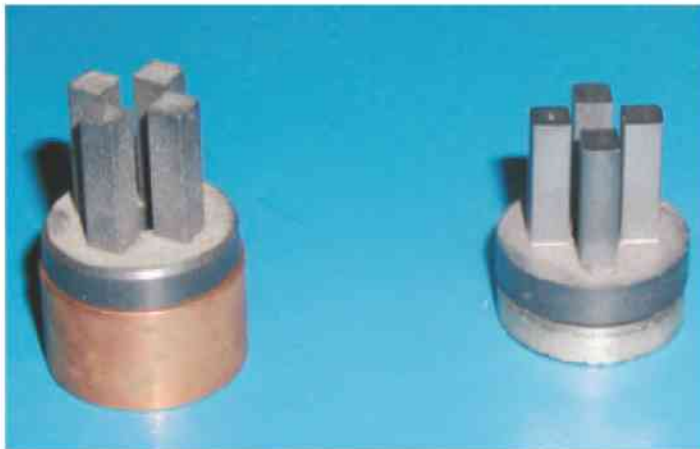
1.5. INSTITUTE OF METAL TECHNOLOGY

METALLIZATION OF FERRITE AND CREATION OF THE ONE-PIECE CONNECTIONS FERRITE-METAL



Metallization of ferrite is based on restoration of metal from oxide-forming elements of ferrite under the influence of electrodeless plasma and laser radiation. The restored metal is deepened in a ferrite blanket. For a layer thickening it is used electrotype deposition or a dusting by a material with the set properties. After grinding and polishing the covering in superficial layer of ferrite and in its plane with the set of electrotechnical properties and good adhesion to a material of the ferrite sample turns out. The method allows creating passive elements in electroschemes and products from ferrite in precision instrument making.

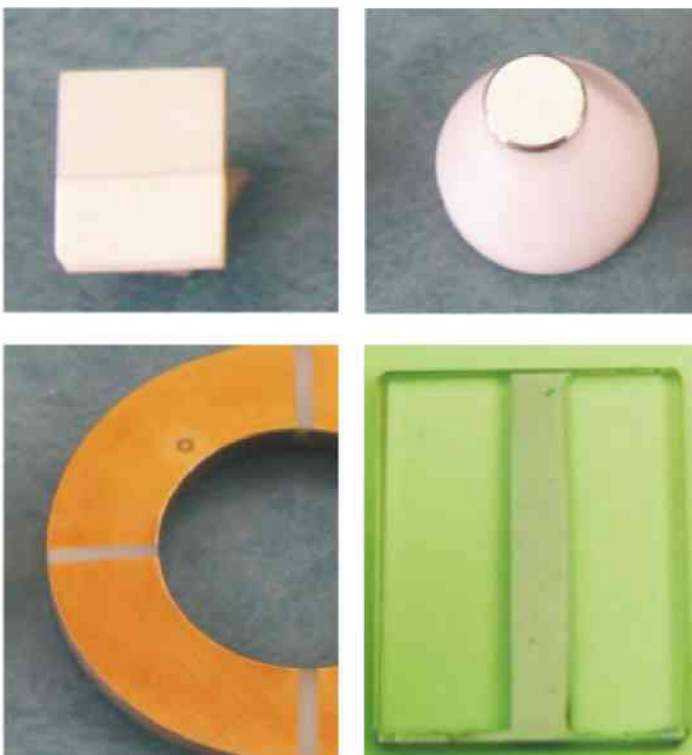
HIGH-PRECISE ONE-PIECE CONNECTIONS FERRITE-METAL



One-piece connections in precision execution ferrite-metal are created by the radiating soldering by soft and firm solders with application of preliminary created metal covering.

At creation of connections of certain appointment it is necessary to consider properties of materials, to observe safety of their initial properties. The given method allows to create and other one-piece connections (ferrite-ferrite, ferrite-ceramics, ferrite-polycore, quartz-ferrite and others).

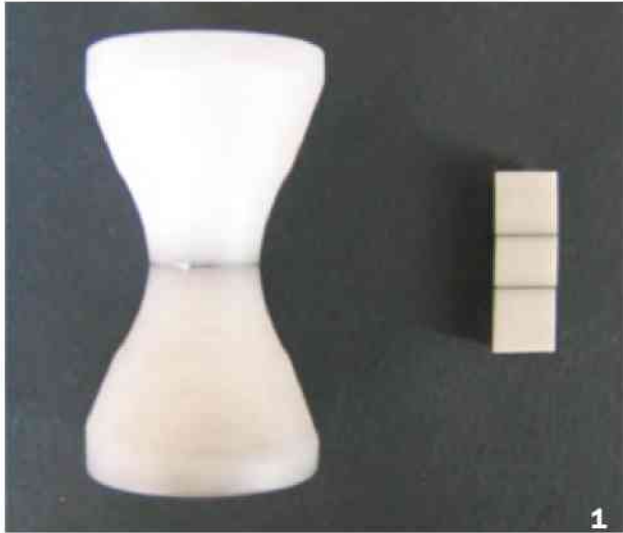
METALLIZED DIELECTRIC MATERIALS



Metallization of dielectric materials (polybarks, ceramics, quartz, polycrystalline glass and others) is made at high-energy influence of laser radiation and plasma with use of the active metals causing restoration in certain environments with simultaneous it doping by other metals.

Careful processing of a surface by a chemical or laser-plasma method is preliminary made. Coverings have high adhesion to a basis and can be used as electronic elements, current-carrying paths, and also by manufacture of high-quality connections with metals and dielectric materials.

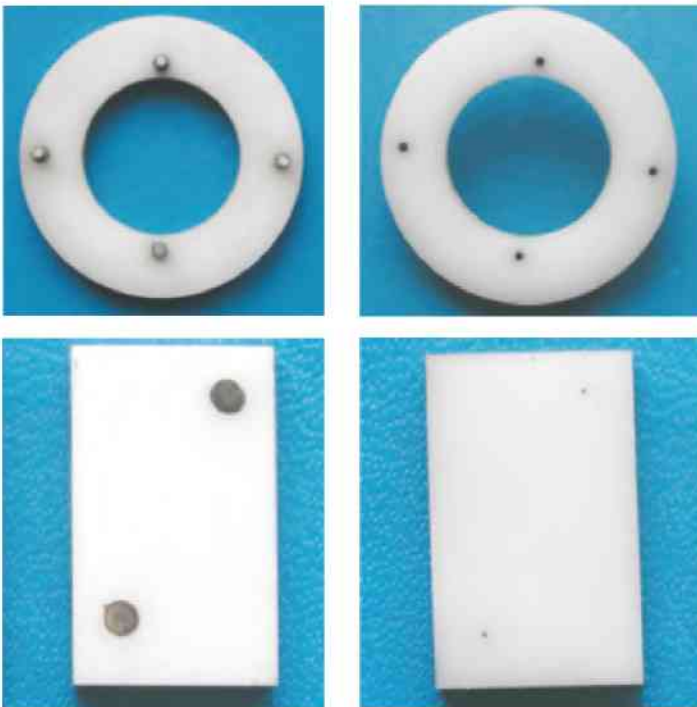
ONE-PIECE CONNECTIONS HIGH-ALUMINOUS CERAMICS K 95
(CERAMICS-CERAMICS, CERAMICS-METAL)



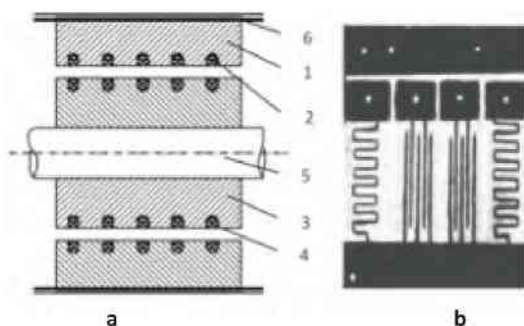
Metallization of surfaces of ceramics is preliminary made for creation of one-piece connections. The soldered seam is created between the metallized surfaces. The soldering is carried out by soft or firm solders by method of radiating heating. Solder steals up taking into account close equality of factors of thermal expansion with ceramics.

On figure 1 one-piece connections of ceramics among themselves, and on figure 2 ceramics with metal are presented. Durability of connection is commensurable with durability of ceramics at a stretching. Similar quality connections with others dielectrics are received also. Considering high durability of the ceramics. It is possible to recommend the given method of formation of one-piece connections for hardening of the tool of different function.

VACUUM-HARD SEALED LEADS-IN PRODUCTS FROM CERAMICS K 95



Are intended for pressure giving, for example, in the vacuum chamber. Manufacturing of conic apertures is made for creation sealed leads-in in pottery and conic ceramic inserts. Surfaces of apertures and inserts are lead up to high-class frequency. After that the insert and an aperture are metallized by special solder which carries out restoration of ceramics to metal and doping it. The insert is located in an aperture under certain pressure and the system heats up to solder fusion. As the current-carrying channel the thin layer of solder serves. Whereas sealed leads-in are created from the same material, as the article, special solder is used with low specific resistance, one-piece connection possesses high durability, vacuum density and electro-conductivity.

THE SCHEME OF THE RING TRANSFORMER AND THE ELEMENTARY SCHEME OF THE MULTIVIBRATOR


In the transformer (a): 1, 3 – ferrite stator and a rotor; 2, 4 – a winding from current-carrying channels, deepened in a ferrite body; 5 – a rotor shaft; 6 – the case. Under the circumstances of an insignificant clearance between stator and a rotor dispersion streams decrease.

In the multivibrator (b) resistive elements and capacities are created on a ferrite plate by a method of restoration of metal from ferrite oxides.

INSTRUMENT MAINTENANCE OF PROCESSES OF METALLIZATION OF FERRITE AND CERAMICS AND CREATION OF ONE-PIECE CONNECTIONS


Installation is intended for formation of linear and continuous metal coverings on oxide compositions by a method of their contact restoration.

THE UP-TO-DATE VACUUM INSTALLATION FOR METALLIZATION AND A RADIATING SOLDERING OF FERRITES AND CERAMICS


The special device for metallization of products from electric materials and formation of one-piece connections by a method of radiating heating.



2.1. INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

PIEZOELECTRIC CERAMIC SENSORS FOR THE VIBRATION METERS AND BALANCING EQUIPMENT



▶ They are designed for the use in the composition of vibration meters and balancing equipment.

Diameter: from 6,0 mm to 50,0 mm;
thickness: from 0,5 mm to 15,0 mm.
Sensitivity, not less than 50 pC/n.

TECHNOLOGY OF APPLICATION OF A THIN-FILM (UM-THICK) HARDENING (ON THE BASE OF AMORPHOUS ALLOYS HV > 800) AND SELF-LUBRICATING COATINGS (ON THE BASE OF THE COPPER ALLOYS) FOR PRECISION PARTS, FUNCTIONING IN THE REGIMES OF INTENSIVE ABRASIVE WEAR



▶ Advantages:

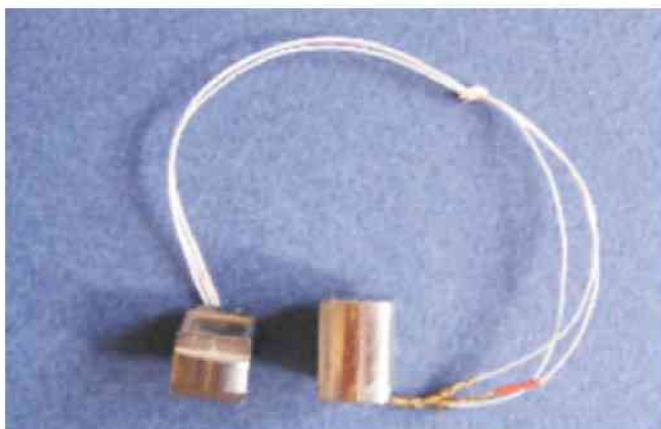
Increase of the service life by more than 1,5 times (even after the recovery) in comparison to the existing and used methods of hardening. Electrical-chemical method of application makes it possible to harden the parts with complicated surfaces. One does not need complicated technological equipment for the application. High accuracy at the application of the coatings with a specified thickness (0,5 um). Low-temperature (up to 60 °C) conditions of deposition. Low cost (from 0,5 to 1,5 Euro per set).

Examples of using:

Hardening coatings for the recovery and application at the industrial production of new plunger pairs of diesel motors (hundreds thousand parts). Self-lubricating surfaces of compressors of the household refrigerators (millions parts).

The technology of application of thin-film (um-thick) hardening (on the base of amorphous alloys Hv > 800) and self-lubricating coatings (on the base of the copper alloys) for precision parts functioning in the regimes of intensive abrasive wear. Testing of the experimental samples has been carried out in the Scientific-Production Association "Tribotechnologies".

WEAR-RESISTANT AMORPHOUS COATINGS ON THE BASE OF TUNGSTEN



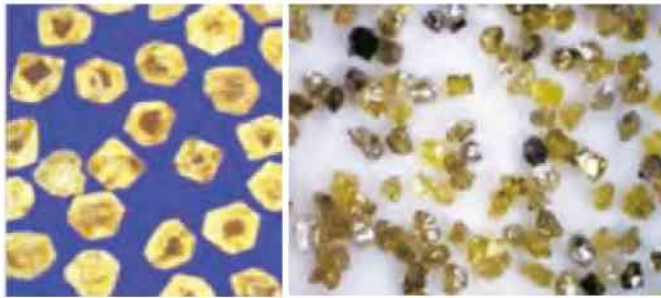
▶ Testing of the experimental samples has been carried out on the equipment of the "МРОВТ".

Application area:

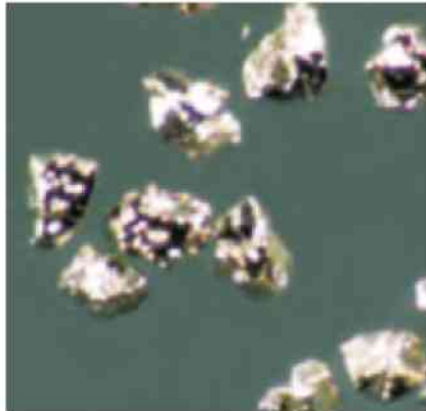
Magnetic heads.

The achieved results:

Microhardness Hv > 1500, which by 1,5–2 times increases that for the magnetic heads which are used in the world (including ceramic coatings and materials for magnetic cards). This has led to the change and direction of wear (not the cards, but the heads wear out).

DIAMOND POWDERS

- ▶ Model AC15-AC32.
- Grain - 315/250-20/14.
- They are used in manufacturing of polishing pastes, In materials processing.

CUBIC BORON NITRIDE (CBN) POWDERS

- ▶ Grain - 160/125-5/2.
- They are synthesized in the Mg-B-N system (black) and Li-B-N system (yellow).
- The CBN powders are quite competitive to the synthetic diamonds of the Ac 32 type.
- A high thermal stability and chemical sluggishness make it possible to use them in the fabrication of tools and polishing pastes, which used for processing of various alloys and hard-working materials, minerals and glass.

COMPOSITE SUPERHARD MATERIAL ON THE DIAMOND BASE

- ▶ Designed for edge tool.
- The hardness (Hv) is 60-80 GPa, crack-stability is $8-10 \text{ MPa}\cdot\text{m}^{1/2}$, abrasiveness is $400-500 \text{ cm}^3/\text{mg}$.

COMPOSITE SUPERHARD MATERIAL ON THE CUBIC BORON NITRIDE BASE

- ▶ Designed for an edge tool.
- The hardness (Hv) is 30-45 GPa, crack-stability is $13-16 \text{ MPa}\cdot\text{m}^{1/2}$, stability at the turning of hardened steel (HRC 52-54) - 60 min.

INDUSTRIAL HIGH PRESSURE CHAMBER

- ▶ Field of application: The chamber is made for carrying out of treatment processes of materials at high pressures and temperature, in particular for synthesis of diamond and cubic boron nitride in Industrial conditions.
- Technical and economic characteristics: The chamber of high pressure is intended for work with industrial hydraulic presses of A0137, A0138 types and similar to them. It has the following technical characteristics.

TUBULAR PERFORATED DIAMOND DRILLS



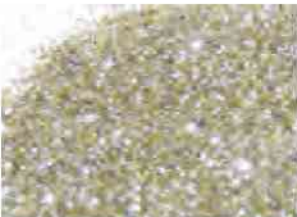
- ▶ Main dimensions are according to the Technical Specifications 2-037-68-85. is 1,5-26 mm. Specific charge of diamonds per drilling depth at the working of technical glass is no more than 0.4 mg/cm for the drill with diameter up to 3 mm and no more than 0,9 mg/cm for the drill with diameter more than 3 mm.
- ▶ The working material is technical glass of the Government standard No. 7132-78. Frequency of the drill rotation is 2800 rot/min. Cooling method- water.

DIAMOND BOWL-SHAPED CONICAL ABRASIVE DISK



- ▶ Main dimensions are according to the Government standard No. 16172-90.
- ▶ Contains metallic binding M2-01 or ceramic binding B2-01. Diamonds concentration in the binding is 25-200%.
- ▶ The working material is technical glass of the Government standard No. 7132-78, ceramic tile, quartz, minerals.

THE DIAMONDS POWDERS THE TYPE AC100-AC125



Technical and economic data: The diamonds were synthesized at high pressures and temperatures from charge mixture with composition: catalyst PRGN-40,

- ▶ the graphite of brand TM3" (SRI «Graphite Moscow»), additions. Field of application: The diamonds powders are used for manufacturing of boring rock cutting tools, etc.
- ▶ The diamonds output of brand AC100-AC125, 5 - to 35;
- ▶ Strength by compression, N-65-72;
- ▶ Time of synthesis, mln - 5;
- ▶ Pressure of synthesis, Gpa - 4,1;
- ▶ The diamond powders correspond to the Government standard №9206-80.

HIGH-THERMO-CONDUCTING STRENGTH CUBIC BORON NITRIDE POWDERS OF INCREASED HARDNESS



Field of application: The powders are used for manufacturing of tools for cutting and treatment of glass, grinding and polishing of rock, rough honing of cast irons, cutting of reinforced concrete.

- ▶ Technical and economic data:
- ▶ The cubic boron nitride powders were obtained by using special additions in lithium system. Grain size, um - 5-200; Strength, N - 12-38; Thermoconductivity, W/m·K - 300-450; Thermostability, °C - 1400; The increase of microhardness as relatively to the best of foreign analogues, % - 5,5; The increase of thermoconductivity of cakes, % - 12; The increase of thermostability as relatively to the best of foreign analogues, % - 22; The cubic boron nitride powders are corresponded to the technical specifications RB03535138.002-98.

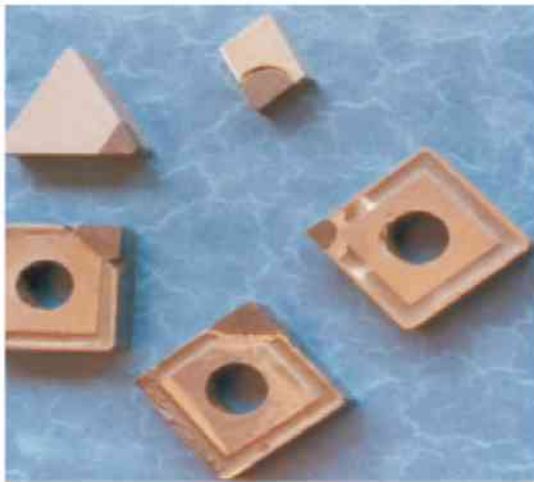
CBN MICRO-POWDERS (MP CBN) OF FRACTION (5/2) AND CBN POLYCRYSTALLINE POWDERS (PP CBN) OF WIDE RANGE OF GRAIN SIZE (50/40-2000/1600)



Field of application: The powders are used for manufacturing of tools for metals treatment, cutting and treatment of glass, grinding and polishing of metals and cutting reinforced concrete.

- ▶ Technical and economic data:
- MP CBN output of fraction 5/2, % - 40;
- Abrasive ability - 2,8;
- Strength by compression (for CBN of fraction 125/100), N-57;
- ▶ The CBN micro-powders of technical specifications RB 100029036005-2000 and CBN polycrystalline powders of technical specifications RB 100029036006-2000 correspond to the Government standard No. 9206-80.

EDGE TOOL, ARMED WITH CUTTING PLATES OF THE POLYCRYSTALLINE CUBIC BORON NITRIDE

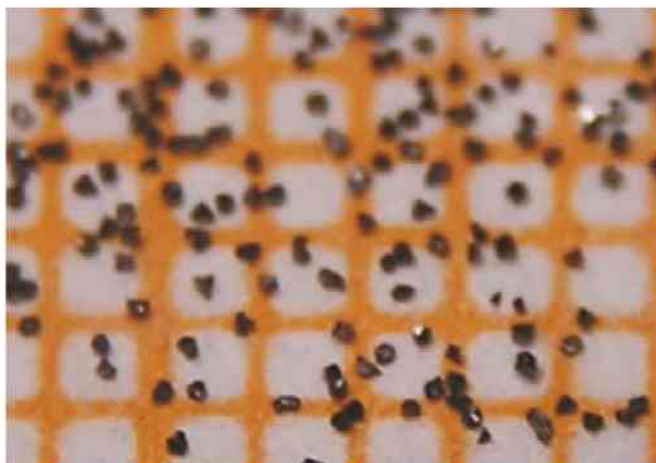


Cutters and cutter inserts, equipped with the cutting plates on the base of the polycrystalline cubic boron nitride (PCBN), are designed for the roughing, half-finishing and finishing work of black metals, cast irons, hard steels, nickel- and titan-containing hardly-working alloys, built-up, hardened and strengthened surfaces. By their hardness they predominate the cutters from fast-cutting steel by 5–15 times, the cutters from metal-ceramics by 3–5 times.

The fields of exploitation are: automobile, aircraft and tractor industries, Instrumental manufacturing on the operations of smooth and dashed turning pieces of various designation.

Cutters with PCBN can successfully process the pieces with gas-thermal coatings from powders of various base, for instance Ni-Cr-B-Si system, being applied on their surface. The use of cutters with PCBN makes it possible to process the pieces with coatings with high performance, and to refuse from grinding in a number of cases. Processed surfaces have a high quality grade and low value of the asperity parameter.

HIGH-STRENGTH CUBIC BORON NITRIDE POWDERS WITH HIGH SPATIAL AND STRENGTH SHAPE FACTOR



Field of application: The powders are used for manufacturing of tools for cutting and treatment of glass, grinding and polishing of rock, rough honing of cast Irons, cutting of reinforced concrete.

Technical and economic data: The cubic boron nitride powders were obtained by using special additions in lithium system.

Strength, N - 50-60;

Diapason of fractional composition - 200/160-14/10;

Form factor - 1,3-1,6;

Crack viscosity, $MN \cdot m^{1/2}$ - 3,0-4,0;

The increase of strength on pressure as relatively to the best of foreign analogues, % - 10; The increase of fracture toughness on relatively to the best of foreign analogues, % - 5; The increase of output on relatively to the best of foreign analogues, % - 10;

The cubic boron nitride powders are corresponded to the technical specifications of RB 03535138.002-98

DIAMOND POWDERS AC65 AND HIGHER WITH OUTPUT OF GRAIN 125/100–250/200 NO LESS THAN 40%



Field of application:

The diamond powders are used for manufacturing of cutter In diamond tools for processing of stone and building work.

Technical and economic data:

- The grain size of basic fractions, μm – 100–250;
- The output of good product as relatively to the total mass of diamonds, % – 44;
- Strength by compression of fraction 125/100, N – 43,4;
- Expense of hard alloy for 1000 carat, kg – 0,5;
- The multiplication of good product output, % – 15;
- The diamond powders correspond to the Government standard No 9206–80.

HIGH-STRENGTH DIAMOND AND CUBIC BORON NITRIDE POWDERS WITH AMORPHOUS COATINGS



Field of application:

The powders are used on composites based on superhard materials and in tools for the treatment of different difficult-to-cut materials as well as on pastes, being in free-standing state.

Technical and economic data:

The amorphous coatings on high-strength diamond and cubic boron nitride powders are produced by the method of a metal deposition from the water solutions:

The weight increment coefficient of the amorphous coatings on the metallized grains – at least than 50% of the total mass of the powder;

Microhardness, GPa – 8,0–8,5 (loading of 100g), 10–13 (for the heat-treated ones); Soldering ability coefficient – about 0,8–1,1.

COMPOSITION SUPERHARD MATERIAL (CSHM) BASED ON DIAMOND AND CSHM BASED ON CUBIC BORON NITRIDE (CBN) WITH DIAMETER 5 MM AND THICKNESS 3–4 MM



Field of application:

CSHM based of diamond is used as cutter of cutting tool for turning of nonferrous metals, aluminium alloys, plastics, siliconized materials, solid and titanic alloys; CSHM based on CBN is used as cutter of cutting tool for turning of hardened steels, alloys, cast iron, intractable construction materials.

Technical and economic data:

CSHM based on diamond:

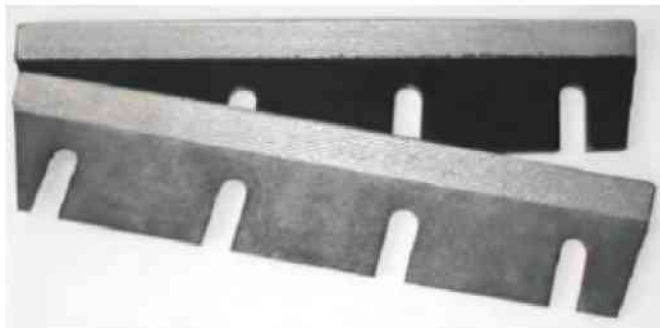
- Vickers's microhardness, Gpa – 84;
- Fracture toughness, $\text{MPa} \cdot \text{m}^{1/2}$ – 10,5;
- Abrasivlty, cm^3/mg – 510.

CSHM based on CBN:

- Vickers's microhardness, GPa – 50;
- Crack viscosity, $\text{MPa} \cdot \text{m}^{1/2}$ – 16;
- The durability at turning of hardened steels (HRC52–54), min – 85.

2.2. PHYSICAL AND TECHNICAL INSTITUTE

TECHNOLOGICAL PROCESS OF THE COMBINED HARDENING OF KNIVES OF HARVESTER TECHNIQUE



Appointment:

Hardening of knives of harvester technique, exposed in the course of work to intensive abrasive deterioration and shock loadings.

Technical characteristics:

The combined technological process includes induction heat treatment and laser doping.

Advantages:

Increase of wear resistance of a cutting part of a knife, exception of formation of dents and having chopped off at shock loadings, increase in durability and a resource of work of knives, cost price decrease in comparison with the import.

Field of application:

Agricultural mechanical engineering.

AUTOMATED COMPLEXES FOR LASER AND PLASMA CUTTING



Appointment:

For exact cutting of metal and non metallic sheet materials on the set contour.

Technical characteristics:

Moving range on axes X, mm – to 3000;

Moving range on axes Y, mm – to 2000;

Moving range on axes Z, mm – to 300;

Accuracy of positioning, μm , is not worse – 50;

The permission, micron –1;

Range of speed of moving on axes X, Y mm/s – 0–800.

Management type – contour 2D/3DHPGL. DIN/ISO from the external personal computer.

Advantages:

High speed and quality of cutting.

Field of application:

Cutting of metal and non metal lie sheet materials.

TECHNOLOGY AND THE EQUIPMENT FOR LASER HARDENING OF FAST-WEAR DETAILS OF THE STEERING MECHANISM OF CARS



Appointment:

Technological processes of laser hardening of 5 items of fast-wear details of the mechanism of a steering are developed and introduced. The technology is based on the use of high speeds of heating of a blanket to the temperatures exceeding temperature of phase transformations or fusion of an alloy, and the subsequent highspeed cooling by the basic heat-conducting path in weight of metal and additional cooling of a surface.

Technical characteristics:

Depth of the strengthened layer – to 1 mm; hardness for steels of 40X type–till 60–62 HRC.

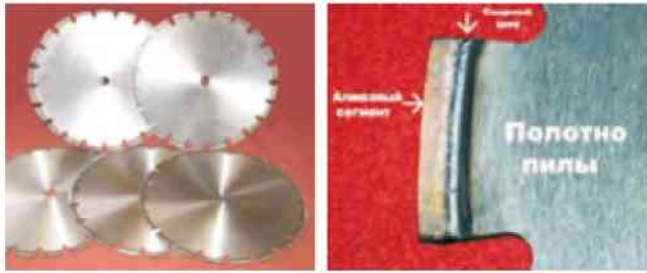
Advantages:

Hardening of local sites of details, Increase in a resource of work of details and the steering mechanism in 2 and more times.

Field of application:

Mechanical engineering.

LASER WELDING



Laser welding of cut diamond segment circles



The unified industrial equipment and typical resource-saving technological processes of manufacturing foundry goods inserts of stamps in reusable casting moulds



Metal-shell casting mould Casting of stamps insert

- ▶ Appointment: Manufacturing of details and the tool with high quality of welded connections.
- Technical characteristics: Thickness of welded steel sheets is up to 4 mm.
- Advantages:
 - Durability of seams is close to durability of the basic material;
 - Minimum distortion of welded knots and designs;
 - Possibility of reliable connection of hard-welding traditional methods of materials;
 - Simplicity of the organization of protection of a place of welding from harmful influence on air metal.

Field of application:
Mechanical engineering, repair manufacture.

- ▶ Appointment: Manufacturing of foundry goods inserts of stamps for toggle hot-stamping press.

- Technical characteristics:
 - Material consumption – 1,0 ton 1,0 ton of foundries;
 - Metal consumption – 1,45 ton 1,0 ton of foundries;

- Exit suitable of foundries – 64,8%;
- Advantages: Possibility of manufacturing of 6 names of foundry goods inserts of stamps in 1 casting mould.

Decrease in expenses for manufacturing of a forming mix on 25 %.

Reduction of harmful emissions in atmosphere at manufacturing of foundry goods on 20–30 %.

- Field of application: Forge-stamp manufacture with use of cast inserts of stamps. Now it is on the assimilation process on a foundry site of Open Society "БЕЛКАРА" in Grodno. Assimilation started in 2008.

SPARINGLY DOPED WEAR-RESISTANT ALLOY AND SKILLED MANUFACTURING TECHNIQUES OF PUMP EQUIPMENT PRODUCTION ON ITS BASE



Soil pumps



Case

Driving wheel

Iron-plating, casting from a new alloy

- ▶ Appointment: Manufacturing of foundries details of soil pumps from sparingly doped wear-resistant alloy "ЧХ22Г".

Technical characteristics:
Hardness – 55–60 HRC;
Impact strength – 59 J/cm²;
Strength at a bend – 540 Mpa.

- Advantages:
 - Economy of scarce burdening materials.
 - Decrease in the expense of nickel – 15 kg on 1 ton alloy.

Expense decrease ferrochromium – 46 kg on 1 ton alloy.

Ecology improvement for the account of economy of chrome at fusion.

Decrease in the self-cost price of moulding on 20%.

- Field of application: Foundry manufacture of wear-resistant alloys.

LASER SURFACING



1. Wear-out profile of casting draw plate of refrigerator compressor



2. Forms of casting of gas-burner and neck of bottle after laser surfacing



3. Wide range of the details subjected to laser processing



4. Cutters PKC-1 mountain-tunnel combine



5. Crankshaft of diesel engine- locomotive



6. Press-stamping equipment and the tool

- ▶ **Appointment:**
Restoration and hardening of responsible details of cars and mechanisms.
- Technical characteristics:**
The overlaying materials on iron, nickel, cobalt, etc. bases, a thickness of surfacing layersto – 1,5–2 mm.
- Advantages:**
The minimum zone of thermal influence, decrease in residual deformations.
- Field of application:**
Mechanical engineering, power- and aircraft engineering, repair manufacture

LASER MODIFYING OF WORKING BODIES OF AGRICULTURAL TECHNIQUE



- ▶ **Appointment:**
Increase of a resource of work of fast-wear details.
- Technical characteristics:**
Hardness of the modified layers-till 165–70 HRC.
- Advantages:**
Hardening of local sites; the minimum zones of thermal influence.
- Field of application:**
Knives of harvester, beet-harvesting combines, mowers, etc.

LASER CUTTING



Technological complex of laser-plasma cutting

- ▶ **Appointment:** Cutout of metal and nonmetallic sheet materials, shaped cutting of pipes, manufacturing forming shapes for manufacture of cardboard packing.
- Technical characteristics:** Thickness of cutout material: steels – to 5 mm; plastic, plexiglass, a tree – to 20–30 mm.
- Advantages:** The minimum mechanical influence on a material;
A wide range of cut materials (a tree, glass, asbestos, ceramics, metal);
Cutting is possible on a difficult contour at the minimum width of cut.
- Field of application:**
Preliminary manufacture, machine – and instrument engineering, etc.

TECHNOLOGICAL PROCESS OF MANUFACTURING OF SEALING RINGS OF TRANSMISSIONS OF HIGH-LOADED AUTOMOBILE TECHNIQUE FROM EXTRA-STRONG PIG-IRON WITH FIBROUS GRAPHITE



- ▶ **Appointment:**
Manufacturing of sealing rings of increased operational firmness with use of hot plastic deformation of preparations from high-strength pig-iron.
- Technical characteristics:**
Strength at a stretching - 1000-1300 Mpa.
Relative lengthening - 10 %.
- Advantages:**
Increase in an exit of suitable metal.
Increase of strength and operating properties of sealing rings in 1,8-2,1 times.
Decrease in leak of oil in transmission in 4-7 times.
Stability of characteristics of sealing rings during run of 300 000 kilometers.
Increase in terms of between-repairs service to 2 times.
- Field of application:**
Manufacture of high-loaded automobile technique.

COMPLEX OF ALUMINIUM SHAVING PROCESSING



- ▶ **Appointment:**
Preparation of a shaving for complex processing, both moulding methods, and mechanical dispersion for the purpose of its use for obtaining of products with high operational properties.
- Technical characteristics:**
Productivity of process to 300 kg/h;
Metal operating ratio at moulding to 0,95.
- Advantages:**
Increase in factor of an exit of suitable metal, decrease in expenses at reception of aluminium powders, pastes, products with high operational properties.
- Field of application:**
Metallurgy, mechanical engineering.

INSERT OF HARDENING AND PROTECTIVE HEAT-RESISTANT COVERING OF THE BOTTOM OF INTERNAL COMBUSTION ENGINE PISTON



- ▶ **Appointment:**
Are intended for hardening and protection of pistons of the forced diesel.
- Insert technical characteristics:**
Strength at a stretching of a material of an insert 180-190 Mpa;
Relative lengthening, not less - 2,6 %;
Density - 7300 kg/m³;
Factor of thermal expansion - 17,5-10⁶/°C;
Hardness - 135-160 HB;
Factor of heat-conductivity - 81,8 W/m-K,
Relative condensation, not less - 2,5%.
- Covering technical characteristics:**
Thickness of a covering - 30-60 microns;
Stratification on border a covering - the basic metal of 0,5-1,0 %.
- Advantages:** Capacity and wear resistance
ICE increase, import substitution.
- Field of application:**
Engine-bulldng.

TECHNOLOGIES AND INDUSTRIAL EQUIPMENT FOR HARDENING BY WEAR-RESISTANT ALLOYS AND THERMAL PROCESSING OF CUTTING ELEMENTS OF DETAILS OF AGRICULTURAL SOIL-CULTIVATING AND HARVESTER MACHINES



► Appointment:

Wear resistance increase soil-cutting details and knives choppers.

Technical characteristics:

Cutting elements of details are strengthened by wear-resistant firm alloys and/or heat treatment. Edge of a cutting element the bimetal consisting from wear-resistant hard-alloy layer and a shock-resistant basis.

Advantages:

- Increase in service life of details on the average in 2 times;
- Depreciation in 2-3 times in comparison with imported goods;

Field of application:

Soil-cutting details of ploughs (a ploughshare, a chisel, a sailing breast), disks of harrows, paws of cultivators, knives of choppers.

THE COMBINED TECHNOLOGIES OF HARDENING- RESTORATION OF FAST-WEAR DETAILS OF CARS



► Appointment:

Restoration of fast-wear surfaces of details of cars and buses.

Technical characteristic:

Material of the restored surface - wear-resistant alloy.

Advantages:

- Resource is on competitive level.
- Depreciation in 2-4 times in comparison with the delivered.

Field of application:

Details of buses and cars.

DIAMOND GRINDING CIRCLES



► Appointment:

For processing of a hard alloy, a hard alloy in common with a steel, including in a mode of electrochemical influence.

Technical characteristics:

Standard sizes in accordance with the Government standard and TS of the customer.

Productivity of grinding, mm^3/min :

- hard alloy - 400-600;
- hard alloy+hard steel - 300-600.

The specific expense of diamond at processing, mg/mm^3 :

- hard alloy - 20-35;
- hard alloy+hard steel - 25-35.

Advantages:

Stable cutting ability.

DIAMOND CORRECTING PENCIL



► **Appointment:**
For editing and profiling of abrasive circles from corundum, carbide of silicon, pine forest carbide.

Technical characteristics:
Standard sizes in accordance with the Government standard and of the customer. Specific productivity of grinding of 45–60cm³/mg.

Advantages:
Provides increase of accuracy of editing.

Scope:
Mechanical engineering.

DIAMOND GRINDING CIRCLES



► **Appointment:**
For processing of a hard alloy, a hard alloy in common with a steel, SHM, the tempered steels and sharpening of the special tool.

Technical characteristics:
Standard sizes in accordance with the Government standard, drawings and specifications of the customer.

Advantages:
Made on new adhesion-active polymeric, polymer-ceramic and polymer-metal sheaves.

Field of application:
Mechanical engineering, tool, furniture industry.

TECHNOLOGIES OF FINAL PROCESSING OF MATERIALS BY MAGNET-ABRASIVE ENVIRONMENTS AND TOOLS FROM SUPERHARD MATERIALS



► **Appointment:**
Final processing of details of cars,

Technical characteristics:
High level of automation, maintenance of parameters of roughness Ra - 1,6–0,2 um, tp₂₀ = 16–24%.

Advantages:
High class of a roughness and formation of a micro-profile of surfaces with high bearing ability.

Field of application:
Mechanical engineering, tool, pulp and paper industry.

TECHNOLOGY AND THE EQUIPMENT FOR SUPERFICIAL HARDENING OF SPRINGS



► **Appointment:**
Hardening of springs.

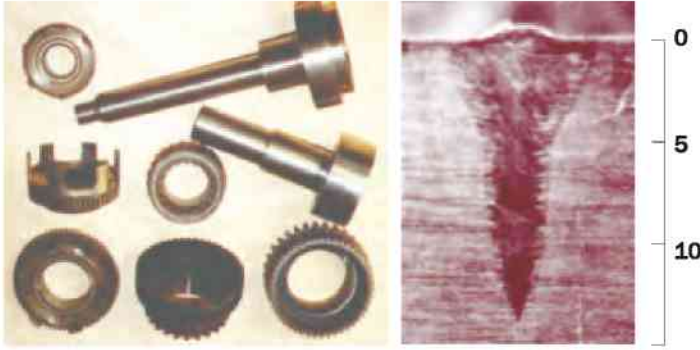
Technical characteristics:

1. Productivity - 200 pieces/hour.
2. Detail dimensions: length 400–2500 mm, width 50–120 mm, a thickness 4–28 mm.

Advantages:
Resource increase in 1,6 times;
Ecological cleanliness.

Field of application:
Automobile mechanical engineering, agricultural mechanical engineering.

ELECTRO-BEAM WELDING (EBW)



Appointment:

Obtaining of connections of materials under EB influence in a mode of deep profusion, including from diverse metal materials, and limited cooking steels.

Technical characteristics:

- Depth of profusion - 0,1 - 50,0 mm;
- Speed of profusion - 1-25 mm/s;
- The relation of depth of profusion to width of a seam to 50:1;
- Factor of durability of a seam - 0,9-1,0 from durability of the basic metal.

Advantages:

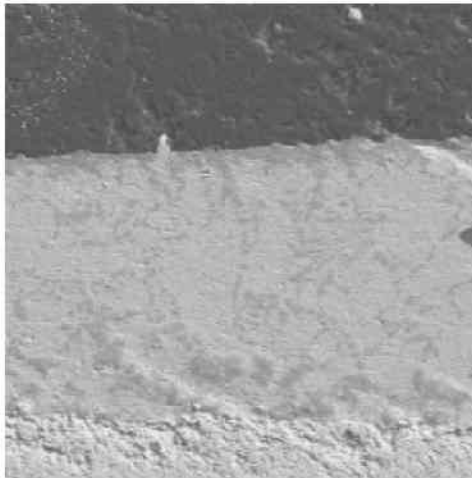
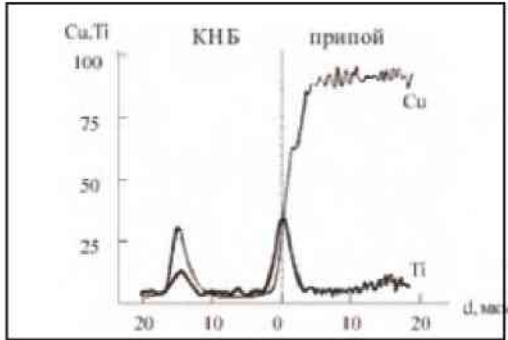
- Possibility of welding of products from steel, Al, Cu, Ti and their alloys and diverse materials (steel - copper, steel - aluminium, etc.), thermally strengthened materials;
- Insignificant thermal deformations of a product;
- Welding possibility of both thin and thick-walled details, refractory and chemically active metals.

Standard of Belarus 1149-99 establishing the requirements to degree of quality of EB welded connections is developed. Developed technologies of EB welding provide manufacturing of knots of machine tools and cars from constructional steels with decrease material consumption up to 50 %.

Field of application:

Mechanical engineering, turbo-craft and shipbuilding, power mechanical engineering, atomic engineering, tool manufacture, automobile and chemical industry, etc. Welding of knots of machine tools, cars and tractors according to orders of the enterprises is carried out.

SOLDERING OF THE TOOL EQUIPPED WITH ELEMENTS FROM SUPERHARD MATERIALS



Appointment:

Obtaining of connections of diverse materials (ceramics-metal, SHM-a substrate) with use of adhesion-active alloys on the basis of Cu and Ag.

Technical characteristics:

Soldering time - 1-2 minutes, power inputs on a product - 10-20 kJ.

Durability of connections «SHM a basis»: on a stretching - to 120 MPa, on shift - to 300 Mpa.

Advantages:

The possibility of processing with edge tool with elements from cubic boron nitride (CBN) and polycrystalline diamond materials to HRC 60-75, colored alloys (including Al-Si), ceramics with speed of cutting 10-50 m/s. High accuracy of processing, a roughness of a processed surface - 0,634),05 microns. Increase of firmness of the tool - to 25 times.

TECHNOLOGY AND THE EQUIPMENT FOR MANUFACTURING OF FLAT PROTECTIVE ELEMENTS OF CASES OF PLOUGHS

- ▶ **Appointment:**
Improvement of quality of protective elements of cases of ploughs.
- Technical characteristics:**
Protective elements of a variable profile.
- Advantages:**
Metal consumption decrease on 25–30 %.
- Field of application:**
Agricultural mechanical engineering.

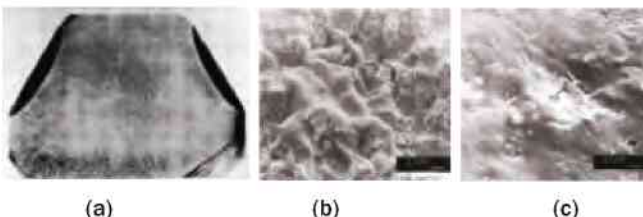
ION-BEAM PROCESSING OF METALS AND ALLOYS

Appointment: Hardening of responsible details of cars and the mechanisms working in the conditions of a friction and fatigue loadings, including in vibration-active environments.

- ▶ **Technical characteristics:** Process gives the chance to strengthen constructional and tool steels at temperatures of processing 670–800K, power consumption 3–5 kW, duration of processing – from 0,3 till 5 hour, the gas expense to 2 l/h.
- Advantages:**
Thickness of the modified layer to 200 microns, increase of hardness of a surface in 1,5–5 times, wear resistances in 2–100 times, impact strength of tool steels to 25 %, cyclic durability to 100 %.
- Field of application:**
Mechanical engineering, aircraft engineering, tool manufacture.

METALLIZATION OF ROLLED MATERIALS ON POLYMERIC AND PAPER BASES

- ▶ **Appointment:**
Aluminium applying on rolled materials on polymeric and paper bases.
- Technical characteristics:**
Productivity of the equipment – to 20 tons a month. A thickness of processed rolled materials 20–250 microns.
- Advantages:**
Possibility of applying of metal on rolls with the width up to 1 m.
- Field of application:**
Packing production for food, chemical, medical, light industry.

ELECTRO-BEAM HARDENING OF STEELS SURFACE

Cross-section section of a ring of the bearing of a turbo-drill after EB hardening (a), a surface of a plasma covering from TiO_2 in an initial condition (b) and after EB flashing (c)

Appointment: Modifying of properties of a surface of details from constructional and tool steels, aluminium and copper alloys. Hardening from firm or liquid conditions is made by high-speed heating by the dot or developed beam of a product and cooling by tap to a cold core of a detail.

- ▶ **Technical characteristics:**
Depth of the modified layer – 0,1–5 mm. Time of processing of one detail ~ 1–60 sec.
- Advantages:**
Carrying out of local hardening of materials. Firmness increase in comparison with products after hardening from oven heating – in 1,2–2 times.
- Field of application:**
Mechanical engineering, tool manufacture. Technologies of EB hardening of stamps matrixes, rings of radial-persistent bearings, plates of compression moulds (EB fitting of blanks and finishing EB hardening).

SHOCK NON-PUNCH FORM-SHAPING OF THIN-LAYER MATERIALS WITH THE USE OF LIQUID AND ELASTIC ENVIRONMENT



Appointments:

It is intended for punching of thin – layer materials.

Technical characteristics:

- An impulse of working pressure to 500 Mpa;
- An energy source – compressed air of a workshop pneumo – network with pressure to 0,63 Mpa;
- Maximum blanks' dimensions – 750 x 750 mm with maximum in diameter of punching 350 mm (for a liquid) 200 mm (for polyurethane);

- ▶ - Maximum thickness of preparations – 1,0–2,0 mm.

Advantages:

- Possibility of obtaining of details of the difficult form for one transition as at performance form – building, and dividing operations;
- Punching possibility in one matrix of details of a various thickness;
- Possibility to operate with pressure impulse in wide ranges both on amplitude, and on time of its action;
- Cheap industrial equipment (in 2–4 times is cheaper than tool stamps);
- Terms of development of new production are reduced in 2–3 times.

Field of application:

Performance practically all sheet – stamping operations in a machine – building complex of the country.

DIAMOND CIRCLES ON THE METAL SHEAF OF FORMS 1A1 AND 1EE1X



Appointment:

Engraving works of products from crystal, for ceramics and glass processing.

Technical characteristics:

The circle form – 1A1 and 1EE1X.

Angle at top of a profile 90° and 110°.

External diameter – 40; 75; 80; 125 mm.

Height of a circle 6–8 and 12 mm.

Landing diameter – 10; 20; 32 mm.

Powder from synthetic diamonds of marks ACH and Ac–6.

Granularity of powders: 63/50; 50/40.

Concentration of diamonds of 50; 100%.

Hardness of a sheaf – 755 HRB.

Speed of cutting – 25–30 m/s.

MACHINE FOR COLD FORM-SHAPING OF SPIRAL PIPES OF SELF-COMPENSATED SYSTEMS OF HEATING MAINS



Appointment:

Manufacturing of the preisolated pipes for a heating main.

Technical characteristics:

Productivity – 30 piece/hour,

Length of products – 6500 mm.

Advantages:

Economy of Isolating materials, economy of thermal energy, exception of application of jacks on heating mains.

Field of application:

Housing and communal services.

TECHNOLOGIES OF ELECTRO-SPARKING PROCESSING



Appointment:
 Form-shaping of the tool and machine-building products. Technological processes forming without metalwork operational development of cavities in matrixes of dividing stamps and working parts of punches with use of punches of a stamp, or profile electrodes. Technological processes of forming and hardening of a profile surface of a cutting edge of knives for wood-processing and their subsequent regrinding. Technology of small-module screw helical profile forming on an internal surface of the rolling tool. Manufacturing techniques of working cavities in dies for processing of a potato and ways of manufacturing of electrodes-tools.

Advantages:
 Increase of firmness of stamps and knives - in 1,5-2,5 times (at the expense of uniformity of a backlash on a profile and surface hardening). Decrease in labour input of manufacturing and a tool regrinding - in 1,5-5 times.

Field of application:
 Mechanical engineering, tool manufacture, wood-, food-processing industry.

CROSS-WEDGE ROLLING



High-efficiency resource-saving technology of processing of metals pressure with operating ratio of metal 0,80-0,98. It is used for manufacture of details of type of bodies of rotation with the extended axis in motor industry, machine-tool construction, instrument making, agricultural mechanical engineering, combine-engineering, aircraft engineering, moto- and bicycle engineering, the mining and nuclear industry. The use of cross-wedge rolling helps to process virtually all constructional steels, and also a brass, the titan, zirconium and nickel.

Technical characteristics:
 The range of rolling equipment for the parts with diameter 5-120 mm and length 30-1000 mm is developed.

- Advantages:**
- simplicity of manufacturing and low cost of replaceable wedge tool made on universal milling and grinding machine tools;
 - a split-hair accuracy of the sizes ($\pm 0,01$ - $\pm 0,5$ mm) of rolling details;
 - maximum possible clearness of surface - 0,6 Ra;
 - high firmness of flat wedge tool (to 500000 details);
 - low metal consumption of the equipment;
 - low cost price of rolled details;
 - simplicity in management and camp adjustment;
 - fast readjustment of the equipment on release of new details, a process all-around automation.

Field of application:
 Working out is applicable for all machine-building enterprises having forge-stamping manufacture.

CROSS-WEDGE ROLLING AND PUNCHING

**Appointment:**

The combination of technologies cross-wedge rolling and punching allows creating low-wasted technological processes with operating ratio of metal 0,80-0,98. Cross-wedge rolling is used for manufacture of intermediate profiled blanks under the subsequent exact punching or other processes of plastic shaping.

Advantages:

- reduction of norm of the expense of metal on 30-40 %;
- labour productivity increase;
- a split-hair accuracy and cleanliness of a surface of products;
- improvement operating characteristics of received products on 20-30 %;
- decrease in power consumption of process.

Field of application: The new combined technologies of plastic shaping are used for obtaining of high-quality details in forge-stamping manufacture.

PLANETARY SEPARATION OF BLANKS

**Appointment:**

Separations of bar on measured blanks with formation of two conic face (or one conic and one direct) for rolling or punching from the same heating.

Technical characteristics:

The equipment is intended for division bars in diameter 30-120 mm without restrictions on length.

Advantages:

- reduction of norm of the expense of metal;
- possibility of work from dimensionless bar without restrictions on its length and curvature;
- the detachable car is well built in the automated complexes;
- high efficiency;
- decrease in power consumption of process.

Field of application:

The equipment is built in the automated complexes forge-stamp manufactures.

THREE-HIGH MILL OF CROSS ROLLING

**Appointment:**

The mill is made for small-scale cross rolling of blanks of various details by the universal tool quickly readjusted by means of numerical programmed control. Equipment readjustment on release of a new product is extremely simple and consists in input of the new operating program.

Technical characteristics:

The mill is made for blanks rolling in diameter 20-75 mm and length 100-800mm.

Advantages:

- possibility to roll blanks of various diameter (without replacement) with one universal tool;
- obtaining of various profiles of details by the universal tool by input of new program of numerical program control;
- reduction of norm of the expense of metal;
- decrease in probability of destruction of metal in an axial zone of preparation;
- an intensification of process at the expense of transfer of bigger twisting moment;
- simplicity in management and mill adjustment;
- all-around automation of the process.

HOT EXTRUSION OF PROFILE CUTTING PARTS OF END TOOL



► **Appointment:**
Manufacturing of the end metal-cutting tool from fast-cutting steels.

Technical characteristics:

Increase in cutting firmness of the tool in 1,2-1,4 times. Improvement of structure of a fast-cutting steel, increase in dispersion of grain up to 11-12 points, Increase of mechanical properties of a material of a cutting part of the tool flexural durability in 1,2-1,3 times, hardness increase on 1-2 units of HRC.

Advantages:

Increase of operating ratio of a fast-cutting steel up to 0,7-0,8, productivity increase of shaping in comparison with processing by cutting on 40-45%.

Field of application:

Big-scale tool manufacture.

MANUFACTURING OF SHAPING PUNCH TOOL



► **Appointment:**
Industrial equipment manufacturing (matrixes and punches) for hot expression of cutting parts of the end tool and machine-building details.

Technical characteristics:

Obtaining by the combined methods of plastic deformation and electro-erosion processing of form building cavities of punch tool.

Advantages:

Productivity increase of shaping in comparison with processing by cutting - in 2-4 times, decrease in labour input of manufacturing - on 30-40 %, quality maintenance of a surface of compression moulds.

Field of application:

Procuring and forge-stamp manufacture.

HOT EXTRUSION OF SEMI-FINISHED PRODUCTION OF MACHINE ENGINEERING PARTS



► **Appointment:**
Manufacturing of details of mechanical engineering with difficult internal and external contours of cross-section.

Technical characteristics:

Optimum schemes of the intense-deformed condition in the course of processing.

Advantages:

Increase of operating ratio of materials to 0,7-0,8, reduction of labour input of manufacturing of details with a difficult profile on 40-50 %, possibility of shaping the details from hardly-deformed alloys including from high-strength pig-iron, powder composite materials, aluminium and titanic alloys. Improvement of physical and mechanical properties of deformable materials.

Field of application:

Mechanical engineering.

FREQUENCY MAGNETIC PRESS

Appointment:

Sheet-stamping and assembly operations, including cutting down operations, shaping, dudgeon, stamping, calibration, reception of one-piece and mobile connections on products from pipe blanks, pressing sintering of metal powders, including formation of porous and compact products.

Technical characteristics:

Maximum store up energy, kJ	2,5	4	10	20	40
Maximum charge voltage, kV	22	10	8	8-17	17
Productivity, parts/hour	610	400	360	360	180
Sheet and pipe blanks, Ø up to	100	150	200	250	350
Thickness, mm	0,05-1	0,05-1,5	0,05-3,5	0,05-3	0,05-8
Mass, t	0,4	0,15	0,5	1,0	1,5

Advantages:

Sheet punching:

- Combination of dividing, forming and assembly operations;
- Absence of one of working parts of a stamp-punch and a matrix. This work is carried out by a magnetic field or the elastic environment;
- Raises degree and uniformity of deformation on 30 %;
- Decrease in size of agnails, degree of springing;
- Expenses on stamp equipment time decrease in 5-20 times;
- Possibility to conduct processing without contact of the tool with the blank, keeping initial quality of a surface, metal, plastic and paint and varnish coverings;
- Possibility to conduct processing through walls of the heating device, the vacuum chamber and protective cover.

Assemblage:

- Increase of durability and reliability of connection at the expense of after-deformation hardening, small springing and a thermo-tightness;
- Combination of assemblage of details with dividing, forming and calibrating operations;
- Decrease of contact electro-resistance in 1,5-2 times and increase of durability, tightness and thermal stability of assemblages of cable tips and cases of connecting clutches with wires;
- High sterility of process of assemblage In view of absence of contact of the form-building tool with details of assemblage and possibility to make assemblage and hermetic sealing of vessels through walls of chambers with the special environment or vacuum.

Shaping of powder materials:

- The big degree of consolidation of a material at the expense of pulse character of pressing;
- changing permeability in accordance with certain law in filtering elements in a filtration direction;
- Shaping of complex-profile lengthy products with the big ratio of length to the cross-section size;
- Volume punching of porous blanks without the use stamping equipments;
- High cleanliness of a filtering material from extraneous inclusions because of absence in blend softener, porous shaper etc.;
- Low metal consumption and labour input of manufacturing of tool equipment.

Field of application:

Machine-, craft-, auto- and instrument making, powder metallurgy, chemical, food and medical industry.

TECHNOLOGIES OF PROTECTIVELY-DECORATIVE COVERINGS
SEDIMENTATION

Technical characteristics:

Productivity: 0,5-1,5 m²/h
Speed of sedimentation: 0,1-1,0 um/min.
A thickness of a covering: 0,1-50 um.

Advantages:

Wide colour spectrum of coverings, replacement of the ecologically harmful galvanic processes, increased corrosion firmness in a number of chemically excited environments.

Field of application:

Metal wares, glasses, ceramics, plastic, for the hour industry, furniture and leather accessories, consumer goods.

TECHNOLOGY OF DEPOSITION OF WEAR-RESISTANT CARBON-CONTAINING COVERINGS



Appointment:

Matrixes of press equipments and other details working in the conditions of increased wear out

Technical characteristics:

- Productivity: 0,8 m²/cycle.
- Material consumption: 3g/m².
- Power consumption: 3 kW/h.

Advantages:

Increase of factor of operational firmness of products in 2,5 times, decrease in expenses for lubricants and materials-preservatives.

TECHNOLOGY OF APPLYING OF MULTI-COMPONENT STRENGTHENING COVERINGS



Appointment:

Metal-cutting and wood-processing tool from a fast-cutting steel and firm alloy.

Technical characteristics:

- Factor of increase of wear resistance - 2,0-2,2.
- Increase of productivity of process of cutting - 10-15%.
- Factor of decrease in operational expenses - 1,20-1,25.

Advantages:

Decrease in intensity of deterioration of the tool in 1,5-2,4 times depending on a processed material.

Field of application:

Enterprises of a machine-building and tool profile.

ELECTROLYTE-PLASMA POLISHING OF PARTS



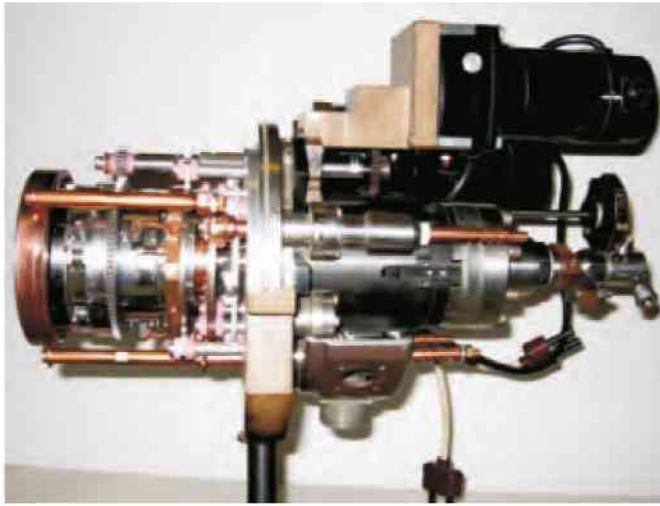
Field of application:

Processing of products from stainless steels, copper, titanic and aluminium alloys. The enterprises of medical and home appliances, hour industry, electronics and electrical engineers, mechanical engineering, jewels.

Technical and economic indicators:

1. Processing of a surface to 10 classes (Ra, a um - 0,05-0,12).
2. Current density, A/cm² - 0,15-0,25.
3. Time of processing of products, min - 0,5-10.
- 4 Working temperature of electrolyte, °C - 70-90.
5. Working pressure of the straightened current, V - 220-340.
6. Productivity of process, m²/h - to 2,0.
7. The specific expense of electrolyte, kg/m² - 0,7-0,9.
8. The cost price of processing of a product, dollar USA/m² - 25-30.

IMPULSE PLASMA VACUUM-ARCH OF ACCELERATOR OF CARBON AND METAL PLASMA



Field of application:
The vacuum technique, equipment and technologies of drawing of super-firm coverings of carbides and carbon-nitride metals, diamond-like carbon on a working surface of tools, details of cars and mechanisms, parts for medical technique.

Technical and economic indicators:
Accelerator type coaxial face with the spent cathode;

System of Ignition contact/contactless.

Diameter of the cathode, max, mm - 37.

Size of giving of the cathode, max, mm - 40.

Electric capacity, max, W - 1500.

Pressure of the basic category, V - 200÷600.

Frequency of impulses of ignition, Hz - 1÷30.

Cathode giving manual/automatic/remote.
Weight, kg, no more than 15.

ABRASIVE MATERIAL FOR SUPER-FINISHING PROCESSING OF A SURFACE OF PRODUCTS



Field of application:
Machining of a surface of products, high-precision operational development and clean polishing of products from glass, ceramics, plastic, firm and super-firm substances and alloys, natural minerals.

Technical and economic indicators:

Basis material - lavesan.

Covering type - diamond-like carbon/diamond-like carbon, alloyed by metal.

Micro-hardness, kgf/mm², not less than 7000.

Thickness of an abrasive layer, micron - 0,02-0,5.

Processing class - 12÷14.

Material cost is 5-7 times lower of material on the basis of natural diamond.

THE TOOL WITH A WEAR-RESISTANT MULTI-LAYER COVERING FOR METAL, TREE AND PLASTIC PROCESSING



Field of application:
Machine tools, equipment and tool, machining of various materials.

Technical and economic indicators:

Covering material: a combination of thin - film layers from carbon and nitrides, carbides, carbon-nitrides, oxi-carbon-nitrides of refractory metals (the titan, chrome, molybdenum, tungsten).

Microhardness, kgf/mm² - 2000÷7000.

Thickness of a covering, micron - 0,2÷5,0.

Service life increase - 2÷3 time.

Improvement of quality of processing, reduction of time of processing, time for equipment readjustment, decrease in power inputs, resource-saving.

DETAILS OF MACHINES AND MECHANISMS WITH WEAR-RESISTANT MULTI-LAYERED COVERING ON THE BASIS OF REFRACTORY METALS AND CARBON



Field of application:
 Mechanical engineering. Intended for the use in machines, tractors, agricultural machinery, in internal combustion engines, in fuel and other kind of pumps, compressors etc.

Technical and economic indicators:
 Covering material: a combination of thin-film layers from nitrides, carbides, carbon-nitrides, oxi-carbon-nitride of refractory metals and diamond-like carbon.

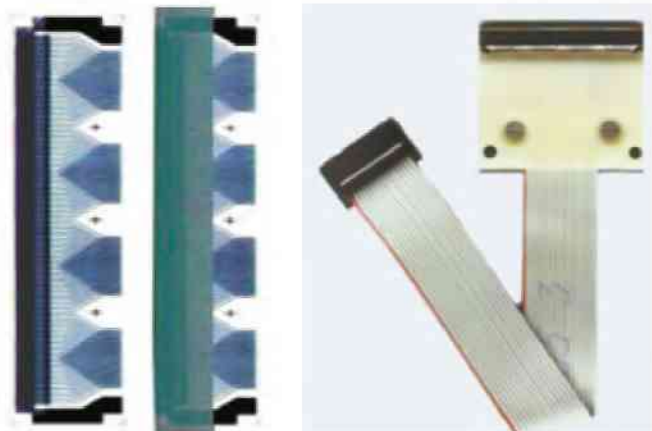
Microhardness, kgf/mm^2 - 2500÷6000.

Thickness of a covering, μm - 0,2-5-3,0.

Service life increase - 2÷5 time and more.

Decrease in expenses for technique repair, increase of working resource of technique, decrease in power inputs, resource-saving, economy of currency means etc.

VACUUM WEAR-RESISTANT COVERINGS FOR THE HEAD THERMO-PRINTING INCREASE



Field of application:
 The mechanical engineering, creation of thermo-printers. Used for protection from abrasion of elements of the thermo-press by a moving paper tape, increase of a resource of heads of the thermo-press of cash and other printing devices.

Technical and economic indicators:

1. are created by gas-phase synthesis of diamond-like carbon films;
2. thickness of coverings, μm - 2÷4.
3. allow to make (on heads TPG-128):
 - seed of the press > 250 Hz.
 - quantity of cycles of the press > 10^8 .
 - a resource of heads of the thermo-press with a covering, m > 50 000.

STRENGTHENING DIAMOND-LIKE CARBON COVERINGS ON ENGINES DETAILS



Field of application:
 Mechanical engineering, manufacture of engines of auto-tractor technique and other machines, in friction knots of mechanisms.

Technical and economic indicators:
 Coverings are besieged from plasma of the cathode-arc category in atmosphere of hydrocarbons.

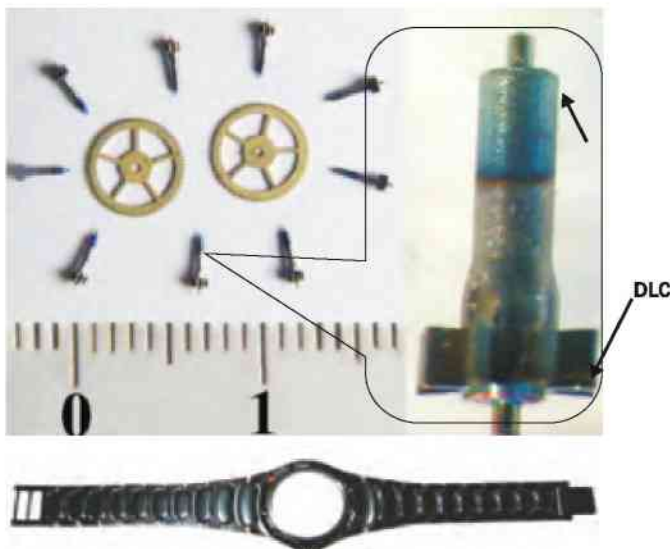
1. Thickness, μm - 1,5÷2;
2. Hardness, Gpa - 25-40;
3. Young's modulus, Pa - 1000;
4. Factor of deterioration, mm^3/Nm - 10^6 - $0,510^7$;
5. Increase of term of operation in 1,5-2 times.

WEAR-RESISTANT CARBON DIAMOND-LIKE COVERINGS FOR METAL- AND WOOD PROCESSING TOOL


- Field of application:
Tool industry.
- Technical and economic indicators:
Coverings are applied by method of cathode-arc sedimentation in vacuum.
1. Thickness of coverings, $\mu\text{m} - 0,5 \div 1$;
 2. Hardness, Gpa - 30-60;
 3. Preventions of pitch sticking;
 4. Increase of corrosion firmness of tools;
 5. Increase of operation terms of tools in 1,8-2,5 times.

STRENGTHENING CHEMICALLY RESISTANT COVERINGS ON THE BASIS OF CARBON CONTAINING MATERIALS ON SURFACES OF CASTING MOLDS OF PRODUCTS FROM PLASTIC


- Field of application:
Manufacture of products from plastic.
- Technical and economic indicators:
Coverings are applied on casting moulds in vacuum by method of sedimentation of the accelerated pulse carbon plasma in atmosphere of hydrocarbons.
1. Thickness, $\mu\text{m} - 0,85 \div 1,5$;
 2. Hardness, Gpa - 30-60;
 3. Thermal stability, $^{\circ}\text{C} - 350$;
 4. Chemical firmness to thermo- setting plastic;
 5. Increase in term of operation of forms in 50 times;
 6. Improvement of quality of a surface of products.

WEAR-RESISTANT ANTI-FRICTION AND DECORATIVE COVERINGS OF DIAMOND-LIKE CARBON FOR THE PARTS OF WATCH INDUSTRY


- Field of application:
Watch industry, instrument engineering.
- Technical and economic indicators:
Coverings are applied on hour details in vacuum by methods of plasma sedimentation.
1. Thickness, $\mu\text{m} - 0,1 \div 5$;
 2. Hardness, GPa - 75;
 3. Factor of a friction with steel - 0,08;
 4. Increase in an exit of suitable mechanism, increase of terms of operation;
 5. Firm, saturated color of different tints;
 6. Absence of allergic reactions and indifference to biological fabrics.

2.3. INSTITUTE OF CHEMISTRY OF NEW MATERIALS

LUBRICATION-COOLING FLUID (LCF) "ЛХ-2"



Short description of R&D:

Lubrication-cooling fluid (LCF) AX-2 (Technical standard of RB 100289145.001-2003) is a universal nonpolluting and is intended for the use at machining by cutting of products from metal alloys, including alloys with the lowered anticorrosion characteristics: grey and high-carbon special cast-irons.

Provides greasing, effective cooling of cutting zone and reliable preservation of a processed surface. Lubrication-cooling fluid LCF-AX-2 represents the water-soluble concentrate of a semisynthetic composition consisting of surface-active substances (on the basis of secondary terpene products), anti-corrosion, and antiscuff additives.

Lubrication-cooling fluid LCF-AX-2 concerns to low-dangerous chemical substances - 4 class of danger. Technical characteristics: Lubrication-cooling fluid LCF-AX-2 on its physical and chemical indicators corresponds to requirements:

- appearance, colour - a homogeneous liquid of light yellow colour;
- a smell - specific (needles light smell);
- pH - 8,5-11,0;
- corrosion aggression - stands tests;
- a total mass fraction of chemical additives (%) - 18-22;
- water (%) - the rest.

Field of application:

Intended for the use at machining by cutting of products from metal alloys, including alloys with the lowered anti-corrosive characteristics: grey and high-carbon special cast-irons.

2.4. INSTITUTE OF TECHNICAL ACOUSTICS

TECHNOLOGY AND EQUIPMENT FOR ULTRASONIC WELDING



Intended for welding of polymers (polystyrene, lavsan, polyvinylchloride, caprone etc.).

Technical characteristics:

- Frequency of fluctuations, kHz - 18,0;
- Power consumption, kW - 4,0;
- Time of welding of a product, sec - 0,1-10;
- Effort of a clip, N - 0-500.

INSTALLATION FOR ULTRASONIC SUPERFICIAL HARDENING



Intended for ultrasonic hardening and smoothing of crankshaft necks.

Technical characteristics:

- Resonant frequency, kHz - 20;
- Amplitude of fluctuations, μm - 10-13;
- Effort of a clip, N - 10-50;
- Capacity of 1 kW.

ULTRASOUND WASHING SETTING



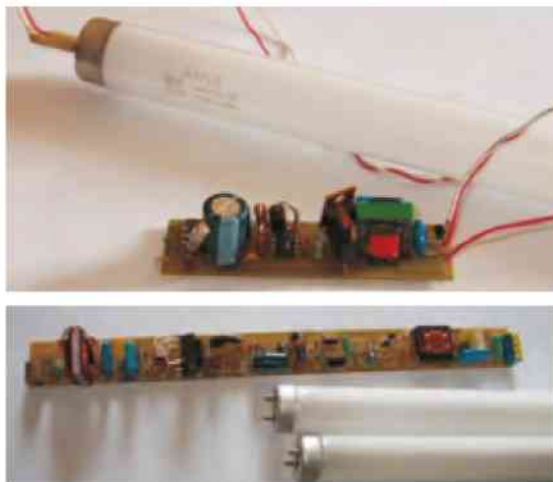
- ▶ Intended for wedging and clearings of atomizers of diesel engines.
- Technical characteristics:
- capacity, kW – 4 ;
 - frequency, kHz – 22 .

TECHNOLOGY OF MANUFACTURING OF CABLE PARTS ON METAL SHEATHINGS

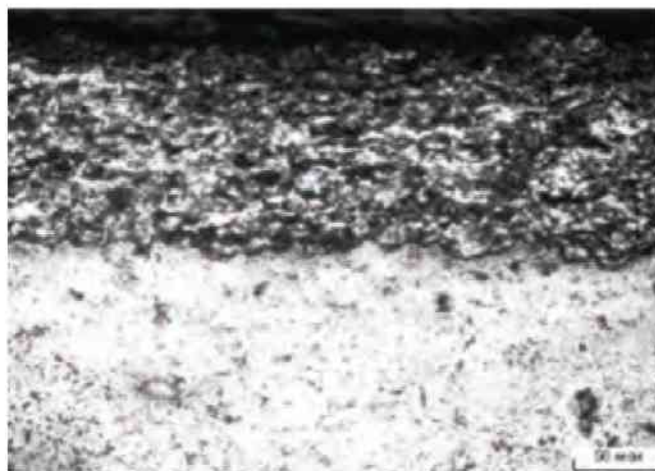


- ▶ It is intended for manufacturing of heat-resistant and thermo-pair cables in metal sheathing with the use of ultrasonic fluctuations.
- Technical characteristics:
- Frequency of fluctuations, kHz – 18,0 ;
 - Power consumption, kW – 4,0 ;
 - Speed of drawing of, m/s – 0,1-10 .

ELECTRONIC START-REGULATING DEVICES



- ▶ Intended for ignition and managements of work of luminescent lamps on frequency 40 kHz.
- Advantages:
- economy of the electric power to 25 %;
 - increase of light efficiency factor in a lamp;
 - power factor > 0,95;
 - absence of pulsations of light stream;
 - reduction of weight of fixtures;
 - absence of acoustic noise;
 - a wide range of working temperatures and entrance pressure;
 - increase in service life of lamps.

COMPOSITE COVERINGS METAL/CERAMICS AL:ZN/AL₂O₃, AL₂O₃/CU

- ▶ Intended for restoration of the lost sizes of aviation technics.
- The technology of reception by a method gas-dynamic dusting of composite coverings metal/ceramics with raised strength characteristics is developed:
- adhesion, Mpa – 50 ;
 - microhardness: 2,25 GPa (Al₂O₃/Cu); 3,15, GPa (Al:Zn/Al₂O₃).

LATHE OF REFINEMENT OF DIE BLOCKS (CBД-7)



Intended for operational development dragged from super-firm materials (natural and synthetic diamond, firm alloys) diameter 0,05–8,0 mm.

Technical characteristics:

- diameter of aperture, mm – 0,05–8,0;
- speed of rotation of, turns/minute – 1300;
- number of double courses of lap, min^{-1} – 140;
- amplitude of lapping lap, mm – 80;
- an angle of rotation of a spindle – 200;
- power consumption – 120 W;
- weight – 20 kg.

MAGNETO-DEFORMATION GLASS BREAKING



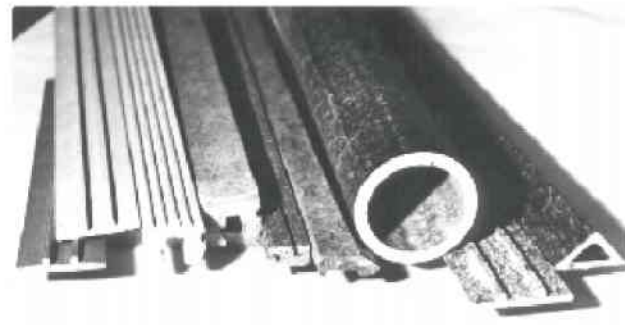
Made for manufacturing of complex-profile glass products.

Technical characteristics:

- Glass thickness, mm – 0,3–6;
- Deflecting force, N – 440;
- Consumed power, W – 60.

2.5. INSTITUTE OF MECHANICS OF METAL POLYMER SYSTEMS OF V.A. BELIY

EXTRUSION TECHNOLOGY OF WOOD-PLASTIC



EXTRUSION PROFILE PRODUCTS

Extrusion PROFILE PRODUCTS are intended for replacement of similar profile products from wood, polymers and metal.

It is obtained from materials on the basis of a wood waste (till 60–70 mas. %), polyvinylchloride and target additives. Characterized by high technological properties at processing, possibility of the use of not scarce raw materials and production wastes. The technology is implemented on serially let out equipment completed with simple and reliable auxiliary equipment.

BANDING TAPE FROM SECONDARY POLYPROPYLENE



Intended for packing of piece production, banding of piles with production, lengthy, sheet and moulded products, production fixing on pallet (except foodstuff and children's toys).

Technical Indicators:

- content of secondary material, % – 100;
- discontinuous loading N, not less – 1860;
- section of tape, mm – 12 x 0,8;
- comparative lengthening at rupture, %, no more 14;
- accordance to Standard of Belarus 400087698.189–2008.

CHEVRON CUFFS FROM MODIFIED POLYVINYLIDENFLUORIDE

▶ Intended for consolidation of plunger of oil-field pumps which are pumping over mixes of acids (HCl, HF), chisel solutions, oil, bedded waters, washing liquid at pressure to 70 MPa. Expire date of service of cuffs - 2 years, an operating time (total moving of plunger concerning a cuff) not less than 500 km. Cuffs have passed trade tests in RUF "Belarusoil".

SEALING ELEMENTS FOR OIL-FIELD PUMPS AND GATE LATCHES OF MAIN OIL PIPELINES

▶ Intended for gate latches of the main oil pipelines. Service conditions: a working environment - crude oil, pressure of a working environment is up to 8,0 MPa, difference on working body - from 0 to 8,0 MPa. Tightness of a shutter is not lower of "A" class. Quantity of cycles of operation opening-closing not less than 1000.

CONSTRUCTIONAL MATERIALS ON THE BASIS OF ALIPHATIC POLYAMIDES

▶ Polyamide shock-resistant alloy is intended for manufacturing of case details and details of technical appointment, it is processed by moulding under pressure and extrusion, for manufacturing of details of electro-technical appointment, for manufacturing of products triboengineering appointments (loose leaves of spherical support of tractors and cars, etc.).

COMPLETE SET OF MOBILE CONSOLIDATIONS FOR HYDRAULIC CYLINDERS

▶ Intended for hydraulic cylinders, plungers, hydro-shock-absorbers as a part of mechanical engineering products, technical equipment, transport.

COMPOSITE MATERIALS ON THE BASIS OF THE POLYESTER THERMO-LAYERS AND ELASTOPLASTICS

▶ Intended for manufacturing of details of electro-technical and general technical appointment.

Fiber-filled, multipurpose thermo-layers on the basis of polyamides, polysulphone, thermo-elatoplast Belast are intended for manufacturing of details of technical appointment, for obtaining of cuff consolidations, wiper seals, protective covers of hinges, consolidations of spherical cranes, flexible pipes, etc.

TECHNOLOGY OF PREPREG OF STRATIFIED PLASTICS



▶ The technology and the equipment are developed for prepregs obtaining of constructional materials on the basis of fabric and cord-like fillers of various nature (electro-conducting and dielectric) and powder-like polymeric binding.

HYBRID ORGANO(METAL)SILICATE NANO-COMPOSITES



▶ Intended for the use as functionally active disperse fillers of composite materials, additives to the lubricants, working in heavy-loaded friction knots; as colour pigments-fillers in ceramic glazes. Thermal stability $T_{20} = 650-700^{\circ}\text{C}$ (organo-silicate), $1500-2000^{\circ}\text{C}$ (metal-silicates).

BIODEGRADABLE POLYMERIC FILM



▶ The biodegradable film on a basis of starch-filled polyethylene is recommended as packing materials and products of disposable use. Corresponds to sanitary-and-hygienic requirements. It is admitted for packing of dry food and non-food stuff. Has vapour permeability $2,1\text{g}/(\text{m}^2\cdot\text{day})$, speed bio-destruction 4,5 points for 12 months.

THE POLYMERIC FIBROUS FILTER-ELEMENTS FOR AIR AND WATER REFINING



Thin-fibered electret filter-elements are intended for purification of gases of sub- micron firm particles and liquid drops in individual protection frames of respiratory

▶ organs, dust collectors, pneumatic systems, at refining of gas wastes. It possesses porosity up to 85%, ratio of aerosol penetration - 0,01%, aerodynamic resistance - 40-60 Pa, thinness of refining - 0,2-0,5 μm , substitute filters of Petranov.

Electret and magnetic filter-elements are intended for refining of technological liquids, draw-through and sewage. Can be used as biomass carriers in bio-filters for refining of high-loaded drains. Provide thinness of purification 1-5 microns from ferromagnetic pollutants.

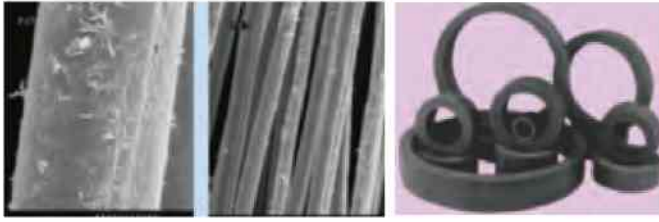
COMBINED FILTERS "GRIF" WITH MATERIAL "GRIFTECS"



▶ Intended for refining of compressed air, natural and technological gases from aerosols (water, oil) and firm particles. Three filtering layers of various porosity, including fiber-porous fluoroplastic "Griftecs", provide effective clearing and high dirt capacity.

Are used in automobile gas-filled compressor stations, gas-turbine engines, installations for painting, barbotage, etc.

COMPOSITE ANTI-FRICTIONAL MATERIALS OF FLUVIS GROUP



Fluvis, Vakofluvis and Superfluvis materials on basis of fluoroplastio-4 и carbon-fiber of Belarusian manufacturing are made for production of parts of strengthening knots, piston rings of compressors and laking armatures.

▶ Possesses of high wear resistance, thermo- and chemical firmness, hermetic sealing ability. Work without greasing; Vakofluvis, besides, - in dry gases and vacuum. The material of Superfluvis is made on a basis carbon-fabric by "Belum" (Standard of Belarus 400084698.177), consisting of carbon-fibers with plasma polymerized fluoropolymer covering. It is used in high-loaded knots of a friction working in extreme conditions. Fluvis composites are serially made on JSC «Grodno mechanical factory», and fabric Of Belum - in IMMS of NAS of Belarus.

POWDER ANTI-FRICTIONAL MATERIALS AND PRODUCTS



1.

1. Metal-ceramic for highly-load friction:

It is obtained on non-polluting and high-efficiency technology of the electro-contact sintering, allowing the use of components with various physical-mechanical characteristics.

2.

▶ Operating ratio of a material - 0,98.
2. Hybrid metal-polymer tape material:

It is intended for the knots of the friction working without greasing or at its limited giving, in the presence of water, for non-stationary modes of a friction at temperature to 600 °C.

The basic characteristics:

- material use coefficient - 0,98;
- Breaking pressure at stretching, MPa - 90-100;
- heat-conductivity, W/(mK) - 20-25;
- friction coefficient without greasing - 0,12-0,13;
- wear-out speed, a $\mu\text{m}/\text{km}$ - 0,10-0,12.

FRICTION MATERIALS ON ORGANIC MATRIX



▶ Intended for manufacturing a friction parts of transmissions which work in the environment of oil. It is used in knots of a shaft of selection of capacity, clutches of coupling, friction clutches of a hydro-mechanical box of change of transfers of tractors of "Belarus", career dump-body trucks of "BelAZ", rope cars on RUF «Belarusian metallurgy factory».

Friction factor environments of oils - 0,11-0,13;

Specific capacity of a friction, W/mm^2 - 1,0-1,7;

Thermal stability, °C - not lower than 280.

HEAT-RESISTANT FRICTIONAL MATERIALS AND PARTS FOR WORK IN FRICTION KNOTS WITHOUT LUBRICANT



▶ Intended for manufacturing of overlays of clutch couplings, frictional disks of clutch blocking of differential, brake disks and frictional dampers for work without lubricant in knots of a friction of auto-tractor technics. Are made on the basis of thermoset polymeric pitches.

Friction factor - 0,45-0,63;

Intensity of wear process - $(3,1-5,0) \cdot 10^{-8}$;
Specific capacity of a friction, W/mm^2 - 1,5-2,9;

Thermal stability, about °C - 370.

SUBSHEAF TRANSPORTING DEVICE FOR QUADRILATERAL EXPOSURE OF FLEXIBLE LONG-LENGTH ARTICLES



The device is designed for operation in process lines of radiation setups on the base of commercial electron accelerators with standard outlet devices. It is used for a uniform exposure of cable items and polymeric tubes to a beam of accelerated electrons. The setup ensures uniform distribution of absorbed dose over the perimeter of exposed object. The setup is used at "Belaruskabel" company.

PENDULUM TRIBOMETER WITH MICROPROCESSING AND STORAGE OF EXPERIMENTAL DATA



The tribometer is designed for precise tribophysical measurements and simulation of friction processes in natural joints. It ensures high accuracy and reproducibility of the friction force measurements in the supporting unit that is a function of damping oscillations amplitude and their variations per pendulum oscillation period.

FRICTIONAL DISCS FOR OIL-COOLED BRAKE UNITS



The discs are designed for operation in oil-cooled brake devices of wheel tractors and cars.

The materials of the friction discs display refined vibroacoustic characteristics and close in values static and dynamic friction coefficients.

The discs allow for reaching the following characteristics:

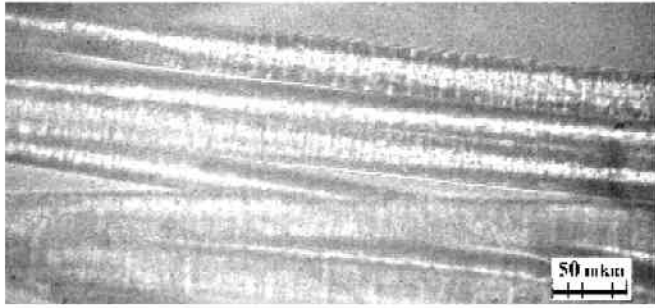
- friction coefficient in mineral oil – 0,11–0,14;
- linear wear per brake event, μm – not more than 0,002;
- thermal resistance, $^{\circ}\text{C}$ – 330;
- the discs are available with external diameter, mm – 120–890.

The discs ensure:

- strength of adhesive bond with the metallic frame, Mpa – 8,0–10,0;
- specific friction power, Wt/mm^2 – 0,8–1,7.

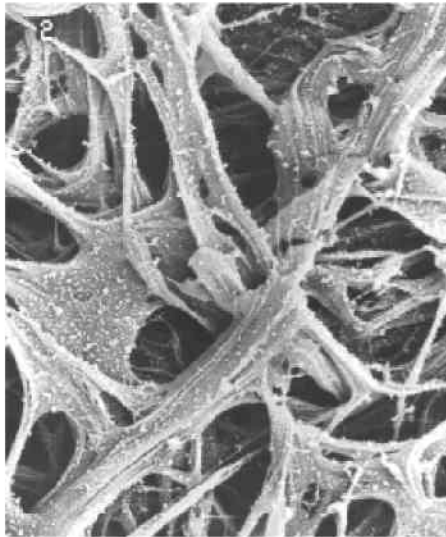
The discs were developed for RUPP "BelAZ", RUP "Minsk tractor plant".

PRODUCTION TECHNOLOGY OF ANTIMICROBIAL POLYETHYLENE TEREPHTHALATE FIBERS



Antimicrobial PET fibers manufactured by the given technology contain a system of branching micropores, so-called crazes (see photo) Inside which antimicrobial components are immobilized. Antimicrobial PET fibers are intended for addition into cotton, wool or silk yarn. Their density is 0,17–0,80 tex, they do not cede in deformation and strength characteristics to the initial PETP fibers, and keep inhibiting bacteria growth after 50 cycles of washing.

FIBROUS-POROUS FLUOROPLASTICS "GRIFTEX"



The material is used for manufacture of filters, surgical endoprotheses, etc. It is made in the form of wool and felt. It is resistant to hostile media (acids, alkali), is bioinert, hydrophobic and oleophilic.

SOUND-ABSORBING LAMINATED MATERIALS



The materials are intended for manufacture of sound-absorbing structures used in locomotive and vehicle cabs, In production areas to reduce noise level. They are characterized by low density and sufficient structural strength.

Characteristics:

- normal acoustic absorptivity within frequency range 315–2000 Hz – 0,52–0,85
- k-factor at 293 K, Wt/(m·K) – 0,04–0,05

The materials are supplied to the enterprises of Belarussian railroads and Ministry of transport of Belarus

FRICTIONAL WEAR-RESISTANT COMPOSITE MATERIALS AND PARTICLES



▶ Intended for the use in knots of a non-stationary friction of the process equipment on metal works, in manufacture of glass and chemical fibres, in technical arrangements of railways and the airports, in drives of presses and metal-cutting machine tools.

Friction coefficient – 0,52–0,67.

Specific capacity of friction, W/mm^2 – to 2,0.

Heat-resistant, °C – 350.

HIGH-STRENGTH COMPOSITES ON THE BASIS OF THE THERMOSET POLYMERIC BINDING



▶ Intended for formation of case products, details of hydro-cars and harvester combines, elements of fastening of a railway way, details of aerial-feeding devices. Made with organic or mineral fibrous filler. Possess high durability, good damping characteristics, resistance to influence of atmospheric factors.

Breaking point at compression, MPa – to 170;

Breaking point at a bend, MPa – to 170;

Impact strength, kJ/m^2 – 47–70.

FRICTIONAL COMPOSITE MATERIALS FOR STATIONARY FRICTION KNOTS

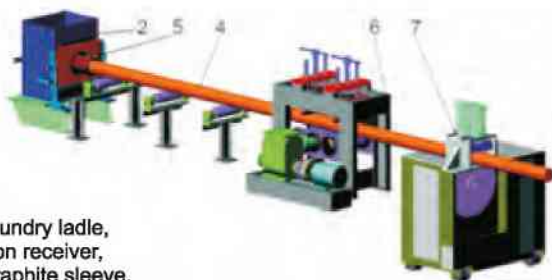


▶ Intended for knots of stationary friction of the process equipment in the conditions of a friction without lubricant at temperatures to 260 °C, used manufacturing of metal and polymeric cord, chemical and glass fibres for regulation of speed of unwinding-winding and stress of a tension of mono-threads.

It is obtained on a basis of polytetrafluoroethylene and heat-resistant sewed oligomer, which forms in the course of processing reinforcing skeleton. It possesses increased stability of friction factor that provides high quality of received cord threads. Steady against influence of aggressive environments and mechanical vibrations.

2.6. INSTITUTE OF TECHNOLOGY OF METALS

TECHNOLOGY AND THE EQUIPMENT FOR CONTINUOUS HORIZONTAL MOULDING



1. foundry ladle,
2. iron receiver,
3. graphite sleeve,
4. casting,
5. mold,
6. withdrawal device,
7. cutting device

▶ The melt is teemed into iron receiver, joined with water cooled crystallizer. Solidifying casting is extracted periodically: move stop.

The plant is designed for every concrete customer in accordance with his range of castings, outputs and other requirements, which determine technical parameters and a final cost of the plant.

The equipment for moulding bronze bars is completed with an induction channel mixer (Capacity 60 ± 5 kV; productivity of 170 kg/h; capacity 700–800 kg; Dimensions 1900 x 1200 x 900 mm).

Material of castings:

Bronze, pig-iron, aluminium.



Diameter of cast bars from:

- bronze, mm 25–200;
- pig-iron, mm 30–150;
- aluminium, mm – 40–190.

Section of the rectangular pig-iron bars, mm from 30 x 50 to 150 x 200.

Productivity at single-impression bars moulding:

- bronze, kg/hour 280–420;
 - pig-iron, kg/hour 240–680;
 - aluminium, kg/hour 120–150.
 - power consumption, kW – 11.
- The technology and the equipment can be used for obtaining of blanks of machine – and mechanical engineering, hydro- and pneumo-equipment. As initial raw materials can serve colour alloys, a breakage of nonferrous metals, steel and pig-iron breakage, foundry and reefficient irons. The blanks have the set structure and physical–mechanical properties. Process of continuous horizontal moulding provides in comparison with moulding in single forms smaller capital expenses, cost price decrease of castings on 30–50 %, reduction in 2–4 times of allowances on machining, increase in 2–4 times of labour productivity, an exit of suitable goods is up to 92 %.

TECHNOLOGY AND THE EQUIPMENT FOR ELECTROSLAG REFINING



▶ The electroslag casting is based on an electroslag process of melting of a consumable electrode. The electrode melts by heat released in the electro-conductive slag when electrical current passes through. A casting is crystallized in a thin rim of the slag skull. As a result of the slow and strict unidirectional solidification of a small amount of liquid metal, high chemical and structural homogeneity of metal is ensured. Typical parts which can be produced by the electroslag casting method are the following: blanks of stamp and cutting tools, blanks of large-sized gears, rings, pulleys, gear-wheels, different forks, lugs, cases, journals, bimetallic blanks such as worm wheels, rollers for rolling, and so on.

BIMETALLIC CASTING OF PREPARATIONS OF WORM WHEELS OF THE MAIN DRIVE OF LIFTS



▶ Bimetallic casting bronze – grey pig-iron “C420” are intended for manufacturing of worm wheels of the main drive of lifts. The use of bimetallic blanks of wheels instead of a modular construction allows to obtain essential reduction the quantity of intermediate machine operations during manufacturing of worm wheels.

JET CRYSTALLIZER AND THE DEVICE WITH SUBMERGED-JET SYSTEM OF SECONDARY INGOT COOLING



▶ Allow to raise productivity of moulding of an ingot in 2–5 times and to crush its structure in 4–10 times in comparison with moulding in a usual (slot-hole) crystallizer. It is used in pilot production of Institute of Technology of Metals. Jet crystallizer constructions and the device of submerged-jet cooling of steel ingot for “MHA3–2” are developed.

WORM WHEELS FROM ANTI-FRICTIONAL SILUMIN



Worm wheels are received from alloy "AK18M2" with inverted and high-disperse microstructure. The worm wheel made are from antifriction silumin and established in a reducer of the polishing machine tool "6ШП-100", has work resource in 4 times higher than a worm wheel from antifriction bronze "БрАЖ9-4".

BLANKS OF EXPLOSION ENGINE PISTONS WITH THE IMPROVED STRUCTURAL HEREDITY



Blanks of explosion engine pistons from alloy "KC-740" are received from secondary materials without application of modifying gumboils and ligature. In comparison with serial, blanks of pistons with the improved structural heredity, have three times more disperse micro-structure.

SLEEVES FROM DEFORMED SILUMINES



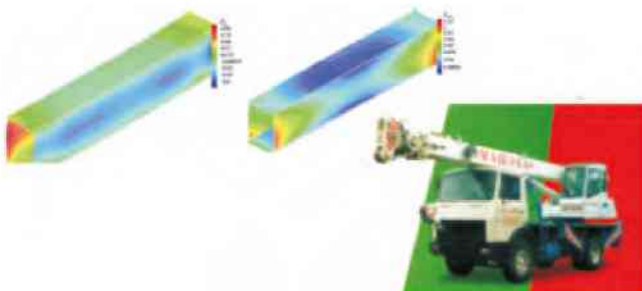
Have the inverted micro-structure with high structural dispersion of phase components. Alloys used: "AK6M2÷AK12M2". Method of obtaining – hot punching. Applied as a directing rod of shock absorbers.

BLANKS FROM ALUMINUM-SILICON ALLOYS WITH NANO-STRUCTURED EUTECTIC SILICON



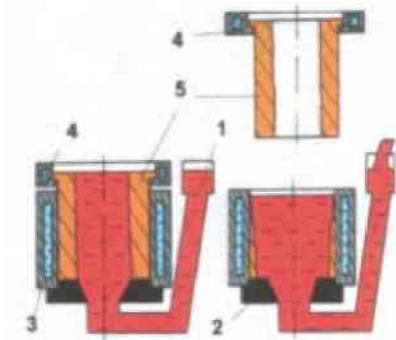
Blanks in a cast condition have globular crystals of eutectic silicon in the size to 200 um. After refining the high-disperse alloy microstructure remains. Wear-out of sample pistons from alloy "KC-740" of the engine of a racing car of type of "Kapr" is 3 times less than usual serial pistons. At a dry friction about the tempered steel of preparation from alloy AK18M2 with nano-structured eutectic silicon surpass similar of bronze "Бр03Ц7С5Н" in 32 times.

TECHNOLOGY OF COMPUTER MODELING AND PROJECTING OF LOAD-CARRIINGS OF AUTOMOBILE OF JIB CRANES



The carrying out technique strength calculations is developed, allowing to estimate load-carrying capacity of jib cranes on a design stage and to develop recommendations to decrease in metal consumption and increase of accuracy of a design. The mathematical model can serve for optimization of a design of a wide spectrum of auto-crane technicians.

CONTINUOUS-CYCLING CASTING BY DIRECTED HARDENING



Essentially new technological process of obtaining of hollow cylindrical blanks of measured length without application of a core for manufacturing of details of responsible appointment with high operational characteristics from irons of various types. The technology allows to receive casting with in advance set structure and physical-mechanical properties at level of the world standards at the expense of the directed hardening and the heat treatment, united in a uniform work cycle.

INSTALLATION FOR CONTINUOUS-CYCLUNG CASTING BY DIRECTED HARDENING



Intended for obtaining of hollow cylindrical moldings in continuous-cycling mode.

Productivity, castings/hour - 100-250;

Blanks sizes, mm:

-outer diameter - 40-200;

-length - 90-280;

-the wall thickness - 10-30.

Expense of reverse water, m³/hour - 15-20;

Overall dimensions, m - 3 x 3 x 2;

Mass, kg - 1500.

TIGHTENING RINGS FROM HF



Made for integration of pneumocompressors, which are used on engines of MTZ, MAZ, BelAZ, MoAZ, KrAZ, ZIL, gearboxes of tractors T150 and K700, hydro-movable coupling of front axle drives of energy-saturated tractors "Belarus" of new generation.

PISTON RINGS FROM GREY SPECIAL IRON



Made for integration of compressors of different appointment. Delivered to all trolley, tram and railway depots of Belarus as well as for export.

BIMETALLIC DISKS «STEEL-COPPER ALLOY»



It is used as blanks for manufacturing of plain bearings and sliding nuts.

BIMETALLIC DISKS «STEEL - COPPER ALLOY»



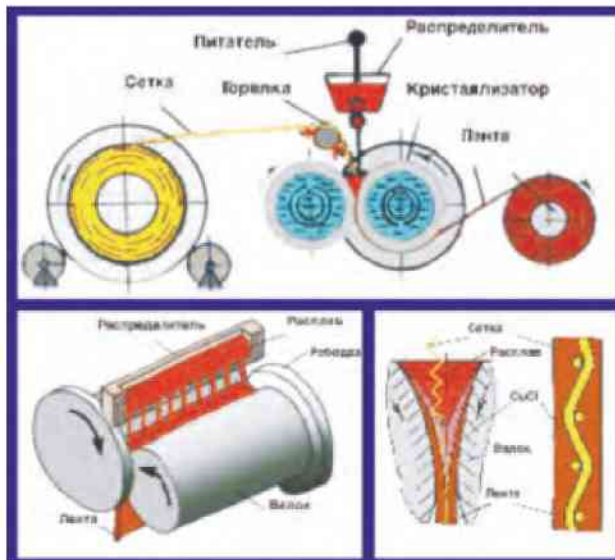
► Used as blanks for manufacturing of face disks of guided-vane pumps.

CENTRIFUGAL-CASTED MOLDINGS FROM COPPER ALLOYS



► Used for manufacturing of bushings, plain bearings, sliding nuts, gear rings.

TECHNOLOGICAL PROCESS OF CONTINUOUS MOULDING OF REINFORCED CHLORIDE-COPPER TAPE FOR WATER ACTIVATED SOURCES OF THE CURRENT



► The cast tape from reinforced copper grid CuCl replaces hire from AgCl in chemical sources of a current activated by sea water. Cost of a cathode material on the basis of CuCl in 30–40 times more low, than from AgCl. Equipment characteristics:

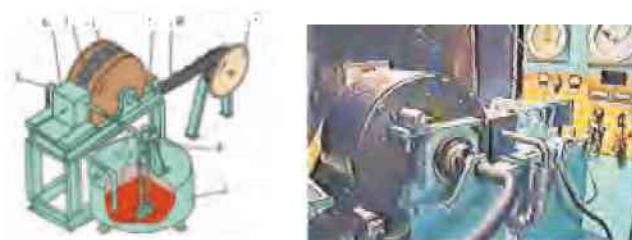
1. The melting furnace with power consumption – 100 kW.
2. Roll crystallizer:
 - capacity of electric drives – 10 kW;
 - water consumption on cooling – till 16 m³/hour;
 - weight of a roll of a tape – to 200 kg.
3. The area for equipment installation – 75 – 100 m².
4. A thickness of a tape – 0,4 – 0,9 mm.
5. Width of a tape – to 430 mm.

TECHNOLOGICAL PROCESS AND THE EQUIPMENT FOR OBTAINING OF ZINC ANODES FOR GALVANIC MANUFACTURES



► The technology helps to create such conditions of metal crystallization, where the blank under rolling forms with pretty thin micro-structure. Such metal after hot rolling minimum compression (20–30 %) can be used for manufacturing of anodes. The technology helps to obtain precise-sized anodes, economy of zinc and decrease in the cost price of production.

BATTERY FOR LATTICE SPIRAL BATTERY



Lattice for lead-acid batteries is made in conditions of continuous giving melt of the furnace 1 by centrifugal pump 2 on the pipeline 7 in a crystallizer consisting of a form-building drum 4 and boot-feeder 3. Through the front crack in a wall of a boot-feeder contacting with the drum melt fills a relief of a lattice 9

on the drum, and its surplus on the pipeline 8 comes back in the furnace 1. Hardening lattice tape together with a drum slide relatively the boot-feeder wall. After an exit from under the boot the tape 10 is cooled on a drum till its set, and then turned off in a roll 11.

Technical characteristics:

- thickness of a lattice, mm – 0,9–1,8;
- speed of moulding, m/min – 20–40;
- furnace capacity, kg – 1200;
- established electric capacity, kW – 32,7;
- expense of water on cooling, m³/hour – 5;
- car dimensions, mm – 3500 x 2300 x 1400.

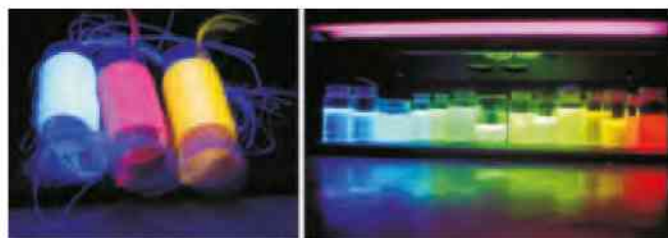
FOUNDRY GOODS FROM MULTI-COMPONENT IRONS WITH ORIENTED CARBIDE PHASE



Details for the centrifugal crushing equipment work in the conditions of intensive dispatch-abrasive influence with a processed material. Firmness of details is in 2–5 times higher than at traditionally applied irons of marks "ИЧХ28Н2". Casted cores for empty-formers by manufacture of ceramic blocks and bricks work in conditions rheological influences of ceramic weights. Work resource is 50–70 % higher than at the cores made from thermo-processed high-alloyed steel.

2.7. INSTITUTE OF CHEMISTRY OF NEW MATERIALS

OPTICALLY WHITENING SUBSTANCES FOR POLYMER MATERIALS



Optically whitening substances competitive with the best world analogues in its exploitation characteristics are produced. It represent bis (5-alkyl-benzo-ksazol-2-yl) aryls, which are obtained by condense of aroma diaceds with alkylaminophenols.

Field of application:

It is used for whitening of polyethers, polyamides, polyakrylnitrile and other polymers.

Technical characteristics:

The indicator name	Meaning
Outer look, color	Powder of sand color
Relative concentration according to standard sample, %	100,0
Temperature of melting, °C	270 not less
Mass fraction of water and volatile substances, %	1,5 not more
Mass fraction of ashes, %	1,5 not more
Mass fraction of rest after dry bolting on sieve №063K, %	2,0 not more

Optical decolorant "ОПБ-1" (Standard of Belarus 14532025.005-98)

Empirical formula: C₂₈H₂₀N₂O₂.

Structural formula: molecular mass - 416.479.



3.1. INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

NEW GENERATING MEDIUM ZnSe:Cr FOR THE LASERS OF MEAN IR-REGION (2–3 μm)



The fields of their application are: compact tuned lasers with a diode excitation for medicine (neurosurgery, plastic surgery, ophthalmology, urology), optical communication, spectroscopy and ecological monitoring of the atmosphere. The medium exceeds the best commercial solid state generating laser medium of a mean IR range $\text{MgF}_2:\text{Co}^{2+}$ (1,75–1,25 μm) by the efficiency, damage threshold and overlap-ping generation range (2,2–2,8 μm). By their optical quality our ZnSe:Cr crystals are highly competitive with the similar crystals created in the Lawrence Livermore National Laboratory.

MULTIFUNCTION HIGHLY EFFECTIVE NONLINEAR OPTICAL $\text{K}_3\text{Li}_2\text{Nb}_5\text{O}_{15}$ SINGLE CRYSTALS



Intensive development of laser engineering demands the development of new nonlinear optical single crystals. The crystals of the $\text{K}_3\text{Li}_2\text{Nb}_5\text{O}_{15}$ (KLN) are of a big interest.

the KLN crystals have a high radiation strength and do not reveal an optically-induced change of refraction index; they are optically transparent in the range of 0,4 to 5,0 μm . Depending on the crystal composition, the temperature of 900- degrees synchronism for various frequencies is changing in a broad range, up to the room temperature. The presence of high nonlinear coefficients and high value of birefringence makes it possible to use them as conversion devices of laser radiation with acquisition if phase con-formation up to $\lambda=0,9$ μm . The KLN crystals can be used as a highly effective electro-optical elements. Thus, the half-wave voltage at 20 ° C equals to 1350 V, and the corresponding effective electro-optical coefficient is $r_{c} = 4,8 \cdot 10^{-9}$ cm/V.

OPTICAL FILTERS IN IR-RANGE SPECTRUM

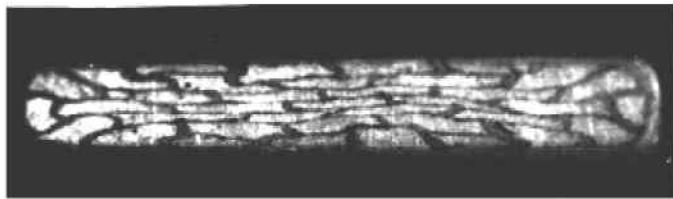


Optical filters in IR-range spectrum on the basis of crystals ZnAs_2 and Zn_3As_2 with steepness $K \sim 1,6\%$, $K \sim 2,1\%$ accordingly (the steepness of optical filters on the basis of Si and Ge makes $\sim 10\%$ and $\sim 8\%$), and permittivity at level of 60–70% in spectral area 1,2–15 μm .

ELEMENTS FOR MANAGEMENT OF DURATION OF IMPULSES OF GENERATION OF RUBY AND NEODYMIUM LASERS



Using CdP_2 as a nonlinear optical element (in common in Institute of physics of NAS of Ukraine) elements for management of duration of impulses of generation ruby and neodymium lasers are made.

COMPOSITON CRYOCONDUCTING MATERIAL

High-current hyperconducting electromagnetic systems.

Unique features:

Conducting highly-pures aluminum fibres are placed into the matrix of high-strength Al alloy, which is suitable for their joint working and operation. This fabrication technology allows a reliable electrical and thermal contact of a matrix and a conductor.

Main technical data:

Conducting highly-pures aluminum fibres are placed into the matrix of high-strength Al alloy, which is suitable for their joint working and operation. This fabrication technology allows a reliable electrical and thermal contact of a matrix and a conductor.

A multi-fiber conductor, consisting of the Al-Mn-Mg alloy with the 94% aluminum content, which has a high yield limit $\sigma_y = 360$ МПа при $T = 4,2$ K, and also heat conductivity and linear expansion coefficient being close to those of pure Al. During the fabrication of the multi-fiber conductor, in each of tubes of Al alloy, rods of pure aluminum with $R_{300K}/R_{42K} \sim 10000$ are introduced. After that the ingots are placed in a tube with a diameter of 35 mm from the similar Al alloy. The combined billet undergoes radial pressing at $T = 180^\circ\text{C}$. On the final stage the composite material obtains a form of flat busbar with a rectangular cross-section, and with that the scheme of current-carrying fibres, surrounded by the strengthening matrix, is not violated.

The R_{300K}/R_{42K} value of the busbar equals to 2700-800 in the helium-neon temperature range (4,2-28 K). The magnetoresistance value does not exceed the range 5-7 in magnetic fields up 15 T.

AUTOMATED SPECTROSCOPIC MEASURING COMPLEX

Fields of application:

Optical spectroscopy; nondestructive control of semiconductor materials and devices.

Unique characteristic properties:

The automated spectroscopic measuring complex is designed for the registration of optical spectra in a broad temperature range;

it has a high spectral resolution, high sensitivity and a large rate of registration and processing of measurements results.

Main technical data:

Spectral registration range-200-3000 nm; Excitation wave length - 405 nm, 457 nm, 488 nm, 514 nm, 532 nm;

Laser excitation - up to 500 mW;

Dispersion of monochromator - 13 A/ mm (1200 grooves/ mm), 26 A/ mm (600 grooves / mm).

Measuring modes:

Registration of photoluminescence spectra with a high spectral resolution (less than 1 A) in a broad temperature range (4,2-300 K);

Registration of luminescence excitation spectra of semiconducting structures in the region 200-2500 nm.

Operation of the spectroscopic measuring complex is based on the synchronous phase detection. Registration of optical signals is carried out with the use of Hamamatsu photodetectors (Japan). These are photoelectric multipliers for the spectral region of 200-900 nm, InGaAs p-i-n photodiodes on the spectral region of 0,8-2,6 μm , and a cooled photoresistance of PbS on the spectral region of 0,8-3,5 μm . The spectroscopic measuring complex provides a possibility to carry out measurements of luminescence, optical transmission and optical reflexion in the temperature range 4,2-300 K.

3.2. PHYSICAL AND TECHNICAL INSTITUTE

VACUUM WEAR-RESISTANT COVERINGS FOR INCREASE OF HOLOGRAPHIC WORKING MATRIXES



Field of application:

Protection of documents and products against fakes, use as wear-resistant coverings of the holographic relief of nickel working matrixes from

which the press of holographic production is made by a stamping method.

Technical and economic indicators:

- made by gas-phase synthesis of diamond-like carbon films;

- thickness of coverings, nm – 30÷80;

Advantages:

- reproducibility without distortions of a holographic relief of working matrixes;

- increase in a resource of matrixes in 2 and more times.

3.3. INSTITUTE OF CHEMISTRY OF NEW MATERIALS

POLARIODS FOR OPTICAL-ELECTRONICS AND PROTECTIVE TECHNOLOGIES



Method of creation of dichroic structure on the base of polyvinylspirit (PVS) and dichroic agent – molecular iodine is used.

This method is used by firms-monopolists for production of high-quality polaroids of all types – "Nitto Denko"(Japan), "Polaroid Co" (the USA) and "Ace Digitech" (South Korea).

Specifications of composite of glue composition:

Despite the method of saturation with iodine of PVS film from alloy, containing KI and I₂ [JP2003029042, Jp2003227934, US6757102, US2003151813], new way of color of produced by molecular iodine (exuded from iodide-ions under the influence of oxidizer from solution) PVS-film is developed (Patent of Republic of Belarus №1706).

Received polaroids have high indicators under 550 nm: light-permittivity is not less than 44,5%, polarization effect is not less than 99,9%, dichroic ratio is not less than 500, polarizing ability is higher than analogues have produced by companies "Nitto Denko" and "Ace Digitech" [catalogues, JP20030115650, Jp2004341503].

Advantages:

Mobility of the developed manufacturing techniques of competitive polaroid films, focused for needs of the home producer, reduces currency expenses for acquisition of materials abroad, eliminates dependence on conditions of the market and foreign suppliers, widens the assortment of let out production also raises its competitiveness.

Scope:

Polaroid films of transmitting, reflecting and transmitting-reflecting (semi-luminal) types-necessary elements of LCD display of information, devices of the control of the latent image, polarizing optical filters for optical and laser equipment, and also for protection of trade marks of the high-quality consumer goods and securities against fakes.

Forms of cooperation: the know-how sale.

TECHNOLOGY OF OBTAINING OF FERROMAGNETIC MATERIALS FOR FORMATION OF THIN-FILM LAYERS ON THE METALLIZED FOIL IN PROCESSES OF SPLICING OF HOLOGRAPHIC IMAGE WITH THE PAPER BASIS



The short description of R&D:

The thin-film magnetic coverings formed on an aluminium foil with the use of "hot-stamping" technologies.

Advantages:

Uniqueness of a technique of formation of thin-film magnetic coverings. The low cost price.

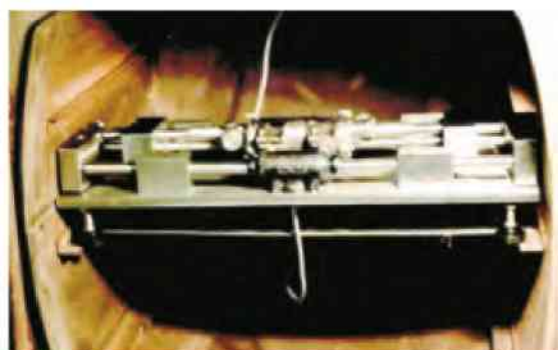
Technical characteristics of structure of a glutinous composition: a ferromagnetic liquid (FML) with the stabilizer oleate 3-ethanolamine – no more than 3,5 % (weights.), acryl glue – not less than 15 % (weights.), FML with the stabilizer of tetramethylammonium hydroxide – not less than 7,5 % (weights.).

Technical characteristics of thin-film layers on the basis of a ferromagnetic liquid: the Size magnetic nano-particles – not less than 10–20 nm. The minimum thickness of a film – 1,0 μm . Roughness – 0,002 μm .

Scope: Technologies of protection of securities and documents.

3.4. INSTITUTE OF TECHNICAL ACOUSTICS

HERMETIZATION INSTALLATION



Intended for hermetic installation of impulse lamp of pumping in solid-state laser.

Provides with:

- Liquid pressure, kPa – 100;
- Pressing effort, kg – 50;
- Pressing time, minutes – 30;
- Temperature, °C – 800.

COMPLEX FOR REPAIR OF LASER SYSTEM 25F/01



Intended for repair of quantifier of laser range-finders.

Specifications:

- Temperature – 80 °C;
- Cycle durability – 30 minutes;
- Pressure – 3 atmospheres.

INSTALLATION FOR LASER CUTTING OF THE GLASS



Intended for laser cutting of sheet particles with increased demands to the quality. Helps to produce particles of thickness up to 10 mm and size up to 1x1 mm and accuracy up to 0,2 mm.

4 CONTROL-INSTRUMENTATION DEVICES, SENSORS AND MEANS OF AUTOMATION



4.1. INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

ELECTRIC CURRENT SENSORS FOR THE RANGE 0,5 A TO 50000 A



- ▶ The sensors are measuring direct current, alternate current, impulse current. Galvanic decoupling is supplied. The sensors have a high response speed.

Fields of application: electric transport, electrical equipment.

ELECTRONIC MANOMETERS FOR LIQUID AND GASEOUS MEDIA FOR THE PRESSURE RANGE FROM 0,6 MPA TO 2,5 MPA



- ▶ Manometers have high reliability. Two measuring channels can be adjusted – visual indications of the manometer, current output in the region 0 – 5 mA.

The fields of application are: heat and water supply, teleautomatics.

ROTATION ANGLE SENSORS—SECTOR, COMPLETE ROTATION AND TWO-CHANNEL



- ▶ The sensors are designed for a strict mechanical and environmental operational conditions.

The fields of application are: electrical transport, control systems, machine tool building, industrial equipment.

MAGNETIC FIELD SENSORS FOR THE RANGE FROM 1 mT TO 15 T



- ▶ These sensors are magneto-metric probes for the measurement of normal and tangential components of magnetic field, for the measurements in small gaps from 100 μm , and for the cryogenic measurements from 1,5 K. The fields of application are: magnetic measurements, sensing elements.

FLEXIBLE THIN FILM SOLAR CELLS BASED ON $\text{Cu}(\text{In,Ga})\text{Se}_2$ SEMICONDUCTOR MATERIALS



- ▶ Now as the bearing substrate of the thin-film solar cell (SC) high-temperature grades of the polished glasses generally are used. SC on their basis have the big weight, low reliability at wind loadings and mechanical influences. Alternative option are flexible metal or dielectric substrates. The main advantages of the last – the reduced mass, better characteristics, higher durability, the effective heat sink that predetermines their unconditional prospects for applications as autonomous and space sources of the electric power.

CRYOGENIC HYPER-CONDUCTING TRANSFORMER



- Field of application:
On-board power supply systems, mostly in the space vehicles.
- Main technical characteristics:
- power, MW – 1;
 - frequency, Hz – 400-600;
 - phase number – 3;
 - operating temperature, K – 4-28.
- Dimensions:
- diameter, mm – 390;
 - height, mm – 320;
 - mass, kg – 70.
 - mass/ energy ratio, kg/kW – 0,07.

MICROPROCESSOR TEMPERATURE METER



- Technical data:
- Temperature measurement region:
The K-type thermocouple – (0÷1300) ° C;
The S-type thermocouple – (0÷1600) ° C;
The limit of the given error:
The K-type thermocouple – 1,0%;
The S-type thermocouple – 0.5%;
The indicator is 4-or 5-bit light-diode one;
Resolution of analogue – to digital converter – 13 bits;
Period of scanning – 5,35 mS.

- A single-channel temperature meter with accuracy class 0,1 with the frontal dimensions of 96 x 48 mm is designed for the measurements of temperature in the industry and scientific research in the laboratory and workshop conditions. The characteristic features of the meter are: high accuracy of measurement, indication in the Celsius degrees, high noise stability, readiness to operate immediately after the switching on, the possibility to work with the thermocouples chromel-alumel (K-type) and platinum/rhodium (S type) (there are two types of the meter), digital filtering of the thermocouple signal, presence of two threshold comparators and one relay output, sound signalling, compensation of the cold junction temperature with the use of thermo-resistor NTC as a temperature sensor and mathematical information processing, presence of the breaking control and short circuit of the thermocouple and the cold junction temperature sensor.

INVENTOR WELDING UNIT WITH THE USE OF COMPOSITE MAGNETICALLY-SOFT MATERIALS



- The composition magnetic materials with saturation induction up to 2T in the frequency range up to 50 kHz have been developed on the base of water-atomized iron powders ASC 100,29 and Atomet 1000 HP. With the use of the developed magnetically-soft materials, the samples of various devices are elaborated: power supplies of different capacity with a toggle frequency up to 40 kHz, inventor welding units on the frequency 40 kHz and power of 3-4 kW. The model samples, electric motors with working frequency of 1kHz, linear electric motors, dynamics and a number of other devices are being developed.

The advantages of the developed devices are:

- low weight, so that a model sample of the welding unit does not exceed 2kg being compared with the weight of 30kg of the similar device on the frequency of 50 Hz;
- operation reliability, as a high-frequency of stepping motors with a rotation speed 15-20000 rotation per minute will make it possible to substitute the collector motors;
- small costs.

4.2. PHYSICAL AND TECHNICAL INSTITUTE

EQUIPMENT COMPLEX FOR TRIBOTECHNICAL TESTS OF MATERIALS AND KNOTS IN EXTREME CONDITIONS OF ENVIRONMENT



Appointment:
Tribotechnical tests of materials, small-size friction knots in conditions which imitate space factors.

Technical characteristics: equipment complex for tribotechnical tests in conditions of high vacuum (not worse than 10^{-5} Pa) and temperature range 150–500 K.

Advantages: opportunity to tests to 6 samples simultaneously.

Field of application: tribotechnical tests of new and modified materials for aerospace industry.

INSTALLATION OF OPTICAL TOPOGRAPHY



Appointment – quality control of surface of semiconductor plates.

Technical characteristics:

Length of a wave of radiation, μm – 0,3–0,6;

Pressure of a food, V – 220;

Frequency, Hz – 50;

Power consumption, kW – 1,5;

Productivity, plates/hour – 300.

The defined sizes of defects: on depth of 5 nanometers; in the plan, not less than 0,1 mm.

The program module – definition of qualitative characteristics of a surface under the image, a card of levels, surface modeling.

Field of application - microelectronics.

Advantages: nondestructive quality control of quality of all surface of a plate, instead of its visualization of the received data.

SENSOR OF SHOCK LOADINGS SS-AT-T-01



Field of application: The pressure gauge of membranous type on the basis of thin-film tensity-resistive elements is intended for the use in electronic systems of airbags of vehicles.

Technical and economic indicators:

- range of measured pressure, Mpa – 0,06–0,1;

- range of working temperatures, °C – -40–+95;

- resulted error of measurement, %, no more – 4,0;

- pressure of a food, V – 4,5–5,5;

- dynamic range, kHz – 0–1;

- range of a target signal, mA – 0–4,0;

- nonlinearity of a target signal, % – 1,0;

- weight, g – 50.

TENSITY-CONVERTER



Field of application:

Transformation of pressure in to an analogue differential electric signal to multichannel microprocessor systems.

Technical and economic indicators:

- pressure range, Mpa – 0–1,0;

- resulted error of transformation, % – 2,0;

- nonlinearity of the characteristic of transformation, % – 1,0;

- minimum working temperature, °C – +18;

- maximum working temperature, °C – +40;

- storage Temperature, °C – -60+80;

- temperature error of a target signal

because of drift of zero, % °C, no more – 0,05.

PRESSURE SENSOR PS-AT-ZP (PS-AT-2P)



Field of application: The pressure gauge membranous type on the basis of thin-film tensivity-resistant elements. It is intended for measurement and the pressure control in pneumo-gas and hydro-systems of auto-tractor technics.

It can be applied in systems ABS (anti-blocking system).

- Technical and economic indicators:
- range of measured pressure, MPa – 0–0,1 (0–0,6; 0–1,0; 0–1,6);
 - range of a target signal, V – 0–5;
 - resulted error of measurement, % – $\pm 1,0$ (4,0);
 - nonlinearity of target pressure, %, no more – 5;
 - pressure of a food, V – 9–16 (9–30);
 - weight, g, no more – 150;
- Overall dimensions: Diameter, mm, no more – 35; Height, mm, no more than – 85.

4.3. INSTITUTE OF APPLIED PHYSICS

MAGNET THICKNESS GAUGE MTC-2M



Intended for measurement of thickness of not magnetic coverings: (Chrome, copper, a paint, etc.) in a range 0–5000 umi on a steel, nickel coverings in a range 0–100 um.

- Technical characteristics:
- error of measurements – $\pm 1,5 \text{ um} \pm 2\%$.
 - overall dimensions, mm – 160 x 83 x 33.
 - weight of the device, kg – 0,2.
 - range of working temperatures, °C – 5–40.

UNIVERSAL MAGNETIC THICKNESS GAUGE UMT-1



Intended for simultaneous measurement of thickness of nonmagnetic covering (corrosion layer) in a range of 0–1000 microns on steel and thickness of a basis from steel in the range 0–5000um.

- Technical characteristics:
- Resolution at measurement of thickness of nonmagnetic coverings, um – 10.
 - Sizes of the electronic block, mm – 200 x 100 x 40.
 - Diameter of the converter, mm – 45.
 - Weight of the electronic block, kg – 0,4.
 - Weight of the device, kg – 1,0

AUTOMATED MONITORING SYSTEM OF VIBROSTATE OF ELECTROMECHANICAL SYSTEMS



It is intended for carrying out vibro-monitoring the industrial equipment with application of portable portable indicators vibro-parameters.

The system consists of the indicator vibro-parameters with the corresponding software. Algorithmic processing of a signal allows to calculate average square-law value vibro-speed, vibro-displacement and to carry out the spectral analysis vibrostate of the object.

INSTALLATION FOR MEASUREMENT OF CHANGES OF MAGNET FERROMAGNETIC CHARACTERISTICS IN QUASI-STEADY MODE



It records the main magnetization curve and hysteresis loops on ultimate and private cycles of magnetization, measurement of parameters of hysteresis loop (coercive force, residual induction etc.).

- Specifications:
- Range of measurement of magnetization field, kA/m – -40 – +40;
 - Measuring inaccuracy of magnetization field, % – 2;
 - Frequency of magnetization, Hz – 0,05–0,5;
 - Range of magnet induction measurement, T – -2,5–+2,5;
 - Measuring inaccuracy of magnet induction, % – 2.

CONCRETE STRENGTH GAUGE CSG-M



- Specifications:
 - range of strength measurement, MPA – 10–100;
 - time of measurement, s – 5;
 - measuring inaccuracy – (not more), % – 10;
 - mass, kg:
 - electronic processing block – 0,7;
 - shock transducer – 1,3.

PROGRAMME-APPARATUS COMPLEX FOR EVALUATION OF SENSITIVITY OF SETS OF DEFECTOSCOPIC MATERIALS FOR CAPILLARY CONTROL



- Evaluation is executed by automatic registration, measurement and analysis of optical and geometric characteristics of indicator defects images, revealed on controlled surface of samples with the use of directed set of defectoscopic materials.

DIAGNOSTIC COMPLEX PMEM FOR PARAMETERS MEASUREMENT OF ELECTRONIC MACHINES



- Made for programme-realizable tests of electric machines of direct current in automated mode.
- Specifications:
 - Ranges of measurement of basic of controlled parameters:
 - direct-current voltage, V – 10–150;
 - direct current, A – 100–2000;
 - temperatures, °C – 0–250;
 - vibration speed, mm/s – 0–30;
 - rotation speed, turns/minute – 240–4000.

DEVICE WD-1 FOR DIAGNOSTICS OF WINDINGS OF ELECTRONIC EQUIPMENT



- Helps to execute diagnostics of windings of electronic machines (one- and three phase electro-engines, generators etc.) on occurrence of inter-coil short circuits, short circuits on case, breaks.
- Specifications:
 - Durability of one test (not more), s: 10;
 - Sensitivity to one short-coiled coil is provided.
 - The results are reflected on display, connection with computer.

DEVICE SST FOR PARAMETERS MEASUREMENT OF FORCE TRANSFORMER AND ELECTRIC NETWORKS



- Made for diagnostics of force transformers in the mode of idle running and monitoring of electric networks parameters.
- Specifications:
 - Ranges of basic parameter measurement:
 - Voltages on three channels, V – 10–250;
 - Currents on three channels, V – 0,015–5;
 - Relative measuring inaccuracy:
 - Voltage (not more), % – 0,2;
 - Current (not more), % – 0,2;
 - Power (not more), % – 0,5.

MAGNETIC THICKNESS GAUGE MTC-3



Made for thickness depths measurements of nonmagnet coverings (chromium, copper, dye etc) in the range 0–5000 μm on steel, nickel coverings in the range 0–100 μm .

Specifications:

Measuring inaccuracy – $\pm 1,5 \mu\text{m} \pm 2\%$;
 Overall dimensions, mm – 160 x 83 x 33;
 Mass of the device, kg – 0,2;
 Operating-temperature range, °C – +5–+40.

RESIDUAL INDUCTION GAUGE RIG-5



Made for measurement of three components and module of constant and variable magnet fields with three orthogonal Hall elements, located within one sensor. It is used for control of magnetization of parts and magnet fields of sources (solenoids, electromagnets etc.).

Specifications:

- measurement range, mT – 0,1–2000;
 - measuring inaccuracy – $\pm 1,5 \text{ mT} \pm 3\%$;
 - operating-temperature range, °C – -10–+40;
 - overall dimensions, mm – electro-block: 180 x 100 x 45; transducer – 25x210;
 Mass of the device, kg – 0,6.

PROGRAMME-APPARATUS COMPLEX OF DRAWING OF PETROLEUM PRODUCTS IN PETROLEUM STATIONS AND SYSTEM OF CALCULATION OF POL



Complex structure:

1. Microprocessor POL control block;
2. Simistron pump control cells of transport-distributing petrol stations;
3. Electronic energy independent card of wearable memory;
4. PC with software of POL control support (it is reconstructed in accounts department);
5. Data reader from cards of wearable memory.

INSTALLATION FOR TESTS OF POLYMER MATERIALS AND ARTICLES



It is made for non-destructive entrance and exit control rubber-technical and plastic articles, comparative properties analysis, evaluation of degradation degree of material during its exploitation. Measurable rubber parameters: Shore hardness number A and in International units IRHD, elasticity, tenacity, dynamic module of resilience etc. Measurable plastic parameters: firmness, resilience module, yield point.

Specifications:

- time of measurement, s – 5;
 - measuring inaccuracy: (not more), % – 7;
 - mass of measuring block with transducer, kg – 0,6.

GAUGE FOR ESTIMATION OF MECHANICAL CHARACTERISTICS OF METAL ARTICLES



Specifications:

Measurement range of firmness: units HRS: 20–68, units HB 90–450; of ultimate strength, Mpa – 380–1520 .
 Mass of processing block, kg – 0,85;
 Mass of shock transduction, kg – 0,2.

INSTALLATION IM-MUM FOR CONTROL OF MAGNET PROPERTIES OF ELECTROTECHNICAL STEELS


It is intended for magnet losses and magnet induction measurements, loops of dynamic magnet hysteresis and its basic parameters, basic curve of magnetization and other magnet characteristics.

Specifications:

- magnetization frequency, Hz – 50;
- measurement range:
- specific magnet losses, W/kg – 0,3–10;
- amplitude of magnet induction, T – 0,5–1,9;
- amplitude of magnet field intensity, kA/m 0,1–2,5.

DEVICE FOR CONTACTLESS MEASUREMENT OF SMALL CURRENTS DSCC


It is intended for small currents measurement, including leakage currents in high-voltage equipment. Can be used for operational evaluation of the isolation state of mentioned equipment in conditions of its exploitation.

Specifications:

- frequency of measured current, Hz – 50;
- range of acting meanings of measured current, μA – 20–2000;
- feeding of device is autonomous, from accumulator of Aatype – 6V;
- power consumption (not more), W – 2;
- overall dimensions, mm:
- electronic block – 235 x 130 x 60,
- primary transducer – 200 x 65 x 50.
- mass, kg – electronic block – 0,8;
- primary transducer – 0,4.

PORTABLE INDICATOR OF MAGNET NOISE IMN-1


It is made for reveal of structural heterogeneities, evaluation of stressedly-deformed state, reveal of zones of ultimate voltages of surface layers of details and elements of constructions from metals and alloys.

Specifications:

- magnetization frequency, Hz – 64,128;
- amplitude of magnetization current, mA – 20–200;
- overall dimensions, mm – 200 x 200 x 65;
- mass of device, kg – 1,4.

ANALYZER IMPULSE MAGNET MULTIPARAMETER IMA-M


It is made for non-destructive control of firmness of steel articles after volume hardening, low, medium and high drawing in preliminary fixed correlation dependences.

Specifications:

- range of gradient field measurement, kA/m^2 – 1–250;
- relative measuring inaccuracy, % – 5;
- time of one measurement, s – 30;
- overall dimensions, mm:
- electronic block – 480 x 360 x 170,
- transducer – 56 x 56 x 165;
- mass, kg – electronic block – 16,
- transducer – 0,6.

INDICATOR II-11M OF IRON CASTINGS STRUCTURE



- ▶ It is made for operational estimation of iron structure (high-test cast or grey iron) directly in castings.
- Distinctive features:
- Results of indicator survey do not depend on casting form.
- Preparation process before control requires only shot-jetting refining from calx.
- It is possible to examine castings directly after grounding applying.

INSTALLATION FOR NON-DESTRUCTIVE QUALITY CONTROL OF COUPLING OF RESISTANT INSERTS IN DIESEL ENGINES PISTONS



- ▶ It provides with 100% control of pistons manufacturing.
- Distinctive features:
- Control productivity in inspection mode is not less than 200 pieces per hour.
- The real extent of all defect types is reflected on digital indicator.

RADAR FOR VISUALIZATION OF INNER STRUCTURE OF BUILDING CONSTRUCTIONS



- ▶ It helps to visualize inner structure of material, reveal defects, metallic and other inserts in concrete and other building materials, to estimate the depth of its location and its sizes.
- Specifications:
- The depth of heterogeneous survey, mm – up to 300;
- Range of working frequencies, Ghz – 1,9–6,0;
- Mass of device, kg – 2;
- Scanning speed, m²/h – 15;
- Feeding voltage, V – 12.

PORTABLE DIGITAL MICRO-WAVE THICKNESS GAUGE



- ▶ It is made for thickness measurement of dielectric (varnish-and-paint, polymer, oxide etc.) coverings, applied on metallic base.
- Specifications:
- Range of measurable thickness coverings, um – 3–300;
- Measuring inaccuracy, % – 3;
- Overall dimensions, mm – indication block – 145 x 80 x 38, sensor – 53 x 90;
- Mass of device, kg – 0,4;
- Range of working temperatures, °C – 0–+40.

VORTICAL DEFECTOSCOPE



- ▶ The device is intended for reveal of defects like cracks, located on the surfaces of ferromagnetic articles. It helps to discover defects under low frequency class of controlled surface, and also under isolation covering (paint, putty etc.) with thickness up to 1 mm.
- Specifications:
- Minimal sizes of revealed defects under surface frequency Rz not more than 5: width – 0,01, depth – 0,1, length – 5 mm.
- The feeding is from accumulator, time of work without charge is not less than 10 hours.
- Overall dimensions of electronic block, mm: 45 x 80 x 125.
- Mass, kg – 0,2.

4.4. INSTITUTE OF TECHNICAL ACOUSTICS

COMPLEX FOR COMMERCIAL AND TECHNICAL CALCULATION OF MASOUT "KIMM"



It is made for gathering and processing (in automated mode) of information about storing, consumed and released petroleum products.

Advantages:

Automated commercial calculation
Operational control of mode work of equipment in reserve parks.

4.5. INSTITUTE OF MECHANICS OF METAL POLYMER SYSTEMS OF V.A. BELIY

UNIVERSAL TRIBO-METER MTU-2K7



The device is intended for carrying out tribotechnical tests of thin (from 2 nm and more) films at small loadings (from 10 mN to 1N). Allows to carry measurement of force of friction, factor of friction and to estimate wear resistance of probationer materials. Distinctive feature of the device is realization of a drive of reciprocating moving by means of electromagnetic linear mover, providing smooth moving of the sample in a range of speeds 0,1–10 mm/s. Loading is carried out by a radial-sector electromagnet through lever system.

OPTICAL AND MAGNET DETECTOR



It is intended for tribodiagnostics of friction couples wear-out and evaluation of the state of lubricant oil on the base of analysis of concentration of wear-out parts and general pollution of oil. It can be built – in lubricant system of the control to be used for control of oil tests. It has two versions: stationary (OMD) and portable (OMD-P).

Specifications:

- Sensitivity, mass, %: OMD – 0,001–0,04, OMD-P – 0,00050,02,
- Size of registered particles: OMD – lum – 100 um, OMD-P–5um–1000um.

It is recommended for diagnostics of compressors, turbines, transmissions, internal-combustion engines etc.

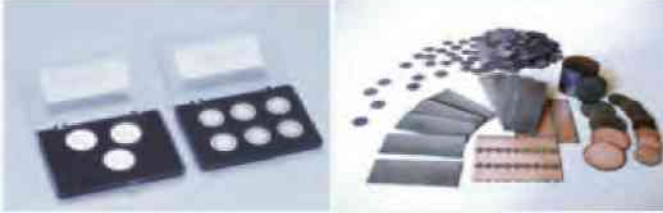
DEVICE FLUOR-2 FOR OPERATIONAL DIAGNOSTICS OF OIL QUALITY



The device helps to define the level of oil oxidation, to measure moisture content as relatively saturation in the range 0–100%, to measure oil temperature in the range -40–+125 °C. Measurement and processing of the results are executed with the help of micro-controller. Probationer parameters are reflected on display. The device provides connection outer PC or company's automotive control system through standard consequent interface RS232 or Rs485.

5.1. INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

PIEZOELECTRIC IRRADIATORS FOR AEROSOL FLUID DISPERSION



It is made for the use in ultra-sound apparatus for aerosol obtaining.

Frequency – 2,64 MHz, diameter – from 12,0 to 40,0 mm. Plain and focusing.

APPARATUS OF MAGNET INDUCTION THERAPY "CETA-D"



Device of impulse high-intensity induction therapy "CETA-D", working as in low-frequency (to 10 Hz), and a mid-frequency range (to 250 Hz), is intended for treatment of diseases of the central and peripheral nervous systems, any degenerate processes, inflammatory diseases by local contactless influence with pulse magnetic field on various areas of a body of the patient. The device is supplied by two radiators in diameter 40 mm for influence on facial area and diameter 100 mm for treatment of diseases of the locomotor apparatus of person.

5.2. PHYSICAL AND TECHNICAL INSTITUTE

MANUFACTURING TECHNIQUES OF EXACT FORGING OF ORTHOPEDIC IMPLANTS DETAILS



Appointment:
Creation of artificial substitute of a coxofemoral joint for the purpose of maintenance of the locomotor functions lost due to damages or chronic osteo-diseases.

Technical characteristics:

Firmness of stamping tool is 1000-1200 details, conformity of mechanical and functional properties to requirements ISO F206.

Advantages:

High reliability and the raised service of implants life. Economy of expensive titanic or cobalt-chrome-molybdenum alloys to 60 %.

Field of application:

Surgical orthopedy.

CARBON DIAMOND-LIKE COVERING ON THE PARTS OF MEDICAL TECHNIQUE



Filed of application:
Enterprises of medical technique manufacturing.

Boi-compatible diamond-like carbon coverings, obtained by method of impulse cathode-arch deposition from carbon plasma in vacuum. The coverings prevent from pathological hemolysis.

Covering thickness, μm – 3,0;

Microhardness, Gpa – 70;

Unevenness of films in thickness, % – 3;

Size of microinhomogeneity, not more than, μm – 0,05.

ELECTRONIC AND MECHANICAL COMPLEX FOR FEET PATHOLOGY DIAGNOSTICS

Complex is intended for diagnostics and control of locomotor system deceases, evaluation of effectiveness and choose of tactics of conservative and operational treatment of locomotor apparatus disorders, choose and individual adjustment of orthopedic insoles at spinal deformation, diabetes, rheumatic and other deceases of lower extremities joints, correction of bearing and walking stereotype, functional evaluation of orthopedic correction.

Specifications and economic indicators: Complex is made from tens transducers system and system of transformation and primary information processing. It realizes effective registration and computer analysis of pressure distribution on insole parts of person's feet, both in statics and dynamics (during walking, running and carrying other exercises). Insoles size: mm - 220, 270, 280; amount of tens transducers in tens transducers system, psc. - 30, 40, 48; maximum inquiry frequency, Hz, not less than 250; Period of inquiry and information exchange - according to inquiry; amount of examined sensors, psc. - 48; interface—according to customer's order.

5.3. INSTITUTE OF CHEMISTRY OF NEW MATERIALS**«ФУНГИЦИД-П» (WATER-SOLUBLE BIOCID)**

«ФУНГИЦИД-П»- water-soluble biocide of wide activity range.

Specifications and advantages: Medicine—as antiseptic and disinfection source. Veterinary medicine – for cattle-breeding rooms processing and keeping of cattle and bird.

Agriculture – for planting material vegetation plants protection from virus and fungous deceases, soil disinfection, contaminated with decease-producing germs.

Industry – for asepsis of paper, rubber, textile, plastic materials, mineral and carbon adsorbents, protection from bio-fouling of pipe-lines, prevention from bio-damage of technological fluids, paints, surfaces which contact with water, bio-protection of wood, paper articles etc.

5.4. INSTITUTE OF TECHNICAL ACOUSTICS**ULTRASOUND SEALER OF MAIN LINES OF BLOOD TRANSFUSION SYSTEMS**

It is intended for molding of main lines of blood transfusion systems.

Advantages:

Simplicity of mode installment at changes of molding material;

Work in impulse continuous modes;

Fluent launch power regulation;

Automated resonance adjustment;

Specifications:

Stable work in temperature range from 0 to 40 °C;

Consumed power – less than 120 W;

Generator frequency –50 kHz.

METALLIC JOINT-PINS WITH BIO-COMPATIBLE COVERINGS FROM Ti, TiN, CARBONATE-HYDROXYLOAPATINE (CHA)

It is intended for intro-medullary osteo-synthesis. Clinical researches are carried on the base of clinics of chair of general, special and operational surgery of the «VitebskState Veterinary Medicine Academy».

5.5. INSTITUTE OF MECHANICS OF METAL POLYMER SYSTEMS OF V.A. BELIY

MATERIALS AND ELEMENTS OF JOINT ENDOPROTHESIS



The head for one-pole endoprosthesis of hip joint is manufactured from super-high-molecular polyethylene with micro-porous surface layer.

▶ Thickness of the modified layer is not more than 1000 μm , intensity of wearing-out at $P=0,5$ MPa, $V=0,25$ m/s is not more than 10^{-8} the porous size - 5-30 μm . Cup loose leaf of total endoprosthesis. Equipped on the friction surface with electret micro-porous layer, which imitates the gristle. Technology of applying of bio-compatible electret covering on the legs surface of endoprosthesis from titanium alloy. Provides with electro-stimulation of damaged bone tissues.

ARTIFICIAL MITRAL VALVE



▶ Cardio implant of disk construction for surgeon treatment of heart deceases. It is the modification of (patent RF 2279865) of serial native mitral valve prosthesis Planix. It has antifriction element from bio-compatible fluorine polymer, which supports self-installment in optimal position, improves hemodynamics, reduces erythrocytolysis and thrombus formation.

6 MATERIALS AND TECHNOLOGIES FOR JEWELRY

6.1. INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

SYNTHETIC MONO-CRYSTALS (RUBIES, EMERALDS)



▶ Field of application:
Mono-crystals are used as inserts for jewel ware.
Technical and economic indicators:
Thickness, g/cm^3 - 2,68-2,72;
Mohs hardness - 7,5-8,0;
Refractory index - 1,55-1,60.

6.2. INSTITUTE OF MECHANICS OF METAL POLYMER SYSTEMS OF V.A. BELIY

INSTALLMENTS OF «GRIF» SERIES



▶ Installments Grif-Brilliant, Grif-Diamond, Grif-Gold are made for precious metals processing and for its processing in boiling acids sulphuric, hydrochloric, nitric and its mixtures. It also can be used in the technology of synthetic diamonds obtaining. Installments provide more than twentyfold reduce of acid wastes in atmosphere, increase productivity and labour safety.

7.1. PHYSICAL AND TECHNICAL INSTITUTE

TECHNOLOGICAL PROCESS OF ELECTRO-THERMAL HARDENING OF TITANIUM ELEMENTS OF FLAK JACKETS OF III-V PROTECTION LEVEL



Appointment:
Increase of protection characteristics and weight reduce of titanium elements of flak jackets.

Specifications:
Protective titanium elements - surface hardened plates with the thickness of 7-10 mm.

Advantages:
Titanium armour element provides with the increase of ballistic protection level or weight reduction for 10-15%.

Field of application:
Titanium elements of flak jackets of III-V protection level.

MULTI-LAYER ARMOUR PANEL OF ANTI-SPLINTER AND ANTI-BULLET PROTECTION OF SPECIAL PURPOSE CARS

Appointment:
Armoring of transport means of special purpose, support of anti-bullet and anti-splinter protection.

Specifications:
Multi-layer armour panel consists of internal and external trimming, filler and steel or tissue elements of armor-protection.

Appointment:
Armour panel provides with I-II anti-bullet and III-IV level of anti-splinter protection.

Advantages:
Weight reduction, increase of heat - and sound insulation.

Field of application:
Transport means of special purpose.

8.1 INSTITUTE OF SOLID STATE AND SEMICONDUCTOR PHYSICS

MANUAL AND AUTOMATIC SHUTTERS OF DIFFERENT TYPES, LENGTH AND DIAMETERS



Appointment:
Shutters are designed and suitable for installation in sewage gravity flow network domes, and also in inlet chambers of sewage pump stations as shut-off hermetically-sealed or regulator device.

Shutter opening and closing are realized manually or by means of electric actuation.

Shutters are manufactured from corrosion-resistant stainless steel.

SQUEEZING HELICALLY-FORMED EQUIPMENT, CONVEYER SPIRAL



Appointment:
Squeezing equipment is designed for consolidation and transportation of waste, taken off from bar screens and other debris catchers. Conveyor spirals are only for waste transportation.

The eventual conveyor belt angle varies from 0 to 35°.

Different options of screw production (shaft and shaftless) are possible. It automatically turns on after the bar screen actuation with the tuned working time interval.

Various schemes and algorithms for process automation are possible.

SLUDGE SCRAPERACTUATING UNITS



▶ Actuating units are designed and suitable for rotation of a sludge scraper construction with predetermined rate, providing control of actuating mechanism operation conditions

**COMPLEX PROCESSAUTOMATION APPLICABLETO WATER TREATMENT
AUTOMATION OF SEWAGE DISPOSAL WORKS (SDW), SEWAGE PUMPING STATION, SLUDGE AND
SUCTION SCRAPERS, DEGRITTERS, BAR SCREEN BRANCHES, AEROTANKS AND ETC.**



▶ SCADA, the system which controls apportioning devices, is applied as the upper level control of the technical process.

As communication channels RS-485, Ethernet, Wi-Fi, GPRS are used.

- Software design of the upper and lower levels.

- Design and production of control and electric cabinets.

During the development of the automation projects the following modern components are used:

- programmable logic controllers,
- variable-frequency electric drives,
- electronic flowmeters,
- pressure sensors,
- ultrasonic level transmitters,
- pneumatic and electrical regulating shut-off equipment,
- automated sluice gates of home manufacturing.

Process automation provides the following advantages:

- it reduces costs owing to a significant reduction of staff, energy savings, increase of the overhaul period of the operate equipment;
- execution speed of recurring duty is increasing. Due to the automatic mode the same tasks can be performed faster, as automated systems are more accurate in operation and are not exposed to performance degradation because of the working time.

The quality of work is improving. The exception of human factor significantly reduces the process fulfillment variations, so that it leads to error quantity reduction and, thereafter, it increases stability and process quality.

STEPPED BAR SCREENS (POWER-OPERATED)

▶ A bar screen is designed and suitable for deprivation of average and small (industrial and utility) waste from sewage.

Bar screen standard sizes are selected according to the required transfer capability, waste water composition, channel dimensions, in which the installation is supposed to be carried out.

Base material is stainless steel.

Bar screens turn on automatically with the tuned working time interval.

MECHANICAL HOOKEDBAR SCREENS

▶ A bar screen is designed for good purification by means of medium and small debris removal from the wastewater followed by their power unloading on the transporter equipment or on the waste container. Manufacturing of bar screens of different standard sizes is possible.

A rake bar screen is a rectangular bent, between the side surfaces of which rectangular cross-section (or any other) stems are arranged and form a screen catching the refuse.

A hooked bar screen is a running filter bed formed by replaceable hook assortment comprising of engineering plastic or metal placed on the frame.

SLUDGE AND SUCTION SCRAPERS

▶ Sludge scrapers are used in primary radial-flow settling tanks for sludge removal (from the bed).

The construction is equipped with floating matter extractor.

Suction scrapers are used in secondary radial-flow settling tanks for biological solids removal or from the bed of the tank.

This equipment is produced for the tanks of different diameters.



WATER TREATMENT PLANTS WITH SIMULTANEOUS IRON AND MANGANESE REMOVAL WATER DEIRONING FILTER "GEOFIL-FN ODM" (PRESSURE SINGLE-CHAMBERED FILTER)



Water deferrization station of design capacity, which is equal up to 80 000 m³/day. Water filtration is carried out under modern technology of simultaneous iron and manganese removal.

Stations are equipped both with single filters and filtration units, consisting of different number of service capacitances connected together by collecting-distribution console into the unit. Diameters of service capacitances are taken in depending on the filtration area and speed.

As resign charge are accepted:

- high-silica sand;
- natural material on the ground of manganese dioxide;
- hydroanthracite.

For charge regeneration water washing during 10–15 minutes in three stages is used:

- back flushing with addition of hypochlorite of sodium for charge disinfection;
- stabilization period;
- forward flushing.

Filters are fitted with automated shut-off and control valves. The control system with the use of electric and pneumatic systems.

The main water treatment technology is iron removal along with preaeration of the source water.

To ensure that easy aerator and oil-free compressor with automatic regulation of delivery air are used.

8.1. INSTITUTE OF MECHANICS OF METAL POLYMER SYSTEMS OF V.A. BELIY

MODIFYING ADDITIONS FOR ROAD CONCRETE MIXES



It is intended for longevity increase of auto-road coverings at the expense of strengthening of adhesion interaction in the system "bitumen-mineral filler". Provides with increase of braking point at compression of residual deformation module in 1,2–1,5 times, frost-resistant factor in 1,1–1,3 times, reduce of water-saturation in 1,2–1,3 times, improvement of rheological and physical and chemical properties of astringent.

POLYMER POWDER COVERINGS



Covering type	Fields of application
Protective and decorative	Cases, panels of home appliances and devices, details and household purpose products (accessories for furniture, door handles, overlays, etc.).
Corrosion-resistant	Internal and external surfaces of capacities and industrial equipment, working in chemically excited environments.
Anti-adherent	Surfaces of forms, the welded plates contacting with melts of polymers and foodstuff.
Anti-friction	Working surfaces of friction knots at temperatures up to 140 °C (splined shaft, cylinders, gauges of the expense of gasoline, the case of sliders).

HYDRO-INSULATING ROLL MATERIAL

It is intended for a waterproof of inter-floor overlappings, water closets, bathrooms, building constructions of water-sport and underground constructions. Possesses high adhesion to substrates (concrete, ferroconcrete, brick, metal, bitumen) and high protective properties.

It is developed together with IGIC of NAS of Belarus.