ADVANCED R&D AND TECHNOLOGIES

SPECIAL ISSUES

ENVIRONMENT AND NATURE PROTECTION
FOOD INDUSTRY
FUEL, LUBRICANTS, AND TECHNOLOGIES
INDUSTRIAL AGRICULTURE AND LANDSCAPE GARDENING
INFORMATION AND SENSOR SYSTEMS AND DEVICES
INFORMATION TECHNOLOGY
MACHINE-BUILDING AND INSTRUMENT ENGINEERING
MEDICAL PRODUCTS AND MEDICAL DEVICE ENGINEERING
POWER ENGINEERING AND ENERGY EFFICIENCY
TECHNOLOGIES AND EQUIPMENT FOR EXPLORING, ESTIMATING, AND EXTRACTING MINERAL RESOURCES

TECHNOLOGIES FOR CONSTRUCTION AND FUNCTIONAL MATERIALS
ALLOYS WITH PREASSIGNED ELECTRIC CONDUCTIVITY

Areas of Application
For manufacture of circulating coins and coins of higher denominations

Specification
Electric conductivity ranges 17÷19% IACS with an error up to ±0.4% IACS; hardness of annealed alloys (HRC <90) enables reproducing fine details of design without loss of wear resistance of coining instruments; hardness of tempered alloys (HRC 130−150) enables cutting burr-free blanks from metal strip and imparts a proper wear resistance to minted coins; manufacturable at domestic plants

Advantages
The cost is 20% lower as compared with the EU coins; a high wear resistance matching that of the best European coins ensures a 20-year circulation life; a high corrosion resistance in different media; no growth of bacteria and fungi; nontoxicity; does not change the color while stored and circulating; preassigned electric conductivity

Stage of Development. Suggestions for Commercialization
IRL3, TRL2
Token pilot batch and coinage technique

IPR Protection
IPR2

Contact Information
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ALUMINUM CAST ALLOYS WITH ENHANCED MECHANICAL PROPERTIES

Areas of Application
The alloys can be used to produce critical parts of cylinder-piston group by the casting method

Specification
Tensile strength at 330 °C, MPa 170 – 228
Yield stress at 330 °C, MPa 150 – 204
Plasticity at 330 °C, % 2.1 – 2.6

Advantages
These alloys surpass the existing aluminum piston cast alloys in the combination of high mechanical, injection, and tribotechnical properties. Within the temperature range from 20 to 400 °C their tensile strength exceeds by 7 – 55% that of the best piston group cast alloys

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+38 044 424 12 05, e-mail: bevzv@ukr.net
AUTOMATIC SYSTEM FOR CONTROL AND STABILIZATION OF BLAST SMELTING SLAG MODE

Areas of Application

Used in metallurgy, for producing iron in blast furnaces

Advantages

The system is unparalleled. It provides smelting conditioned iron (with reduced fluctuations of silicon and sulfur content in pig iron) and reducing coke consumption by 3 – 6 kg/t pig iron due to optimized proportion of charge materials

Specification

The system includes: evaluation of sulfur absorption, viscosity, temperature at the beginning and at the end of crystallization, specific heat at fluidity temperature, surface tension both retrospective and for specific cast; evaluation of the crystallization ability and calculation of the slag standard mineralogical composition; control of the furnace thermal state based on the blowing mode parameters (theoretical combustion temperature, slag enthalpy, content of silicon and carbon in pig iron); selection of charging materials proceeding from predicted composition and properties of pig iron and slag based on charge properties and blowing mode parameters. Implementation period: 3 – 6 months

Stage of Development. Suggestions for Commercialization

IRL8, TRL8
Installation, warranty service, and staff training

IPR Protection

IPR3

Contact Information

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BARELY FLAMMABLE BASALT FIBER CONTAINERS FOR TRANSPORTATION AND LONG-TERM STORAGE

Areas of Application

These containers can be used for storing cables, devices and control systems for fire-hazardous and explosive manufactures; munitions, explosive substances, and accoutrements

Specification

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service life, years</td>
<td>≥50 years</td>
</tr>
<tr>
<td>Combustibility (GOST 28157), category</td>
<td>ПВ-1</td>
</tr>
<tr>
<td>Biostability</td>
<td>Stable</td>
</tr>
<tr>
<td>Dust- and water protection</td>
<td>Stable</td>
</tr>
<tr>
<td>Cargo-handling loads</td>
<td>Stable</td>
</tr>
<tr>
<td>Air landing</td>
<td>Stable</td>
</tr>
<tr>
<td>Dropping from height 1.5 and 3.0 m:</td>
<td>Stable</td>
</tr>
<tr>
<td>Stockpiling</td>
<td>Stable</td>
</tr>
<tr>
<td>Corrosion-resistant</td>
<td></td>
</tr>
<tr>
<td>coating of fittings</td>
<td>available</td>
</tr>
</tbody>
</table>

Advantages

The proposed containers surpass the world analogs in physical, mechanical, and operational properties; have a relocatable load-carrying structure made of basalt fiber composite materials with thermal insulating layer. There are unlimited sources of raw material for the reinforcing components

IPR Protection

IPR2

Stage of Development. Suggestions for Commercialization

IRL3, TRL4
Manufacture of small batches.
Seeking partners for industrial production

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+38 044 424 04 27, +38 095 244 36 38, e-mail: fsergej688@gmail.com
BASALT CONTINUOUS FIBERS, TEXTILES, AND COMPOSITES

Samples of continuous basalt fibers and textile on their base

Roving structure of basalt complex fiber

Specification

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber diameter, μm</td>
<td>9 ± 1</td>
</tr>
<tr>
<td>Density, kg/m³</td>
<td>2750</td>
</tr>
<tr>
<td>Tensile strength, MPa</td>
<td>2000–3500</td>
</tr>
<tr>
<td>Modulus of elasticity, GPa</td>
<td>80–110</td>
</tr>
<tr>
<td>Operating temperature, °C</td>
<td>700–900</td>
</tr>
</tbody>
</table>

Areas of Application

Basalt continuous fibers and textiles can be used as technical textiles for filters and water proofing membranes; as reinforcing material for composites (in boats, automobiles, aircrafts, cisterns, etc.); as reinforcing material for construction composites (reinforcement, roof materials, tubes, geogrids for roads, electrical insulations, etc.); and as reinforcement for fibrous concrete.

Advantages

Basalt fibers surpass the mineral, glass, carbon, and synthetic analogs in thermal and mechanical properties.

Stage of Development. Suggestions for Commercialization

IRL3, TRL4
Manufacture of small batches.
Seeking partners for industrial production

IPR Protection

IPR2

Contact Information

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+38 044 424 04 27, +38 095 244 36 38, e-mail: fsergej688@gmail.com
CARBON-CARBON COMPOSITE MATERIALS (CCCM) FOR INDUSTRY

Areas of Application
Mechanical engineering, chemical industry, metallurgy, automobile and aircraft industries

Specification
Density, g/cm³: 1.4 – 1.8
Ultimate strength at 20 °C, MPa:
- compression strength: 150 – 400
- bending strength: 100 – 160
- tensile strength: 50 – 120
Heat conductivity, W/m · deg⁻¹:
- at 20 °C: 5 – 7
- at 500 °C: 7 – 11
- at 1000 °C: 10 – 15

CLTE α = 10⁻⁶ · deg⁻¹:
- 20 – 1000 °C: 3 – 4
- 20 – 1500 °C: 3.5 – 4.5

Advantages
The technology and equipment for production of carbon-carbon compound materials are unique for Ukraine; high mechanical strength; resistance to mechanical and thermal shocks; chemical and radiation resistance; long service life; low weight of product

Stage of Development. Suggestions for Commercialization
IRL8, TRL8
Customized manufacture, manufacture of unit orders

IPR Protection
IPR1

Contact Information
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+38 067 712 16 74, +38 057 349 10 61, e-mail: Igor@kipt.kharkov.ua
CERAMIC BIOMATERIALS

Areas of Application
The developed ceramic biomaterials can be used in orthopedics, traumatic surgery, oncology, ophthalmology, and dentistry to repair bone tissue in various clinical situations; the bioactive ceramic powders are suitable for micro-plasma deposition of coatings with antibacterial properties on metallic implants.

Specification
The bioactive ceramics are analogous to the mineral component of bone tissue and have an exceptional biocompatibility; approved for the clinical use in medical institutions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granule size, μm</td>
<td>80–800</td>
</tr>
<tr>
<td>Size of powder particles for deposition, μm</td>
<td>20–80</td>
</tr>
<tr>
<td>Specific surface, m²/g</td>
<td>2–200</td>
</tr>
<tr>
<td>Compressive strength, MPa</td>
<td>20–200</td>
</tr>
</tbody>
</table>

Advantages
Easy-to-use and highly biocompatible with bone tissue

Stage of Development. Suggestions for Commercialization
IRL3, TRL5
Manufacture of small batches.
Seeking partners for industrial production

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IPR Protection
IPR2
COBALT-BASED POWDER ALLOY
WITH HIGH WEAR RESISTANCE

Areas of Application
The alloy can be used to reinforce shroud platforms of aircraft turbine engines by coating their edges with wear-resistant powder material.

Specification
Production technology: powder metallurgy methods.
- Melting temperature, °C ≥1300
- High heat resistance, °C <1100
- High uniform wear resistance within the temperature range, °C 20—1100

Advantages
Wear resistance of cobalt powder alloy within the temperature range from 20 to 1050 °C exceeds 10 times that of serial cast alloys XTH-61 and XTH-62.

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Vending of patent based on license agreement.

IPR Protection
IPR3

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COMPOSITE NANOSTRUCTURED MATERIALS

Areas of Application

The hydroxyapatite and biopolymer composite materials are to substitute for the hard tissues (bones, joints). The films and gels are used for treatment of burns and external injuries as hemostatic materials. The chitosan-based granules, beads, and gels are used to transport biologically active substances, proteins, DNA, drugs, and to normalize internal microflora.

Specification

The materials are manufactured in dense and porous forms. The biomaterials have a good biocompatibility and bioinertness; the porous forms have good osteoconductive properties (the ability to stimulate the growth of bone tissue). Composite materials as substitute for hard tissues: polymer matrix: chitosan; mineral component: hydroxyapatite; mineral component to biopolymer matrix, wt. %: 50:50; size of mineral component crystallite: ~20 nm; porosity: 0—50%

Advantages

There are no complete analogs in the domestic market. The foreign analogs, in particular, the chitosan-based hemostatic materials, are much more expensive than those manufactured in Ukraine.

Stage of Development. Suggestions for Commercialization

IRL2, TRL4
License for materials manufacture; support in production organization and maintenance

IPR Protection

IPR1

Contact Information

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CONTACTLESS THERMOMETRY SYSTEM

Areas of Application
Continuous contactless control of melt metal temperature in stream while tapping or pouring from metallurgical furnaces. Can be used for continuous temperature control of slab under mold, metal sheets, strips, and wires, as well as in chemical, refractory, glass, and other industries.

Specification
- Range of measurable temperatures, °C: 200 – 2500
- Primary measurement error, %: ≤1.0

Advantages
The applied multicolor algorithms of primary pyrometric information processing and the new measurement methods provide much higher metrological characteristics and widen the application scope of continuous temperature control under difficult conditions at metallurgical and other plants.
COST-EFFECTIVE POWDER TECHNOLOGY FOR MANUFACTURING TITANIUM ALLOYS AND PRODUCTS WITH DESIRED PROPERTIES

Areas of Application
The technology can be used for manufacturing titanium alloy parts operating under noncritical loads for automotive, chemical, defense, medical, and aerospace industries.

Specification
The technology uses the multicomponent powder mix method in its simplest version that is pressing and unpressurized sintering. Its distinctive feature is the use of cheap hydrogenated titanium powder instead of conventional one. Hydrogen purifies the material from impurities, decreases porosity, and provides the desirable microstructure of products obtained.

Stage of Development. Suggestions for Commercialization
IRL4, TRL4
License agreement for commercial use of technology

Advantages
The technology advantage is a significant reduction in the production prime cost (2–5 times depending on the product type) and the obtaintment of required characteristics of alloys and products that meet the standards for corresponding alloys produced by casting and forging technologies.

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Areas of Application
Automotive connecting rod (Ti-6Al-4V alloy)
Lock body of aircraft hatch (Ti-6Al-4V alloy)
Watch bodies (CP-Ti)
CRYOGENIC SYSTEM FOR CYCLIC THERMAL TREATMENT OF STEELWORK

Areas of Application

The cryogenic system is designed to implement the comprehensive technology for steelwork treatment. The technology combines deep cold cyclic treatment and tempering and improves operating properties of special steels.

Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature control range, °C</td>
<td>-173…+150</td>
</tr>
<tr>
<td>Cooling rate within the range</td>
<td>1—5</td>
</tr>
<tr>
<td>from +20°C up to −173 °C, °C /min</td>
<td></td>
</tr>
<tr>
<td>Keeping at deep cold, temperature (−173 °C) h</td>
<td>24—48</td>
</tr>
<tr>
<td>Keeping at hot temperature (+150 °C) h</td>
<td>5—6</td>
</tr>
<tr>
<td>Cryogenic agent: liquid nitrogen; flask volume</td>
<td>≥15</td>
</tr>
</tbody>
</table>

Advantages

The cryogenic system with deep cold treatment of high-precision figurine-shaped steelwork (gearings, cutters, drills, bearings and others) enables relieving internal stresses, improving the microstructure and hardness uniformity, increasing the service life of steelwork 1.5—2 times, and reducing the maintenance costs; the system is software-controlled.

Stage of Development. Suggestions for Commercialization

IRL3, TRL3

Customized cryogenic system manufacture and warranty service; open to investors and business partners for serial production.

Contact Information

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DEVICE FOR DEEP PURIFICATION OF Cd, Zn, AND Te ISOTOPES

Areas of Application
The unit is designed for the deep purification of enriched isotopes $^{106}$Cd, $^{116}$Cd, $^{64}$Zn, $^{128}$Te, $^{130}$Te, and others and for the creation of low-background scintillation crystals based on them to study the properties of neutrinos and the weak interaction and to search for effects beyond the standard model of elementary particles.

Advantages
The equipment is unique in Ukraine. High efficiency of the refining process; high product yield; high purification efficiency (>hundred-fold); minimum non-recoverable losses (<1%).

Specification
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of original charge, kg</td>
<td>0.25</td>
</tr>
<tr>
<td>Product yield, % of original charge</td>
<td>96</td>
</tr>
<tr>
<td>Yield capacity, g/hour</td>
<td>50—80</td>
</tr>
<tr>
<td>Operating temperature, °C</td>
<td>350—650</td>
</tr>
<tr>
<td>Fineness, %</td>
<td>99.9—99.99...</td>
</tr>
<tr>
<td></td>
<td>&gt;99.999—99.9999</td>
</tr>
</tbody>
</table>

Stage of Development. Suggestions for Commercialization
IRL6, TRL6
Pure metals manufactured, upon request

IPR Protection
IPR3

Contact Information
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Cd-106 isotope
DEVICE FOR DEEP PURIFICATION OF Cd, Zn, AND Te

Areas of Application
The device is designed for obtaining semiconductor and scintillation crystals for ionizing radiation detectors.

Specification
- Weight of original charge, kg: 2.5
- Product yield, % of original charge: 90
- Yield capacity, g/hour: 300—400
- Power capacity, kW: ≤3
- Operating temperature, °C: 350—650
- Fineness, %: 99.9—99.99...
- >99.999—99.9999

Advantages
The equipment is unique in Ukraine. Deep purification from a wide range of impurities; high efficiency of the refining process; high product yield.

Stage of Development. Suggestions for Commercialization
IRL6, TRL6
Pure metals manufactured, upon request.

IPR Protection
IPR3

Contact Information
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DEVICE FOR DEEP PURIFICATION OF Ga, In, AND Pb

Areas of Application
The device is used to synthesize microelectronic and optoelectronic materials

Specification
- Weight of original charge, kg: 2.3
- Product yield, % of original charge: 90
- Yield capacity, g/hour: 300—400
- Operating temperature, °C: 950—1300
- Fineness, %: 99.9—99.99…
  >99.999—99.9999

Advantages
- The equipment is unique in Ukraine.
- Deep purification from a wide range of impurities;
- High efficiency of refining process;
- High product yield

Stage of Development. Suggestions for Commercialization
IRL6, TRL6
Pure metals manufactured, upon request

IPR Protection
IPR3

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+38 057 335 68 43, +38 057 349 10 49, e-mail: pugach@kipt.kharkov.ua
DEVICES FOR RAPID ANALYSIS OF ALLOY COMPOSITION AND STRUCTURE

**Adantages**

The devices have higher metrological characteristic due to the use of hot bimetallic electrodes, statistical processing of primary measurement data, and sampling technique; the use of painted metallic cups; the use of dependence of thermal conductivity (instead of ultrasound speed) on cast iron structure.

**Areas of Application**

Rapid thermoelectric, thermographic and thermodynamic analysis of C, Si, Mn content and carbon equivalent in cast irons and steels; C and Si content in cast irons and steels; Si, Fe, Mg, Ni, Cu, Mn, Zn, Ti content in aluminum alloys; graphite form in cast irons.

**Specification**

- Fundamental absolute error of content measurement, % ≤0.1
- Statistical confidence of graphite form measurement ≥0.95
- Time of analysis, min ≤2

**Stage of Development. Suggestions for Commercialization**

IRL8, TRL8
Manufacture, delivery, warranty service, and staff training, upon request

**IPR Protection**

IPR3

**Contact Information**

Anatoly V. Narivskyi, Physico-Technological Institute of Metals and Alloys of the NAS of Ukraine; +38 044 424 35 15, e-mail: metal@ptima.kiev.ua
**Areas of Application**
The materials are to be used for creating sorbents and catalysts for high-temperature and high-exothermic reactions, hydrogen adsorbents, materials for defense industry and electronics.

**Specification**
- Crystallite size, nm: \(~13–70\)
- \(S_{\text{BET}}\), m\(^2\)/g: <410
- \(V_{\text{pore}}\), cm\(^3\)/gr: <1.0
- Hydrogen adsorption at 77 K and 1 atm, wt.\%: <1.24

**Advantages**
As compared with analogs, the offering has higher structural and sorption characteristics, possesses a higher adsorption capacity towards hydrogen and the highest specific adsorption of \(\text{H}_2\) (\(\rho\) up to 15 \(\mu\text{mole/m}^2\)) among the studied porous materials based on silica and carbon.

**Stage of Development. Suggestions for Commercialization**
- IRL3, TRL3
- Batch manufacture, upon request

**IPR Protection**
- IPR3

**Contact Information**
Serhii O. Soloviev, L.V. Pisarzhevskii Institute of Physical Chemistry of the NAS of Ukraine; +38 044 525 66 70, +38 044 525 62 16, e-mail: soloviev@inphyschem-nas.kiev.ua
ELECTROCHEMICAL METHOD FOR APPLICATION OF Co-Mo AND Co-W SUPERALLOY COATINGS

Areas of Application
The cobalt superalloys with molybdenum and tungsten have many valuable properties for the advanced techniques and electronics, namely, high corrosion resistance, hardness, magnetic and catalytic properties, and wear resistance for the use in MEMS.

Specification
The dense, fine-grained, X-ray amorphous coatings containing 13÷25 at.% Mo and 20÷24 at.% W are obtained from electrolytes by electrodeposition. The coatings obtained in standard corrosion environment have a high corrosion resistance (up to 8.5 kOhm for Co-Mo and 19 kOhm for Co-W). The alloys have a higher electrocatalytic activity for hydrogen evolution reaction in alkaline media in comparison with pure cobalt. In the case of Co-Mo alloys, a decrease in hydrogen evolution overvoltage comes to ~400 mV, while in the case of Co-W, it amounts to ~360 mV. The coatings show soft-magnetic properties: they have a low coercive force and reach a magnetization saturation in low-intensity fields.

Advantages
The application of plating technology based on environment friendly citrate-pyrophosphate electrolyte enables to obtain high-quality functional coatings of Co-Mo and Co-W alloys and to control efficiently the plating process to produce the desired alloy composition and properties. These alloys can replace electrolytic chromium coatings having a lower corrosion resistance.

Stage of Development. Suggestions for Commercialization
IRL3, TRL3
The method is ready for developing customer requirement specification.

IPR Protection
IPR2

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EPOXY RESINS MODIFIERS

Areas of Application
The epoxy-urethane modifiers of epoxy resins provide durable adhesive-bond joints for products of mechanical engineering, aviation, and shipbuilding industry.

Specification
Viscous transparent colorless liquids; miscible with commercial epoxy resins; the long-term stability of modified composition (20 °C) exceeds 6 months; the shear strength (modified ED-20 resin, 20 °C, stainless steel) is 13.2 MPa; harden at low temperature.

Advantages
In comparison with the known analogs, the offered modifiers provide, at a moderate cost, the required viscosity of final adhesive composition and durable adhesive-bond joints of different materials; enable adjusting the final composition viscosity.

Stage of Development. Suggestions for Commercialization
IRL5, TRL5
Batches manufactured and supplied, upon request.

IPR Protection
IPR1

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EPOXY-PHENOLIC LACQUERS AND ENAMELS

Areas of Application
The epoxy-phenolic lacquers and enamels with bactericidal activity are to be used as protective coatings in machine-building, medical, and food industries.

Specification
Viscous transparent or nontransparent liquids; the hardened films are highly stable in chemical and biological environment (DSTU 5981-88).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardening temperature, °C</td>
<td>210 – 215</td>
</tr>
<tr>
<td>Hardening time, min</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Hardening time, min, N·m</td>
<td>&gt;5</td>
</tr>
</tbody>
</table>

Advantages
In comparison with commercial composites, these materials provide antimicrobial and anticorrosion protection of the surfaces and have improved decorative properties.

Principal applications of developed coatings

IPR Protection
IPR3

Stage of Development. Suggestions for Commercialization
IRL4, TRL4
Manufactured and supplied, upon request

Contact Information
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EROSION-RESISTANT CARBON-CARBON COMPOSITE MATERIALS (CCCM)

Areas of Application
The erosion resistant CCCM are used in rocket, space, aeronautical, and mechanical engineering for manufacturing the critical elements of solid-fueled, liquid-propellant, and electrothermal rocket engines (critical sections, chambers, heat exchangers, heaters, etc.)

Specification

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, g/cm³</td>
<td>1.3—1.85</td>
</tr>
<tr>
<td>Mechanical strength, MPa</td>
<td>100—400</td>
</tr>
<tr>
<td>Low open porosity, %</td>
<td>3—4…8—12</td>
</tr>
</tbody>
</table>

Advantages
The proprietary techniques and manufacturing technologies enable kicking the dependence on imported dual-use materials. The materials are weldable to metallic (titanium) elements, operable at a high temperature (up to and above 3000 °C) and at considerable thermal and mechanical shocks.

Stage of Development. Suggestions for Commercialization
IRL7, TRL8
Manufactured and supplied, upon request

IPR Protection
IPR1

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+38 067 712 16 74, +38 057 349 10 61, e-mail: Igor@kipt.kharkov.ua
ETU-250 INDUCTION HEATING MACHINE

Areas of Application
The induction heating machine is designed for electro-thermal treatment of components of various equipment. The scope of application covers thermal treatment of component parts and blanks, including heating while repairing industrial, power, and transport equipment.

Advantages
The machine is unique in Ukraine. As compared with the conventional electrothermal technologies, the use of ETU-250 enables to reduce electricity consumption by 20—30%; to increase the labor productivity 1.5—2 times; to significantly reduce the cost of materials for inductor production and repair; to replace the inductors of different sizes and configurations automatically keeping the electro-thermal process parameters at a given level; and to improve the production ecology.

Specification
- Supply voltage: 400 V / 50 Hz
- Maximum output power: 250 kW
- Oscillation frequency: 0.5—25 kHz
- Efficiency: <95%
- Heating rate: 30—50 °C/kg · s
- Heating temperature (max.): <900 °C

ETU-250 prototype
Heating of a cast-iron stop shoe of subway car reduction gear

Stage of Development.
Suggestions for Commercialization
IRL7, TRL8
Manufacture, delivery, warranty service, and staff training, upon request

IPR Protection
IPR1, IPR2

Contact Information
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FERROMAGNETIC NANOPARTICLES FOR HYPERTHERMIA TREATMENT

Areas of Application

The ferromagnetic nanoparticles can be used as magnetic inductors of nano-hyperthermia for controlled local heating of tumors

Specification

The ferromagnetic nanoparticles and magnetic fluids based on them show a high specific power loss (40 W/h) under the action of external AC magnetic fields in the frequency range of 100÷400 kHz

Stage of Development.
Suggestions for Commercialization

IRL5, TRL5
The offering needs financial support for preclinical tests and further manufacture

IPR Protection

IPR1, IPR3

Advantages

The introduction of magnetic liquid (dispersion of ferromagnetic nanoparticles) into tumor and the further action of external alternating magnetic field on it leads to local heating up to a temperature of 42–45 °C that stops the growth of deep-seated tumors. The advantage of this offering is the particle composition and size, which provide the removal of waste products from the body in the natural way. Detailed information on analogs manufactured by pharmaceutical companies is not disclosed

Contact Information

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FILM-FORMING MATERIALS BASED ON GERMANIUM-METAL OXIDE (SULFIDE, SELENIDE) SYSTEMS

Specimens of coatings obtained from Ge – ZnS (brown color); Ge – ZnO (orange color); refined ZnS/Cr (green-blue color) on quartz substrates

Areas of Application
The materials are designed for applying thin-film coatings on germanium optical elements of devices operating in the IR range (imaging IR-equipment, night vision devices, etc.) by the thermal evaporation method in vacuum

Specification
The materials are composites made by sintering the powders of their components. They have evaporation temperature lower than that of initial components (germanium and metal oxide, sulfide or selenide). The materials form coatings with a high refractive index (3.0—3.8), are transparent in the IR range (0.7—20 μm), have high mechanical durability (group 0), climate resilience, and thermal resistance

Advantages
The film materials have no analogs all over the world, expand the range of materials with required refractive index and corresponding range of transparency. The coatings based on them surpass the conventional products with similar properties in mechanical durability and optical transparency

Stage of Development. Suggestions for Commercialization
IRL3, TRL2
Trial samples manufactured, upon request

IPR Protection
IPR3

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FOAMED ALUMINUM ALLOYS OF WIDE USE

Areas of Application
The alloys can be used in construction as wall panels, hung ceilings, slabs for elevators, escalators, and tunnels for the purpose of electromagnetic shielding and sound absorption; in automotive industry as shock-absorbers in bumpers and supporting blocks; in machine-tool building as vibration damping shell.

Specification
The foamed aluminum alloys are manufactured as sheets, panels, rods, and granules. They can withstand high deformations (up to 60—80%) at almost constant load.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, kg/m³</td>
<td>0.4—0.8</td>
</tr>
<tr>
<td>Compression limit, MPa</td>
<td>2.3—10.6</td>
</tr>
<tr>
<td>Heat conductivity, W/(m·K)</td>
<td>3.5—8.0</td>
</tr>
<tr>
<td>Sound conductivity, dB/cm</td>
<td>1.1</td>
</tr>
<tr>
<td>Electromagnetic shielding (f= 1—1000 MHz), dB</td>
<td>78—130</td>
</tr>
</tbody>
</table>

Advantages
The foamed aluminum alloys have a unique combination of physical and mechanical properties including the ability to absorb impact energy and sound, to damp vibration, and to shield electromagnetic radiation. They are inflammable, nontoxic, and resistant to biological impacts, fuels, lubricants, cleaning detergents, solvents, ultraviolet and atomic radiation.

Stage of Development. Suggestions for Commercialization
IRL4, TRL4
Manufacture of small batches.
Seeking partners for industrial production.

IPR Protection
IPR3

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Sandwich panels
Foamed pellets
Sound absorbing panels with foamed pellets
GROWTH OF STRUCTURALLY PERFECT DIAMOND SINGLE CRYSTALS

Equipment for growing structurally perfect single crystal diamonds: 6-cylinder hydraulic press CSXII; load $6 \times 48.5$ MN, piston diameter 750 mm, weight 70 tons; dimensions $4 \times 4 \times 4.5$ m

Areas of Application
The offering is designed to grow structurally perfect diamond single crystals to be used in electronics, optics, précising processing, and in other industries

Specification
Diamond type: Ib, IIA, IIb; growing technique: seed-grown in the diamond thermodynamic stability region by the temperature gradient method; the process parameters: pressure $P = 5.8-6.5$ GPa, temperature: $T = 1400-1700$ °C; 6-cylinder synthetic diamond machine CS-VII-CS-XIII; crystal weight: 0.1-20 ct

Advantages
As compared with the existing methods, the offering has a growing capacity up to 0.5 dm$^3$ and enables obtaining diamonds up to 40 carats in one cycle; reducing significantly the production costs, and raising profitability

Stage of Development. Suggestions for Commercialization
IRL8, TRL8
The offering is ready for large-scale implementation. Design, delivery, warranty service, and staff training, upon request

IPR Protection
IPR1, IPR2, IPR3

Areas of Application

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HIGH-STRENGTH CAST ALUMINUM ALLOYS

Areas of Application
The alloys can be used for producing cast and 3D-printed parts in automotive and aviation industries.

Specification
Mechanical properties of cast alloys after thermal treatment:
- tensile strength, MPa: 500—575
- yield stress, MPa: 360—520
- plasticity, %: 3.3—1.0

Mechanical properties of rods produced by the ingot extrusion method after thermal treatment:
- tensile strength, MPa: 556
- yield stress, MPa: 460
- plasticity, %: 8.5

Advantages
Due to a unique combination of mechanical, cast, and tribotechnical properties the alloys can be used both as cast and after deformation. The wear resistance under dynamic load exceeds 2 times that of some existing wrought industrial alloys; the fluidity exceeds 1.5 times that of the best commercial aluminum-silicon alloys.

Stage of Development. Suggestions for Commercialization
IRL3, TRL3
Vending of patent based on license agreement

IPR Protection
IPR3

Contact Information
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HIGH-STRENGTH INVAR ALLOY

Areas of Application
The alloy can be used in metrology, geodesy, instrument engineering, and in laser optics (for telescopic systems and their structural components to ensure stability of their geometrical dimensions at varying temperature; electro-engineering products and measuring instruments, etc.)

Advantages
High mechanical properties: the yield stress is four times higher as compared with the conventional invar, the ultimate stress and hardness exceed the standard values by 40%; the alloy is stable under cyclic loads; at minor changes in the chemical composition, the alloy shows the anti-invar effect, i.e. abnormally high TEC within the range from 250 to 500 K, which is impossible to realize in the conventional alloys; its chemical composition enables adjusting TEC by thermomechanical treatment in the same product; the alloy shows the invar or anti-invar properties with a reduced content of expensive Ni, which is lower than the standard one (36%)

Speciﬁcation
Thermal expansion coefﬁcient (TEC) within the temperature range 100—400 K: α = (0,9–5)·10⁻⁶ K⁻¹.
Yield stress, MPa ~390
Ultimate stress, MPa 600
Micro-hardness, MPa 1475

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Vending of patent based on license agreement

Contact Information
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HYBRID FLEXIBLE FILM COMPOSITE MATERIALS
FOR ELECTROSTATIC AND ELECTROMAGNETIC PROTECTION

Areas of Application
The materials are designed for protection of environment, electronic equipment, personnel, and information storage devices from electromagnetic fields and static electricity.

Specification
The materials contain conductive polymer, carbon nanotubes, and magnetic nanoparticles, which are distributed in commercial polymer matrix; 1 mm-thick films of these composite materials show a high conductivity (~1.3 S/cm), an electromagnetic shielding efficiency up to -45 dB within the range of 10 MHz–20 GHz, and a quite low specific gravity.

Advantages
These film materials do not have analogs in Ukraine. As compared with foreign counterparts, in particular, the fabrics containing metallic threads, these materials are notable for a small content of conductive and magnetic components, a low specific gravity, percolating electrical properties, and a significant absorption of electromagnetic radiation.

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Manufacture of trial samples, tests in customer operating conditions, support in design and organization of manufacture, upon request.

Scheme of electromagnetic shielding by composite material film (photo of real film sample)

IPR Protection
IPR1, IPR3

Contact Information
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INDUCTORS FOR HEAT TREATMENT OF FLAT-ROLLED METAL PRODUCTS

Areas of Application
The offering is designed for hardening, annealing, and etching flat-rolled metal products in specialized annealing lines; can be used in ferrous and nonferrous metallurgy.

Specification
- Total power, kVA: 100 – 1000
- Power supply: 380 V/50 Hz
- Yield capacity, t/h: 2 – 10
- Power factor: 0.5 – 0.7
- Heating temperature, °C: 700
- Specific energy consumption, kW·h/t: 50 – 80
- Efficiency, %: ≥85
- Strip width, mm: 620 ± 20
- Strip thickness, mm: 0.4 – 4
- Overall dimensions, m: 1 × 1 × 0.6

Advantages
- The specific electricity consumption is 2–4 times lower as compared with the conventional heating in resistance furnaces; no need in the use of mineral fuels; reduced metal fumes and equipment dimensions.
- Heat treatment of ferrous metals is carried out at a frequency of 500 Hz.

Stage of Development. Suggestions for Commercialization
IRL7, TRL8
- Manufacture, delivery, warranty maintenance, and staff training, upon request

IPR Protection
IPR3

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LIGHT-GUIDE THERMOMETRY SYSTEM

Areas of Application
Continuous light-guide temperature control of metal melts in furnaces and melting facilities, in metallurgy; salt and ceramic melts, gaseous environments, and brickworks in other industries

Specification
Range of measurable temperature, °C  600—1800
Fundamental measurement error, %  0.5—1.0

Advantages
Provides optimal online control and regulation of temperature regimes of manufacturing processes; reduces power consumption by 20—80%, temperature defects by 40—100%, waste of charge materials by 20—40%; extends brickwork service life by 50—100%; increases yield capacity of furnaces by 40—80%; prevents failures caused by metal overheating or overcooling

Stage of Development. Suggestions for Commercialization
IRL8, TRL8
Customized manufacture, delivery, warranty service, and staff training, upon request

IPR Protection
IPR3, IPR5

Contact Information
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METHOD FOR MANUFACTURING HIGH-TEMPERATURE PROTON CONDUCTIVE MATERIALS

Areas of Application
The proton conductive materials for high-temperature fuel cells and membrane catalytic contacts used in the synthetic fuel processes: synthesis gas conversion, olefins hydration, alcohols dehydration, and alkyl aromatics hydrocracking

Specification
The materials are products of acetylene dehydropolycondensation, carbamide homopolycondensation, and polyvinylchloride dehydrochlorination. They have the properties as shown in Table below

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton conductivity, S/cm, at 450—460 °C</td>
<td>acetylene dehydro-polycondensation</td>
</tr>
<tr>
<td>Thermostability, °C</td>
<td>600</td>
</tr>
</tbody>
</table>

Advantages
The injected proton conductivity of developed materials ranges within $10^{-4} - 10^{-5}$ S/cm at a temperature of 200—460 °C

IPR Protection
IPR3

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Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Trial batch of proton conductive materials for testing at customer workspace; ready for the elaboration of business plan

Proton conductive material deposited on ceramic hollow tube (a, b) and flexible pad (c)
METHOD FOR RHEOCASTING OF ALUMINUM ALLOYS BY DIE CASTING MACHINES

Areas of Application
For manufacturing cast articles operable at a high pressure, at foundries and machine-building plants

Specification
Time for preparation of dose of aluminum alloy suspension, s: 3—5

Advantages
Both rheo- and tixocasting are possible; guaranteed obtainment of sealed castings; increase in ductility

Stage of Development. Suggestions for Commercialization
IRL4, TRL5
Manufacturing application of the method for casting semisolid melt

IPR Protection
IPR4

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MHD-EQUIPMENT AND TECHNOLOGIES FOR PRODUCTION OF HIGH-QUALITY FERROUS AND NONFERROUS ALLOYS AND CASTS

Areas of Application
The equipment and technologies are designed to prepare and to pour ferrous and nonferrous alloys into molds, die casting machines, and continuous casting molds, to cast under electromagnetic pressure, to obtain metal suspensions for aluminum alloy rheocasting technologies, and to prepare “copper-chromium cast iron” alloys with the “frozen emulsion” structure.

Advantages
The offered MHD-equipment has no direct analogs in the world. It enables intensifying the alloys preparation, reducing the energy consumption and waste of materials, removing impurities, refining the structure, improving the physical, mechanical, and operational properties of alloys, and automating the process.

Specification
The magnetodynamic mixing-and-batching devices (for aluminum alloys with a melt capacity up to 630 kg and a power capacity up to 70 kW; for cast iron and steel with a melt capacity up to 10 tons and a power capacity up to 600 kW) provide out-of-furnace treatment and controlled electromagnetic casting of liquid alloys. The based on the action of pulsed magnetic field electromagnetic stirrer with a power capacity up to 40 kW stirs the melts in furnaces, mixers, ladles, and molds. The specialized MHD-devices provide obtainment of functional alloys.

Stage of Development.
Suggestions for Commercialization
IRL7, TRL6
Customized manufacture, supply, after-sales service of equipment, technology mastering, and staff training, upon request. For the interested companies, organization of joint customized equipment manufacture and supply. Manufacture of small cast batches.

IPR Protection
IPR1, IPR2, IPR3

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Magnetodynamic mixing-and-batching devices for aluminum alloys (a) and for cast iron and steel (b)
MULTIFUNCTIONAL HARDWARE AND SOFTWARE COMPLEX FOR DIAGNOSING THE METAL SAMPLE HEATING AND COOLING PROCESSES

Areas of Application
The complex can be used in engineering and metallurgical industries, at labs and shops, specialized research institutes and universities for testing the cooling properties of different steel-tempering liquids; for development of more effective liquids in accordance with international standards; for contactless acoustic identification of cooling rate and mode in production environment.

Advantages
Identification of process conditions for obtaining fine-grained structure and optimum depth of metal surface hardening, which increases 1.5—3 times the life of products; elimination of production defects: cracks, deformation, “soft spots” on the surface; the possibility of replacing high-alloy steels by cheaper ones; reduces price of new quenching medium by 50% as compared with imported analogs; improves the environment conditions and simplifies the utilization of waste materials; the possibility of acoustic diagnostics for hardening.

Specification
PC: OS: Windows XP, 512MB RAM, processor type Intel Pentium 4 CPU 2.66 GHz.
Dimensions:
- record and control unit, mm 215 × 235 × 235
- furnace, mm 348 × 162 × 35243
Voltage, V 220 ± 22
Furnace capacity, kW 2

Stage of Development.
Suggestions for Commercialization
IRL6, TRL6
Manufactured and delivered, upon request

IPR Protection
IPR2

Contact Information
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NANOPOROUS FILTER MATERIALS

High-strength nanoporous track-etched membranes made of polycyanurate obtained on ion-electron device

Pore diameter 25-30 nm

Specification

The technology is based on bombarding polymer materials by heavy charged particles with further irradiating with picowave radiation. It differs from similar technologies by the use of ion cyclotron U-120 and 4 MeV electron accelerator. The production capacity is 800 sq. m. material monthly. The ion energy is 24 MeV or higher. The pore diameter ranges from 25 to 30 nm.

Stage of Development.
Suggestions for Commercialization

IRL3, TRL3
Nanoporous filtering materials

Areas of Application

The nanoporous filter materials based on nuclear track membranes are to be used for the ultra-filtration in advanced industrial processes in medicine (for hemodialysis), electrical engineering (for production of chemical power sources), metrology (for gas purification), food industry (as semitransparent packing materials), etc.

Advantages

There are no analogs in Ukraine. The materials are cheaper than the foreign counterparts.

IPR Protection

IPR3

Contact Information

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NANOSTRUCTURED CARBON FIBER ACTIVATED SORPTION MATERIALS FOR MEDICAL APPLICATION

Areas of Application
The material can be used in clinics as sorbent for treatment of toxic poisoning; as filter for cleaning of blood and lymph; as antibacterial agent for treatment of wounds, eczemas, and burns; as antiradionuclide agent; as target drug carrier

Advantages
As compared with the world analogs, the offering has 2—3 times higher sorption kinetics and sorption capacity with respect to low-, middle-, and high-molecular physiological active substances, which broadens the area of its application and enables selective sorption and targeted functional treatment of more than 40 diseases

Specification
- Whole porous volume (benzol), cm³/g: 0.8—1.3
- Specific surface area, m²/g: 1500—2800
- Adsorption of methylene blue, mg/g: 450—800
- Residual concentration at 60 min sorption, mg/ml:
  - creatinine (initial concentration — 4.5 mg/ml): 0.02
  - medinal (initial concentration — 6 mg/ml): 0.02
  - urea (initial concentration — 15 mg/ml): 0.013

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Manufacture of small batches. Seeking partners for industrial production

Contact Information
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IPR Protection
IPR2
NANOSTRUCTURED CARBON FIBER ACTIVATED SORPTION MATERIALS FOR TECHNICAL APPLICATION

Areas of Application
The material can be used as electrode for super capacitors; as filter for water and air purification from hard metals, phenol, chlorine, and isotopes; as screen for protection from ultrahard radiation of control systems in robotics, rocket and nuclear power engineering.

Specification
Specific surface area, m²/g  1500—2800
Sorption, %  98.8 Al; 99.0 Cu;
  97.0 Sr; 94.0 Co;
  84.0 Cs
Oxidation stability on an air, °C  700—773

Advantages
The offering has 2—3 times higher sorption kinetics and sorption capacity as compared with the world analogs. The use of various types of structure and shapes (fibers, tubes, threads) broadens the possibilities of sorption purification of water and air from pollutants. Using this offering as protection from hard gamma radiation in aerospace engineering, robotics, and surveillance systems of atomic power plants enables to employ 10 times lighter shields as compared with the steel ones and 9 times lighter than the concrete ones, which have the same protection properties.

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Manufacture of small batches.
Seeking partners for industrial production

IPR Protection
IPR2

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NANOSTRUCTURED CERAMIC MATERIALS

Areas of Application
Nozzles and cutting-tool cartridges for mechanical engineering, chemical and petrochemical industries; medical implant blanks

Specification
Materials for cutting-tool cartridges, nozzles $\text{Al}_2\text{O}_3(95\%), \text{B}_4\text{C}$
Materials for implant blanks $\text{Y-TZP}$
Bending strength, MPa
$\text{Al}_2\text{O}_3(95\%) \leq 550$
$\text{B}_4\text{C} \leq 450$
$\text{Y-TZP} \leq 1300$

Advantages
Nozzles and cutting-tool cartridges: high wear resistance, chemical stability, heat resistance. Medical implant blanks: bioinertness, high hardness and wear resistance, corrosion resistance

Stage of Development. Suggestions for Commercialization
IRL6, TRL6
Manufactured, upon request

IPR Protection
IPR1

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**OPTICALLY-TRANSPARENT PROTECTIVE COATINGS**

**Areas of Application**
For photovoltaic and optoelectronic devices

**Specification**
The coating:
- optical transparency, % ≥92—95
- adhesion to inorganic and organic surfaces, MPa ≥45
- operating temperature range, °C: -190…+200
- ultimate breaking shear stress, MPa 27.5
- thermal-cycling stability (from −100 to +80 °C), cycles 1000

The photoelectric transducer with the coating:
- short-circuit current, A 1.09
- open-circuit voltage, V 12.0
- efficiency, % 16.4

**Advantages**
In comparison with domestic and foreign analogs, the proposed optically-transparent coatings have a higher adhesion to surfaces with various surface energy, a wider operating temperature range, a higher resistance to ultraviolet and radioactive radiation, with the optical properties kept, and a higher mechanical strength. The application of such coatings enables rising the efficiency of solar energy photoelectric converter, reducing its prime cost, and extending its service life more than 2 times.

**Stage of Development. Suggestions for Commercialization**
IRL3, TRL3
Manufactured and supplied, upon request

**IPR Protection**
IPR3

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+38 044 559 42 95, e-mail: brovko@ihvs.nas.gov.ua
PHOTOPOLYMER ADHESIVES

Areas of Application
The photopolymer adhesives are designed for bonding organic and silicate glass to metals, ceramics, cement, wood, and plastics for civil aviation, machine-building industry, and for military purposes.

Specification
Viscous transparent liquids (colorless or slightly yellowish), high water resistance.

- Shear strength (glass/steel; 25 °C), MPa: 15–40
- Operating temperature, °C: -40...+100
- Hardening: UV or visible light
- Setting time, min: 1–5
- Storage life at a temperature ≤30 °C, months: ≥6

Advantages
In comparison with the known analogs, the adhesives have a lower cost, improved adhesion and ability to bond different types of materials, and are characterized by “absolute” adhesion.

Stage of Development. Suggestions for Commercialization
IRL7, TRL7
Manufactured and supplied, upon request

IPR Protection
IPR1

Contact Information
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PHOTOPOLYMERIZABLE ADHESIVE MATERIAL FOR FINISHING PRINTED PRODUCTS

Areas of Application
High-performance photoadhesive material for bonding foil to printed material using the method of cold foil stamping; can be used for manufacturing electronic and cable products.

Specification
One-component photopolymerizable adhesive material, polymer film setting time under UV action is 2 – 3 s, shelf life is, at least, one year, can be applicable to a wide range of printing materials (paper, cardboard, plastics, and metallized films), including heat-sensitive ones.

Advantages
In comparison with the analogs, this material is cheaper, enables reducing the product labor input and manufacturing cost, has a wider scope of application, enables a significant improvement in product quality without any dot gain of image elements. The materials are applied on the printed products by the flexographic printing method followed by bonding to foil and treating with UV radiation through the foil in a single production cycle.

Stage of Development. Suggestions for Commercialization
IRL6, TRL5
Batch manufacture, upon request

IPR Protection
IPR3

Contact Information
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Products manufactured by the cold foil stamping method.
PLANT FOR PRODUCING BASALT SUPERFINE FIBERS (BSFF)

Areas of Application
To produce BSFF (Ø1+3 μm) for the duplex technology. The product is obtained from 5-20 mm gravel fractions in the form of canvas with a given density and size. This canvas is used for manufacturing environment friendly highly resilient heat- and sound-insulating materials with a high resistance to thermal transmission, aggressive substances, extreme temperature, and vibration to be employed in power engineering, metallurgy, machine-, aircraft- and shipbuilding industries, and construction.

Specification
Continuous running plant.
Yield capacity, kg/day ≤600
Consumption:
- natural gas, m³/kg 2.3
- power, kW·h/kg 2.6

Advantages
As compared with the best world counterparts, this plant enables 1.5 times reduction in power consumption; improving the product quality as the share of BSFF-sp type (with the content of non-fiber particles less than 4.8%) increases by 10%.

Stage of Development.
Suggestions for Commercialization
IRL7, TRL7
Manufacture, staff training, and warranty service, upon request

IPR Protection
IPR1

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PLANT FOR PRODUCTION OF FINE LIGHTWEIGHT FILLER OR FILTER POWDER

Areas of Application
The plant is designed for obtaining fine filler or filter powder from volcanic ash (perlite) of various deposits.

Specification
- Plant capacity, kg/h: 500.0
- Bulk product density, kg/m³: 100.0–150.0
- Particle size, mm: 0.5–0.1
- Natural gas consumption, nm³/h: 40
- Overall dimensions, mm: 7950 × 2900 × 7300

Advantages
The plant enables obtaining high-quality lightweight filler or filter powder from fine-powdered raw materials with a particle size up to 100 μm, which no competitors work with; a low natural gas consumption that makes up 70 nm³/ton raw materials; small size, easy installation, simple operation.

Stage of Development.
Suggestions for Commercialization
IRL6, TRL6
Manufacture, supply, maintenance, and staff training, upon request

Contact Information
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IPR Protection
IPR3
**Areas of Application**

The plant is designed to produce activated coal with a high specific surface and a density of 0.5 g/cm³. This material can be used in medicine as sorbent or hemosorbent; in metallurgy, construction, machine building, and power engineering for manufacturing lithium-ion batteries; in military industry for the means of protection (gas masks and bomb shelters) etc.

**Specification**

- Cycle, h: 1–2
- Natural gas consumption, m³/h: 1
- Operating temperature, °C: 900
- Yield capacity, kg/h: 1–3

**Advantages**

The high-quality activated carbon is notable for a high specific surface of 2000 m²/g and a high mechanical strength achieved by special activation method. The know-how is the method of pulsed injection of air and ammonia into reactor to induce a non-stationary residual burning of conversion products and formation of radicals.

**Stage of Development. Suggestions for Commercialization**

IRL7, TRL8

- Manufacture, delivery, warranty service, and staff training, upon request

**Contact Information**

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PLANT FOR SYNTHESIS OF THERMALLY EXPANDED GRAPHITE (TEG)

Areas of Application

The plant is designed for producing TEG that can be used in petrochemical industry as effective sorbent for liquidation of emergency spills of oil and oil products; in metallurgy, construction, and mechanical engineering for the manufacture of heat-resistant, sealing and leak-proofing materials; power engineering for the production of lithium-ion batteries, etc.

Specification

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas consumption, m³/h</td>
<td>2</td>
</tr>
<tr>
<td>Operating temperature, °C</td>
<td>1000</td>
</tr>
<tr>
<td>Yield capacity, kg/h</td>
<td>35</td>
</tr>
</tbody>
</table>

Advantages

The plant is based on a new technology for obtaining high-quality TEG with a low density (up to 3 g/dm³) and minimum residues of sulfuric acid (water extract acidity of 6.5—7 pH). This technology enables reducing specific energy consumption, plant weight and dimensions.

Stage of Development.
Suggestions for Commercialization

IRL7, TRL8
Manufacture, delivery, warranty service, and staff training, upon request

IPR Protection

IPR1, IPR3

Contact Information

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POLYFUNCTIONAL POLYURETHANE MATERIALS FOR BONDING AND COATING OF DIFFERENT TYPES OF SURFACES

Areas of Application
The polyfunctional polyurethane materials (PPM) based on single synthetic model with the use of renewable raw materials are used to ensure durable bonding of different materials and to protect different types of surfaces (metal, concrete, brick, wood) from destruction under the action of (a)biotic and anthropogenic factors.

Specification
The polyfunctional polyurethane materials are water-, oil-, benzo-, and lightproof, bio-, wear-, and chemical-resistant.
Adhesive bond strength, MPa 22—35
Cohesive strength, MPa 41.5—46.0

Advantages
There are no domestic counterparts. The advantages of the offered materials, as compared with the foreign analogs, are as follows: long-term comprehensive protection of materials, structures, and infrastructure facilities from destruction; guaranteed continuous service of facilities for 10—15 years after repair.

Stage of Development. Suggestions for Commercialization
IRL6, TRL5
Manufacture of a wide range of polymer materials for various purposes according to customer requirements; seeking investors for industrial production.

IPR Protection
IPR1, IPR3

Contact Information
Yuri V. Savelyev, Institute of Macromolecular Chemistry of the NAS of Ukraine; +38 044 559 73 95, e-mail: yuri2saveljev@gmail.com
**RAZGAR SYSTEM FOR CONTROL OF CRUCIBLE AND HEARTH INWALL RESIDUAL THICKNESS**

**Areas of Application**
The automatic control system is designed to monitor the remaining thickness of crucible and hearth inwall and the skull formation. This enables a safe and long-term operation of blast furnaces.

**Specification**
The system visualization includes 3D image of vertical and horizontal erosion of hearth inwall. The adaptation to specific blast furnace takes up to 1 year.

**Advantages**
The Razgar system functions enable:
- displaying changes in inwall temperature and average temperature at the horizontal levels of thermocouples;
- taking into consideration the thermal load on the hearth;
- taking into consideration the depth of hearth erosion;
- taking into account the skull thickness;
- calculating crucible and hearth wear rate;
- displaying the horizontal profiles of inwall erosion along the crucible perimeter by the levels of thermocouples.

**Stage of Development. Suggestions for Commercialization**
IRL8, TRL8
System installation, warranty service, and staff training.

**IPR Protection**
IPR3

**Contact Information**
Oleksii Ye. Merkulov, Iron and Steel Institute of Z.I. Nekrasov of the NAS of Ukraine;
+38 056 790 05 15, e-mail: office.isi@nas.gov.ua
SEEDS FOR SINGLE-CRYSTAL BLADES OF GAS TURBINE ENGINES

Areas of Application
The seeds are to be used for manufacturing blades of gas turbine engines (GTE) operating at a high temperature, under mechanical loads and corrosion impact, for needs of aerospace engineering, shipbuilding, and power engineering.

Advantages
The use of seeds with a perfect microstructure eliminates defects of casting the single crystal GTE blades, increases the blade service life and long-term heat resistance 1.5—2 times.

Specification
Crystallographic orientation [100]; deviation from crystallographic orientation [100] is 5 degrees, maximally; a high perfection of microstructure.

Stage of Development. Suggestions for Commercialization
IRL7, TRL8
Manufactured, upon request.
Production output is up to 3000 pcs monthly.

IPR Protection
IPR3

Contact Information
Sergii G. Pugach, National Science Center “Kharkov Institute of Physics and Technology”; +38 057 335 68 43, +38 057 349 10 49, e-mail: pugach@kipt.kharkov.ua
HIGH-PERFORMANCE SOLVENT-FREE BINDER FOR CARBON AND GLASS PLASTICS

Polymer matrices obtained from binders at different temperatures

Areas of Application
Aerospace industry, microelectronics, railway transport, car- and shipbuilding

Advantages
There are no analogs in Ukraine. In comparison with the binders currently used in Ukraine, the materials developed have a significantly lower dielectric loss and operability at a high temperature and humidity. These carbon plastics demonstrate physical and mechanical properties similar to those of the best counterparts from EU and USA

Specification

<table>
<thead>
<tr>
<th>Binder Properties</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic solvent content, wt.%</td>
<td>0</td>
</tr>
<tr>
<td>Viscosity (VZ-4) at T = 60 °C, s</td>
<td>20—50</td>
</tr>
<tr>
<td>Viability at T = 60 °C, h</td>
<td>&gt;8</td>
</tr>
<tr>
<td>Glass transition temperature, °C</td>
<td>235</td>
</tr>
<tr>
<td>Onset temperature, °C</td>
<td>390</td>
</tr>
<tr>
<td>Water uptake, wt.%</td>
<td>1—2</td>
</tr>
</tbody>
</table>

Properties of carbon plastics

| Binder content in plastics, wt.% | 28—32 |
| Tensile modulus, MPa | 1660 |
| Compression strength, MPa | 1090 |
| Flexural strength at T = 20 °C, MPa | 1650 |
| Flexural strength at T = 150 °C, MPa | 950 |
| Flexural strength at T = 200 °C, MPa | 440 |
| Operating temperature, °C | 150—350 |

Porosity, %

0

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Seeking partners for production

Contact Information
Oleksandr M. Fainleib, Institute of Macromolecular Chemistry of the NAS of Ukraine; +38 044 559 53 72, e-mail: fainleib@i.ua
TECHNIQUE FOR LASER-INDUCED SOLID-PHASE DOPING OF NANOLAYERS IN Cd(Zn)Te CRYSTALS AND FORMATION OF p-n JUNCTION

Specification

As a result of laser irradiation of p-Cd(Zn)Te crystal pre-coated with a dopant film, the nanolayer is doped heavily and an abrupt p-n junction is formed.

- **p-Cd(Zn)Te crystals, resistivity:** 10⁹—10¹⁰ Ohm·cm
- **Dopant film thickness, nm:** ~500
- **Environment at irradiation:** Vacuum ~1 Pa, argon ~0.3 MPa, liquid
- **Laser:**
  - wavelength, nm: 248, 532, 694
  - pulse duration, ns: 7—8, 20
  - energy density, mJ/cm²: 80—150
- **Doped layer:**
  - thickness, nm: 30—60
  - electron concentration, cm⁻³: ~10¹⁹
  - resistivity, Ohm·cm: 10⁻²—10⁻³

Advantages

There are no analogs in Ukraine. As compared with the foreign counterparts, the advantages are as follows: a high charge carrier concentration in the doped semiconductor nanolayer due to the introduction of electrically active dopant and suppression of its self-compensation effect, as well as the rate, accuracy, and manufacturability of abrupt p-n junction formation.

Areas of Application

The technique is to be used for the heavy doping of a thin surface semiconductor region, the formation of an inverse layer and abrupt p-n junction, and the creation of In/Cd(Zn)Te/Au diode structures for X/γ-ray radiation detection.

Stage of Development. Suggestions for Commercialization

IRL4, TRL5
Manufacturing application of the technology

IPR Protection

IPR2, IPR3

Contact Information

Anna S. Stanetska, V.Ye. Lashkaryov Institute of Semiconductor Physics of the NAS of Ukraine;
+38 044 525 60 43, +38 099 292 66 60, e-mail: stanetska_anna@ukr.net
TECHNOLOGY FOR LOW-PRESSURE DIE CASTING

Areas of Application
Production of cast articles from aluminum alloys for aerospace industry, machine- and shipbuilding, instrument engineering, etc.

Specification
Automated full-cycle manufacturing process, from pouring into molds to obtaining ready cast articles.

Advantages
Enhancement of mechanic properties ($\sigma$, $\delta$, HB) and operating parameters (vacuum density, cyclic strength) by 15–30%; decrease in power consumption down to 100–300 kW/h per 1 ton castings; decrease in metal consumption by the feeding system 3–19 times

Stage of Development.
IRL6, TRL8
Technology transfer to enterprises with individual, serial and mass production; supply of ready cast articles.

Contact Information
Anatoly V. Narivskyi, Physico-Technological Institute of Metals and Alloys of the NAS of Ukraine; +38 044 424 35 15, e-mail: metal@ptima.kiev.ua
TECHNOLOGY FOR MANUFACTURING
WEAR-RESISTANT CERAMIC AND COMPOSITE
ARTICLES BASED ON ZIRCONIUM NANOPOWDERS

Areas of Application
The technology is used for production of figurine-shaped articles for mine and oil industry, machine-building industry, chemical industry, metallurgical industry, power engineering, orthopedics (hip joints), and dentistry (implants and prosthesis).

Specification
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density, %</td>
<td>95—99.5</td>
</tr>
<tr>
<td>Bending strength, MPa</td>
<td>800</td>
</tr>
<tr>
<td>Fracture strength, MPa · m$^{1/2}$</td>
<td>7—10</td>
</tr>
<tr>
<td>Wear resistance, m$^3$/km</td>
<td>6 · 10$^{-9}$</td>
</tr>
</tbody>
</table>

Advantages
The ceramic articles manufactured using the proposed technology have stable properties that are higher than those of the analogs; they have 20—50 times longer service life than the conventional metallic parts. In medicine, the zirconium-based ceramic materials have a high biocompatibility, speed up the formation of bone-implant contact, do not cause galvanic effects, allergic reactions or inflammation.

Stage of Development.
Suggestions for Commercialization
IRL6, TRL6
Joint venture

IPR Protection
IPR1, IPR2

Contact Information
Dmytro V. Raspornia, Donetsk Institute for Physics and Engineering named after O.O. Galkin of the NAS of Ukraine; +38 050 206 92 21, e-mail: diaprintster@gmail.com
TECHNOLOGY FOR MODIFYING ALUMINUM ALLOYS

Areas of Application
Production of cast articles with enhanced properties for aerospace industry, machine, and shipbuilding, etc.

Specification
Modification of melts using electric current during 5—20 s

Advantages
Production of finely structured aluminum alloys with nanoelements; enhancement of mechanic properties of industrial aluminum alloys smelted from waste and scrap: \( \sigma_s \) by 10—40%, \( \delta \) 1.5—3.5 times, HB by 10—16%; neutralization of iron harmful effect

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Trial batch manufacture, upon request

IPR Protection
IPR3

Contact Information
Anatoly V. Narivskyi, Physico-Technological Institute of Metals and Alloys of the NAS of Ukraine; +38 044 424 35 15, e-mail: metal@ptima.kiev.ua
TECHNOLOGY FOR OBTAINING CERAMIC AND COMPOSITE NANOMATERIALS

Areas of Application

The technology is used to create ceramic and composite nanomaterials for biomedical implants, corrosion-resistant ceramics for mechanical engineering, chemical and food industries; as well as to manufacture medical markers and catalysts, polymer nanocomposites, fluorescent and X-ray contrast materials.

Specification

Pre-determined chemical and phase composition.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle size, nm</td>
<td>( d = 10 - 30 )</td>
</tr>
<tr>
<td>Specific surface area, m²/g</td>
<td>120 – 20</td>
</tr>
</tbody>
</table>

Advantages

The technology is simple in terms of hardware solutions unlike the widespread analogs. The proposed technology enables to widen the range of powder chemical compositions without significant modifications of production.

Stage of Development. Suggestions for Commercialization

IRL6, TRL7

Vending of license for the technology

IPR Protection

IPR1, IPR3

Contact Information

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TECHNOLOGY FOR OBTAINING PHOTOSENSITIVE AND PHOTOCATALYTIC OXIDE NANOPowDERS

Areas of Application
This technology is used to produce composite oxide powders for photocatalytic purification of air and water.

Specification
Phase composition: as required.
Chemical composition: as required.
Particle size, nm \(d = 10-300\)
Specific surface area, m\(^2\)/g \(120-10\)

Advantages
This technology is simpler in terms of hardware solutions as compared with the analogs. The physical actions essentially reduce drying time and decrease the aggregation of nanoparticles, so that no grinding is required. The proposed technology enables to widen the range of powder chemical compositions without significant modifications of production and to control the nanopowder dispersion.

Contact Information
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TECHNOLOGY FOR PRODUCTION OF WIDE-APPLICATION WIRE ROD

Areas of Application
Wire rod for manufacture welding materials and metal products

Advantages
The proposed technology enables producing wire from the rod by direct drawing without prior annealing operations

Specification
The high-carbon type is used to produce steel ropes for critical structures; the low-carbon SAE1005-1010 type with guaranteed mechanical properties enables drawing wires with a diameter from 0.8 to 1.0 mm at optimal rate without additional softening heat treatment; the welding type with guaranteed mechanical properties enables drawing wires with a diameter from 0.8 to 1.0 mm at optimal rate without additional softening heat treatment; the construction type is designed for cold upset

Stage of Development. Suggestions for Commercialization
IRL8, TRL8
BTCtechnical specifications for steel wire rod heat treatment modes and for steel composition

IPR Protection
IPR3

Contact Information
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+38 056 790 05 15, e-mail: office.isi@nas.gov.ua
TECHNOLOGY FOR RADIATION Modification
OF COMPOSITE ORGANIC AND MINERAL CEMENT SYSTEMS

Areas of Application
This technology is designed to enhance water repellency, corrosion resistance, and durability of concrete structures and products made of asbestos concrete and other organic and mineral concrete systems used in extreme operating conditions.

Advantages
There are no analogs in Ukraine. The technology is notable for simplicity of processes and remote control of structuring in the very material mass; no hazardous substances are used; can apply both to the unfinished concrete products at any stage of manufacture and to the ready articles.

Specification
As a result of radiation treatment, the porous construction materials are modified into dense hydrophobic composites with higher strength and corrosion resistance. The technology consists of introducing the modifying structures into the porous material mass and treating the material with electron beams in order to make it monolithic. The technology is based on the use of electron accelerators with average electron energy of 4–10 MeV; at a beam power of, at least, 5 kW, about 1.5 tons of concrete structures can be modified annually.

Stage of Development.
Suggestions for Commercialization
IRL6, TRL6
Technology, mass production line design

Contact Information
Tatiana V. Kovalinska, Institute for Nuclear Research of the NAS of Ukraine;
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IPR Protection
IPR1

Effects of radiation modification of concrete and concrete products: the hydrophobicity test of modified products (corrugated fiber cement sheets, paving slabs)
TECHNOLOGY FOR RAPID HEAT TREATMENT OF COMMERCIAL TITANIUM ALLOYS

Areas of Application
The technology can apply to bulk or local/surface treatment of parts and products in aerospace, automotive, chemical, and defense industries as well as in the manufacture of medical devices, including implants.

Specification
The technology is based on rapid heating at a rate up to hundreds degrees per second, using sources of high energy, under very nonequilibrium conditions. Depending on the size and desired results, the articles can be heated by current passage, heat inductor, electron beam, laser, etc.

Advantages
The technology enables the formation of unique microstructural states in different types of commercial titanium alloys, which ensure the physical and mechanical properties unreachable with any other kinds of treatment, namely, a combination of the highest static and dynamic strength and other high important properties.

Stage of Development.
Suggestions for Commercialization
IRL7, TRL4
Vending of patent based on license agreement

IPR Protection
IPR1, IPR3, IPR5

Contact Information
Vitalii P. Bevz, G.V. Kurdyumov Institute for Metal Physics of the NAS of Ukraine;
+38 044 424 12 05, e-mail: BevzV@ukr.net
TECHNOLOGY FOR REFINEMENT AND DESULFURIZATION OF CAST IRON BY GRANULAR MAGNESIUM IN LADLES

Desulfurization process scheme

**Specification**

- Refined reagent recovery, % \(\geq 95\)
- Reagent consumption, kg/ton of cast iron \(0.2-0.7\)
- Cast iron desulfurization, % \(99\)
- Sulphur content in cast iron after treatment, % \(\leq 0.001\)
- Cast iron temperature loss, °/min \(0.5-0.8\)

**Areas of Application**

The technology is designed to obtain low-sulfur and refined cast iron before its melting or cast iron products (ingots, pigs, castings).

**Advantages**

The key difference of the proposed technology from the world analogs is the most favorable conditions for saturating the cast iron with magnesium and the further mass exchange between magnesium lysed in cast iron and melt sulfur. The technology parameters provide a high concentration of magnesium in carrier gas (over 20 kg/m³), required injection rate, and distribution of refining environment in the melt. The costs are less by USD 3—5/ton cast iron than that of world analogs.

**Stage of Development, Suggestions for Commercialization**

IRL8, TRL8

Technology, specifications and working drawings, control systems, main components of complexes for cast iron off-furnace treatment in ladles of various dimension type (4-350 tons)

**IPR Protection**

IPR3

**Contact Information**

Oleksii Ye. Merkulov, Iron and Steel Institute of Z.I. Nekrasov of the NAS of Ukraine;
+38 056 790 05 15, e-mail: office.isi@nas.gov.ua
TECHNOLOGY FOR TITANIUM ALLOY SURFACE HARDENING

Areas of Application
The technology is designed to improve tribotechnical properties and corrosion resistance of titanium alloy friction couples operating under bearing pressure up to 10 MPa, particularly, in aggressive environments. It can be used in machine building, aviation engineering, aerospace industry, and medicine for treating surgical instruments, brackets, and shafts for curing bone fractures, as well as other products operating under bearing pressure and in corrosive environments.

Specification
The technology is based on diffusion saturation of surface layers with nitrogen.

Advantages
The technology provides a high wear and corrosion resistance due to the formed complex solid-solution areas with a depth up to 100—200 μm; ensures mechanical strength properties and enhances plasticity; ensures a high quality of surface (used as final process operation); enables treating the articles of arbitrary shape, including those with bores of arbitrary diameter and length, with the use of serial vacuum electric furnaces and commercially pure nitrogen.

Stage of Development. Suggestions for Commercialization
IRL7, TRL8
Diffusion saturation works using our equipment under services contract or technology transfer based on license agreement; consultancy support.

Contact Information
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IPR Protection
IPR2, IPR3
TECHNOLOGY FOR TREATMENT OF ALUMINUM ALLOYS WITH SUB-MICROCRYSTALLINE ALLOYING COMPOSITIONS

Areas of Application
Production of aluminum alloy ingots at foundry shops of machine-building plants

Specification
The alloying compositions are proposed in the form of extruded rods

Advantages
No dangerous substances are formed during interaction with the melt; guaranteed and complete assimilation of active substance; no special equipment is required; no pyroelectric effect or smoke emission; environment safety; enhancement of mechanical properties of obtained alloy by 10—15%; longer duration of melt modification effect

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Technology for alloy modification and trial batch of the alloying compositions, upon request

IPR Protection
IPR2

Contact Information
Anatoly V. Narivs'kyi, Physico-Technological Institute of Metals and Alloys of the NAS of Ukraine; +38 044 424 35 15, e-mail: metal@ptima.kiev.ua
THERMOPLASTIC ELASTOMERS FROM TIRE RUBBER AND POLYOLEFIN WASTE

Areas of Application
Hydraulic and floor covering, roofing, various bonding and sealing materials for automobile and construction industries, agriculture

Specification
- Tensile strength (σ), MPa: 13.0—14.0
- Relative elongation (ε), %: 625—720
- Shore Hardness (A): 78—95
- Brittleness temperature (T), °C: -43
- Operating temperature, (T), °C: -40...+80

Advantages
As compared with the competing industrial products, the developed TPEs have equivalent fundamental properties, but are much cheaper

Stage of Development. Suggestions for Commercialization
IRL3, TRL4
Seeking partners for commercial production

IPR Protection
IPR3

Contact Information
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+38 044 559 53 72, e-mail: fainleib@i.ua
THIN BERYLLIUM VACUUM-TIGHT FOILS

Areas of Application
Instrument-making industry: detectors of ionizing radiation, X-ray tubes

Specification
Foil shape: rectangle, disk. Low coefficient of X-ray absorption within the range of soft radiation (energy under 2keV).

<table>
<thead>
<tr>
<th>Beryllium purity, %</th>
<th>99.95—99.999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foil thickness, mm</td>
<td>0.008—0.15</td>
</tr>
</tbody>
</table>

Advantages
The manufacture of beryllium vacuum-tight foils has no analogs in Ukraine and CIS countries. As compared with the analogs, the foils contain purer beryllium, have higher mechanical properties and corrosion resistance

IPR Protection
IPR1

Stage of Development. Suggestions for Commercialization
IRL8, TRL9
Customized manufacture and sale of products

Contact Information
Konstantin V. Kovtun, National Science Center “Kharkov Institute of Physics and Technology”; +38 057 335 65 01, e-mail: kkovtun@kipt.kharkov.ua
TI-V-H ALLOYS FOR NEUTRON SHIELDING

Areas of Application
The alloys can be used in nuclear power engineering, in particular, as materials with a high hydrogen content, which hold much promise for neutron radiation protection as effective moderator of fast neutrons.

Advantages
The proposed alloys with enhanced protective properties have advantages over the known analogs as they enable an increase in the mass coefficient of neutron removal and efficiency of protection, a decrease in the thickness of protective layer and a reduction in the production costs.

Specification
- High sorption capacity: \( \frac{H}{Me} = 2.11 - 2.26 \)
- Initial temperature of intensive absorption, °C: \( \sim 300 \) (for Ti – \( \sim 400 \))
- High average hydrogenation rate, g/s: \( \sim 8.4 \times 10^{-6} \)
- Stability during exploitation:
  - time, years: \( \leq 15 \)
  - thermal, °C: \( \leq 500 \)
- Hydrogen atoms per cm\(^3\): \( \sim 1.03 \times 10^{23} \)

Stage of Development, Suggestions for Commercialization
IRL3, TRL2
Vending of patent based on license agreement

Contact Information
Vitalii P. Bevz, G.V. Kurdyumov Institute for Metal Physics of the NAS of Ukraine; +38 044 424 12 05, e-mail: BevzV@ukr.net

Density of hydrogen atoms in effective fast neutron moderators

![Graph showing density of hydrogen atoms in various materials.](image-url)
TPD-C PORTABLE CONTACT THERMOMETERS

Areas of Application
The thermometers are designed for contact measurements of temperature of solid bodies, liquids, and gaseous environments with the help of thermoelectric transducers; used in metallurgy, chemical, refractory, and other industries. For temperature control of metal melts the thermometers are complemented with thermoelectric changeable transducers TCT-P.

Specification
- Range of measurable temperature, °C: 300 – 2500 (600 – 1700 with TCT-P)
- Types of nominal static characteristics: A-1, A-2, A-3, L, K, S, B
- Fundamental measurement error, %: ≤0.2 (≤0.6 with TCT-P)
- Number of immersions for TCT-P: ≤20
- Measurement time with TCT-P, s: 5 – 10
- Weight, kg: ≤2

Advantages
The special algorithm of primary measurement data processing reduces the measurement time 3 – 4 times. This enables to increase the number of measurements by one TCT-P up to 20 (while the analogs are designed for 1 – 3 measurements) and to decrease the cost of temperature control.

Stage of Development. Suggestions for Commercialization
IRL8, TRL8
Customized manufacture of thermometers and transducers, delivery, warranty service, and staff training, upon request

IPR Protection
IPR3

Contact Information
Anatoly V. Narivskyi, Physico-Technological Institute of Metals and Alloys of the NAS of Ukraine; +38 044 424 35 15, e-mail: metal@ptima.kiev.ua
TPD-N PORTABLE NONCONTACT THERMOMETERS

Areas of Application
Periodical contactless measurements of temperature of solid bodies, liquids, and gaseous environments in metallurgy, chemical, refractory, and other industries

Advantages
Due to the bicolor measurement method, the thermometers have higher metrological characteristics and, consequently, a wider scope of application. They are more convenient in practical use

Specification
- Range of measurable temperature, °C: 200 – 2500
- Fundamental measurement error, %: ≤ 1.0
- Weight, kg: ≤ 2

Stage of Development.
Suggestions for Commercialization
IRL8, TRL8
Customized manufacture, delivery, warranty service, and staff training, upon request

IPR Protection
IPR3

Contact Information
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**TWIST EXTRUSION TECHNOLOGY**

**Areas of Application**
The technology is used for obtaining nonferrous materials with enhanced mechanical properties and operating characteristics for application in medicine (bone and dental implants) and aircraft industry (turbine engine blades).

**Advantages**
The technology has a lesser material consumption as compared with the analogs (by 30—50%); enables working with profiled materials and is highly integrable into the existing processes. The materials treated by the twist extrusion method have 1.5—2.5 times higher mechanical properties and operating characteristics.

**Specification**
The technology is based on severe plastic deformation with the help of special matrix. The use of this matrix enables to create an intensive vortex flow within the treated material, which leads to grain size reduction and significant changes in the microstructure.

**Stage of Development. Suggestions for Commercialization**
IRL3, TRL2
Vending of license for the technology

**IPR Protection**
IPR1, IPR3

**Contact Information**
*Dmytro V. Raspornia*, Donetsk Institute for Physics and Engineering named after O.O. Galkin of the NAS of Ukraine; +38 050 206 92 21, e-mail: diaprintster@gmail.com

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Principal scheme of twist extrusion
XTH-63 WEAR- AND HEAT-RESISTANT CAST ALLOY

Areas of Application
The alloy can be used in machine-building, especially, to protect from wear the shroud platforms of turbine blades.

Specification

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting temperature, °C</td>
<td>1320 ± 10</td>
</tr>
<tr>
<td>Volume wear at a temperature of 1100 °C, mm³/cycle</td>
<td>16.0 · 10⁻⁶</td>
</tr>
</tbody>
</table>

Advantages
The heat resistance of this alloy at a temperature of 1100 °C is 2 times higher than that of the serial XTH-62 alloy used for the same purpose.

Stage of Development.
Suggestions for Commercialization
IRL6, TRL4
Vending of patent based on license agreement

IPR Protection
IPR3

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YAG:RE STRUCTURED TRANSPARENT CERAMICS AS ACTIVE MEDIUM FOR SOLID-STATE LASERS IN THE NEAR-IR RANGE

Areas of Application

The ceramic materials based on YAG doped or co-doped by Nd³⁺, Yb³⁺, Er³⁺ ions can be used as active media for new types of compact diode-pumped solid-state lasers. The ceramic-based microchip lasers can be employed in the devices for high-accuracy distance measurement, laser location and navigation, in communication and data record systems, and so on.

Specification

The garnet phase comprises 100% of ceramic mass. The average size of crystal grains is 10—20 μm. The optical loss for the scattering within the 800—1600 nm spectral range is α < 0.1 cm⁻¹. The active ion absorption on the pumping wavelengths (808 nm for Nd and 940 nm for Yb) is > 10 cm⁻¹.

Advantages

A high homogeneity of dopant distribution in the volume; the cost of active ceramic laser medium is much less than that of the single-crystal one. A high active ion concentration provides a high power density in the active medium with ~2 mm length.

Stage of Development.
Suggestions for Commercialization

IRL3, TRL4
Laser elements for various applications manufactured upon request

Contact Information

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# TECHNOLOGY READINESS LEVEL (TRL) SCALE

<table>
<thead>
<tr>
<th>Stage</th>
<th>TRL</th>
<th>Interpretation</th>
<th>Definition and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invention</td>
<td>TRL1</td>
<td>Basic principles observed</td>
<td>Basic scholarly research is translated into potential new basic principles that can be used in new technologies</td>
</tr>
<tr>
<td></td>
<td>TRL2</td>
<td>Technology concept formulated</td>
<td>Potential areas of application of basic (technological) principles, including the technological concept are identified. Basic manufacturing principles are elaborated and potential sales markets are identified. A small research team is established to assess the project feasibility</td>
</tr>
<tr>
<td>Concept validation</td>
<td>TRL3</td>
<td>First assessment of concept and technology effectiveness</td>
<td>Based on preliminary study, actual research is conducted to assess technical and market feasibility of the concept. This includes active R&amp;D works at the lab and first negotiations with potential customers. The research team expands. Market feasibility is assessed</td>
</tr>
<tr>
<td>Prototyping and incubation</td>
<td>TRL4</td>
<td>Prototype validation at lab</td>
<td>Basic technological components are integrated to assess early feasibility by testing in laboratory environment. Manufacture options are studied with basic manufacturing principles identified. Key markets are researched to study demand. The organization is ready to scale up, possible services are analyzed. Comprehensive marketing analysis is made</td>
</tr>
<tr>
<td>Pilot production and demon-</td>
<td>TRL5</td>
<td>Prototype testing in user environment</td>
<td>The system is tested in user environment with broader technological infrastructure involved. The actual use is tested and validated. Production-support works and pre-production tests are done in lab environment. Trial batches of prototypes enter the key markets. The organization starts activities to further distribute the prototypes and to enter the sales markets</td>
</tr>
<tr>
<td>stration</td>
<td>TRL6</td>
<td>Pre-production, including tests in user environment</td>
<td>The product and manufacturing technologies are completely ready for launch of a pilot line/pilot plant (low-scale manufacture). The product and manufacturing technologies are assessed and finalized. This may include additional R&amp;D works. The early products and manufacturing technologies are tested in the key markets with simultaneous organization of manufacture (marketing research, logistics, production facilities, etc.)</td>
</tr>
<tr>
<td>Initial market introduction</td>
<td>TRL7</td>
<td>Low-scale pilot production demonstrated</td>
<td>The product manufacture is fully operational at low rate. Actual commercial products are manufactured. The final products are verified in the key markets. The organizational component is completed (comprehensive marketing strategy, all components of manufacturing activities). The products are formally launched in test markets</td>
</tr>
<tr>
<td></td>
<td>TRL8</td>
<td>Manufacture fully tested, validated, and certified</td>
<td>The manufacturing flow charts, product final version, production organization, and marketing tools are completed. The full-scale manufacture has been launched. The final product is sold in majority of domestic and international markets</td>
</tr>
<tr>
<td>Market expansion</td>
<td>TRL9</td>
<td>Manufacture and products fully operational and com-</td>
<td>The full-scale manufacture is sustainable, with the product gaining new markets. Minor modifications and improvements create new versions. The technology and product output are optimized through implementing innovative concepts on manufacturing process. The product is fully customized to the key markets</td>
</tr>
</tbody>
</table>
## INNOVATION READINESS LEVEL (IRL) SCALE

<table>
<thead>
<tr>
<th>IRL</th>
<th>Innovation Readiness Level</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRL1</td>
<td>Inventor or team with a dream</td>
<td>The lowest level of readiness where the intention transforms into an idea of space system application or the space technology transforms into a business venture</td>
</tr>
<tr>
<td>IRL2</td>
<td>Paper studies produced</td>
<td>Once the basic ideas have been formulated, they are put down on paper in studies and analyses of business opportunities</td>
</tr>
<tr>
<td>IRL3</td>
<td>Experimental evidence of business opportunity</td>
<td>Active research and development are initiated, including analytical / laboratory studies to validate predictions regarding the market, the competition, and the technology</td>
</tr>
<tr>
<td>IRL4</td>
<td>Capability to implement limited-scope programs with project teams</td>
<td>Basic technological and business components have been developed to establish that they will work together; an initial business plan is available</td>
</tr>
<tr>
<td>IRL5</td>
<td>Capability to support project engineering development and design (no product, no revenues)</td>
<td>The basic technological and business components have been integrated with reasonably realistic supporting elements. The business plan is credible, but still needs to be validated against the final product characteristics</td>
</tr>
<tr>
<td>IRL6</td>
<td>Capability to support development and design with a market-driven business team (product, no revenues)</td>
<td>The representative prototype system has been tested in a relevant environment. The business team is still incomplete and the venture is not yet ready for commercialization. A full business plan including the market, the operational, the technological, and the financial aspects is available</td>
</tr>
<tr>
<td>IRL7</td>
<td>Capability to support limited production; full business team in place (product and limited revenues)</td>
<td>The business can run on a limited scale. The full team is in place</td>
</tr>
<tr>
<td>IRL8</td>
<td>Capability to advance to full production and distribution (product and revenues)</td>
<td>The technology has been proven to work and the venture structure has proven to be able to support growing market shares</td>
</tr>
<tr>
<td>IRL9</td>
<td>Fully articulated business with appropriate infrastructure and staffing (growing market share)</td>
<td>The offering incorporating the new technology has been used in operational conditions and the business is running with a growing market share</td>
</tr>
</tbody>
</table>
## Intellectual Property Rights Protection Levels

<table>
<thead>
<tr>
<th>IPR codes</th>
<th>Protection Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPR1</td>
<td>Technical solutions are know-how¹</td>
</tr>
<tr>
<td>IPR2</td>
<td>Applications for copyright protection of IPR objects are expected to be or have been submitted</td>
</tr>
<tr>
<td>IPR3</td>
<td>The copyright protection of IPR objects as established by the applicable law of Ukraine has been obtained and is kept in force</td>
</tr>
<tr>
<td>IPR4</td>
<td>International industrial patent application(s) (according to the PCT system, etc.) has (have) been submitted. Application(s) for industrial patents has (have) been submitted in foreign country(ies) under national procedure</td>
</tr>
<tr>
<td>IPR5</td>
<td>The industrial patent(s) in foreign country(ies) has (have) been obtained and is/are kept in force</td>
</tr>
</tbody>
</table>

¹ The IPR protection measures are implemented by R&D institutions in accordance with the applicable legislation of Ukraine and the requirements of paragraphs 5, 8, and 9 of the Regulations for the use of intellectual property objects at the NAS of Ukraine as approved by Resolution of the Presidium of the NAS of Ukraine No.15 of January 16, 2008, on the Structural Units Responsible for Technology Transfer, Innovation Activities, and Intellectual Property (as revised)

² Know-how is technical, organizational, or commercial data obtained with the use of experience and upon trials of technology and its components, which are: closely held (not a part of general knowledge or available for public) on the date of license agreement; essential, i.e. important and useful for manufacture of products, manufacturing process, and/or provision of services; and elaborate i.e. detailed and complicated enough to verify their compliance with the criteria of being never-before-known and essential (Clause 1 of the Law of Ukraine on the State Regulation of Technology Transfer Activities)
Reference book

THE NATIONAL ACADEMY OF SCIENCES OF UKRAINE

R&D AND TECHNOLOGIES

IN 11 SPECIAL ISSUES

Issue

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