Summaries

UDC 514.76

Ivlev E.T., Moldovanova E.A.
**DISTRIBUTION OF TWO–DIMENSIONAL AREAS
IN EUCLIDEAN SPACE**

The field of two-dimensional areas associated with the indicated distribution is formed invariantly analytically and geometrically. The authors prove the existence of the finite number of two-dimensional areas connected with Cauchy−Riemann mapping in each point. The article introduces geometric characteristic of space dimension cases $n=6$ and $n=8$.

UDC 514.76

Ivlev E.T., Luchinin A.A., Moldovanova E.A.
**CAUCHY−RIEMANN MAPPINGS OF TWO–DIMENSIONAL
AREAS OF SURFACE TANGENT AND NORMAL
FIBRATION IN EUCLIDEAN SPACE**

The authors study two-dimensional areas of tangent and normal space of m-surface $S_m \in E_n$ and these areas mappings corresponding to each direction in tangent plane.

UDC 517

Churikov V.A.
**EXTERIOR ALGEBRA OF d–OPERATOR
IN FRACTIONAL ANALYSIS OF INTEGRAL ORDER**

The article considers the algebraic properties of d-operator at its action on functions (exterior algebra). In particular the commutative property is considered.

UDC 517

Churikov V.A.
**THE EXPONENTS IN FRACTIONAL ANALYSIS
OF INTEGRAL ORDERS BASED ON d–OPERATOR**

The article introduces and considers the exponent properties in fractional analysis of integral orders. It is shown that the occurrence of more than one exponent is typical for d-operators of integral orders exceeding 1. The exponent properties for even and odd orders differ considerably.

UDC 621.52+511.52

Simonyan S.O., Vasilyan A.K., Tamazyan M.D.
**DETERMINING CHARACTERISTIC EXPONENTS
OF MONODROMY MATRIX USING DT–ANALOGUE
OF $L(t)R(t)$–ALGORITHM**

The simple numerical-analytic method is proposed. It is used for easy determining the characteristic exponents of monodromy matrix.

UDC 519.6

Orlov V.A., Reyzlin V.I.
NEW FAMILY OF QUASI–RANDOM SEQUENCES

The authors consider the family of uniformly distributed sequences generalizing the analogue constructions of Roth, Faure, Sobol. It is proved that all their sequent segments of a certain length have good distribution. The constructed sequences may be used in global search algorithms and other ones as the alternative to the popular AS_τ-sequences.

UDC 530.3:621.826.2

Aistov I.P., Smirnov V.D.
**MATHEMATICAL MODEL OF SLIDER–CRANK MECHANISM
ROD IN SMALL–SIZED PISTON MACHINES MADE
IN THE FORM OF SPRING WITH INTERTURN PRESSURE**

The article introduces the mathematical model of slider-crank mechanism rod in small-sized piston machines made in the form of spring with interturn pressure. It may be distributed to the other spring mechanisms with the helical coil springs including those with the open loop.

UDC 621.87:621.865.8

Korytov M.S.
**THE TECHNIQUE FOR OPTIMIZING THE PROCESS
PARAMETERS OF THE COMBINED WORKFLOW
OF TWO CRANES SHIFTING COMMON CARGO**

The author describes the technique and algorithm for optimizing process parameters of the combined workflow of two cranes shifting common cargo in the space with obstructions by the proposed complex efficiency estimation criteria.

UDC 539.1.03

Gogolev A.S., Cherepennikov Yu.M.
**DETERMINING OPTIMAL PARAMETERS
OF X–RAY EMISSION SOURCE BASED
ON COMPACT ELECTRON ACCELERATOR**

The authors simulated spectra of X-ray emission generated by electrons with energy of 4…10 MeV in targets of different materials and thickness. Optimal parameters of a target-converter were determined to use it in medical sources of monochromatic X-ray emission based on compact electron accelerators. The emission intensity was estimated and the sources based on different accelerators were compared.

UDC 537.862

Koval T.V., Marchenko A.L.
**SPONTANEOUS RADIATION IN A REFLEX TRIODE
WITH VIRTUAL CATHODE**

The article considers the interaction of virtual cathode oscillation with electromagnetic field of resonance multiply connected structure of a reflex triode with radiate divergent beam. The authors study the dependence of spontaneous radiation level on system and beam geometry, the excited wave type. The conditions of the most efficient interaction with the lowest wave type are determined.

UDC 537.533.9

Koval T.V., Le Hu Zung
**INFLUENCE OF CURRENT NEUTRALIZATION
AND RETURN CURRENT DISTRIBUTOR GEOMETRY
ON TRANSFORMATION OF LOW–ENERGY
HIGH–CURRENT BEAM IN PLASMA CHANNEL**

The authors study theoretically the influence of system and beam parameters on beam cross section transformation in axial-inhomogeneous magnetic field of the return current distributor. It is shown that transformation of a section of weakly relativistic charged compensated electron beam depends on current distributor geometry, current neutralization level and initial distribution of electron density.

UDC 621.384.647.001.5

**Sivkov A.A., Isaev Yu.N., Vasilyeva O.V., Kuptsov A.M.
DYNAMICS IN CHANGING CHARGED PARTICLE PATH IN
ELECTROMAGNETIC FIELD IN COAXIAL MAGNETO–PLASMA
ACCELERATOR**

The authors study the change of plasma bunch velocity and mass depending on coordinate in coaxial magneto-plasma accelerator. This change is determined both by energy characteristics and gas dynamic laws of hypersonic jet flows in cylindrical channel. The dynamics of charged particle distribution in electromagnetic field is determined; energy balance subject to the channel wall erosion is plotted. The theoretical model adequacy to the experimental data is introduced.

UDC 621.384.647.001.5

**Sivkov A.A., Isaev Yu.N., Vasilyeva O.V., Kuptsov A.M.
MODELING GAS–DYNAMIC PROCESSES AND ESTIMATING
THERMODYNAMIC PARAMETERS OF PLASMA GAS SHOCK
WAVE IN COAXIAL MAGNETO–PLASMA ACCELERATOR**

The article is devoted to solution of one-dimensional hydraulic gas dynamics equation for coaxial magneto-plasma accelerator by the modified Lax–Wandroff algorithm with optimal selection of regularization parameter – artificial viscosity. The shock wave thermodynamic parameters before plasma piston at its escape from coaxial magneto-plasma accelerator are calculated in MathCAD based on the proposed algorithm.

UDC 621.762.4.04.016.2

**Khasanov O.L., Dvilis E.S., Khasanov A.O., Bikbaeva Z.G.,
Polisadova V.V., Sokolov V.M., Kachaev A.A., Valova Ya.V.
DETERMINING OPTIMAL MODES FOR PRODUCING
HIGH–DENSITY CERAMICS FROM BORON CARBIDE
POWDER BY SINTERING IN SPARK DISCHARGE PLASMA**

The article introduces the experimental results in sintering ceramics of boron carbide industrial powder in spark discharge plasma at Spark Plasma Sintering System SPS-515S. The sintering modes: temperature, time and compacting pressure are selected. It is shown that at optimal operating mode (sintering temperature 1900...1950 °C, compacting pressure 45...90 MPa, sintering time 10 min) ceramics microhardness reaches the value H_v=35,45...36,50 GPa at crack growth resistance K_{ic}=4,22...5,62 MPa·m$^{1/2}$ and relative density $\rho_{отн}$=98,4...98,8 %. SPS-sintering simulates the decrease of sintering temperature and time of ceramics from boron carbide powder in comparison with the hot-pressing technique and forms isotropic grain structure with well-formed intergranular boundaries.

UDC 621.9.048.4

**Egorov Yu.P., Zhuravlev M.V., Remnev G.E.,
Slobodyan M.S., Strelkova I.L., Shubin B.G.
SPARK PROCESSING OF 08G2S STEEL SURFACE**

Spark processing of 08G2S steel surface is studied. It is shown that due to this processing the oxide layer is removed and contact resistance decreases. The intensity of crater formation influencing the roughness value depends mainly on the degree of metal overheating because of crater density increase. The surface cracks at its multiple-pass operation. The most rational mode parameters are determined based on the results obtained.

UDC 621.785.5;621.793

**Mishustin N.M., Ivanaysky V.V., Ishkov A.V.
COMPOSITION, STRUCTURE AND PROPERTIES OF WEAR–
RESISTANT COATINGS OBTAINED AT 65G AND 50HGA
STEELS AT HIGH–SPEED RFC–BORATING PROCESS**

The authors carried out the high-speed borating process (1...2 min) of the surfaces of 65G and 50HGA steels to the depth up to 800 mµm at RFC-heating of samples covered with the compositions based on molten borate flux for induction welding of P–0,66, boron carbide, amorphous boron and different activators. The com-

position and structure of the coatings obtained were determined by the methods of X-ray phase and X-ray spectrum analyses and metallographic studies. Coating microhardness distribution over the depth was studied and their wear resistance was determined.

UDC 621.793:615.461–089.819.843

**Tverdokhlebov S.I., Shesterikov E.V., Malchikhina A.I.
FEATURES OF FORMING CALCIUM–PHOSPHATE COATINGS
BY HF MAGNETRON SPUTTERING ON IMPLANTS**

Thin calcium-phosphate coatings are formed on titanium models of medical items by higth-frequency magnetron sputtering. Microscopic analysis of the coatings shows that they are visually dence without apparent pores and microcracks. It is proved that nanohardness and Young modulus of magnetron calcium-phosphate coatings applied to the surface with high initial roughness equal 10 and 113 GPa respectively. The features of forming coatings on implants are determined; the recommendations for developing tooling are worked out.

UDC 621.793.794.357.7

**Durakov V.G., Gnyusov S.F., Dampilon B.V., Dekhonova S.Z.
THE INFLUENCE OF PROCESS PARAMETERS
OF ELECTRON BEAM FACING ON THE STRUCTURE
OF COPPER–CHROMIUM COMPOSITES**

The article is devoted to the influence of base metal heating temperature and its temperature after the electron beam facing by composite mixture of Cu-Cr powders on coating structure phase state. The authors determine temperature influence on chromium particle size in the coating, their distribution homogeneity over the volume and possibility to form a bimodal structure.

UDC 621.793.794.357.7

**Degterev A.S., Gnyusov S.F.
THE INFLUENCE OF PROCESS PARAMETERS OF PLASMA
POWDER DEPOSITION BY DIRECT POLARITY CURRENT ON
THE FORMED STRUCTURE OF Fe–Cr–V–Mo–C COATINGS**

The authors determined the rational deposition modes supporting the formation of uniform composite structure over the whole volume of hardened layer based on the detailed analysis of the coating structure of Fe–Cr–V–Mo–C system. These coatings are obtained by plasma powder deposition on direct polarity continuous current with and without lateral oscillations of plasmatron in variation interval of current 160...250 A and velocity 4,5...10 m/h.

UDC 621.791.927.55

**Khaydarova A.A., Degterev A.S.
STRUCTURE AND PROPERTIES OF THE COATINGS
ON THE BASE OF P6M5 STEEL OBTAINED
BY PLASMA–POWDER SURFACING**

Using various modes of plasma-powder surfacing the coatings based on P6M5 steel were obtained. The authors studied the influence of surfacing mode parameters on the structure and microhardness of the deposited metal. It was shown that the increase of heat input at plasma-powder surfacing stimulates the decrease in volume ratio of eutectic and carbides of MS type.

UDC 519.635.8:53.09

**Krektuleva R.A.
THE EXACT SOLUTION OF THE PROBLEM ON ISENTROPIC
FLOWER OF NONLINEAR GRADED MEDIUM**

The author obtained the analytic solution of hyperbolic-type equation system including equations of mass balance, quantity of motion, energy and nonlinear state equation. The problem is solved in hydrodynamic statement for a case of weak shock-wave loading of the condensed solid body with gradient coordinate change of properties.

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UDC 53.09:621.791

Krektuleva R.A., Batranin A.V.
SIMULTANEOUS SOLUTION OF INVERSE HEAT TRANSFER PROBLEM AND OPTIMAL DESIGN PROBLEM IN THE TECH-NIQUE OF NONCONSUMABLE ELECTRODE WELDING

The article considers the problems of optimal design in welding technique based on solution of the inverse heat transfer problems applying parallel computing and development of digital regulations for maintaining quality of the obtained process solutions. The authors introduce the solution technique and diagram of parallel search for welding mode optimal parameters. The results obtained by the program «Virtual workplace for welding engineer» developed by the authors are used in the article.

UDC 53.09:621.791

Krektuleva R.A.
THEORETICAL ANALYSIS OF INCREASING RESOURCE EFFICIENCY OF METAL OXYGEN CUTTING

The article considers the main features of oxygen jet interaction with metal in a cut zone. The mathematical model is proposed for their description. It includes the equations of mass balance, quantity of motion, energy, state equation and the equation of oxidation process kinetics. The author obtains a number of analytical relations solving the total equation system. These relations indicate the untapped reserves and reveal the opportunities of increasing resource efficiency of oxygen cutting technique.

UDC 548.55: 669.015.5:539.23

Poryadina A.N., Apasov A.M.
ON THE ISSUE OF THE OBTAINING A HIGH-PURITY METALS OF NANOCRISTALLINE LEVEL

The article generalizes the main experimental results recently achieved in obtaining a number of metals in a high-purity state and researching their properties. The basic principles of physical methods of metals purification (distillation, melting and zone recrystallization) applying vacuum and super-high-vacuum engineering are briefly stated. The perspective of a complex application of physical purification methods for a deep metal refining is shown. Distillation processes in vacuum allow constructing high-purity metals of nanocristalline level by regular assembling from individual atoms and get metals with predetermined properties and structures.

UDC 533.92+544.558

Ryazantseva T.V., Kravets L.I.
EXPERIMENTAL RESEARCH OF POLY ETHYLENE TEREPHTHALATE TRACK MEMBRANES WITH NANOSTRUCTURED SURFACE AS EXPLANTO-DRAINAGE

The article introduces the results of experimental research of nanostructured track membranes implantation as explato-drainage for refractory glaucoma surgery. The treatment of non-polymerizing gases in plasma is applied for nanostructuring the membrane surface. It is demonstrated that the implantation of the proposed explanto-drainage allows achieving a stable normalization of intraocular pressure and long preservation of generated ways of intraocular liquid outflow.

UDC 62−729.3/.-732:629.63.6:66.046.1

Udler E.I., Isaenko P.V., Khalturin D.V., Lysunets A.V.
THEORETICAL ESTIMATION OF FUEL PURIFICATION AND HEATING IN MOBILE MACHINES

The authors propose the techniques for calculating fuel purification and heating systems in diesel motor cars. The adequacy of theo-retical concepts is shown by the example of filter construction for purifying and heating fuel at car operation at low temperatures.

UDC 544.733.422:519.87

Kudryashova O.B.
MATHEMATICAL MODEL OF LIQUID-DROP AEROSOL EVOLUTION

The mathematical model is based on the equation of Smolukhovsky describing the dynamics in changing the function of size distribution of liquid-drop aerosol particles considering evapora-tion and sedimentation. Applying the dimensional theory the author managed to obtain the criteria characterizing relative efficiency of coagulation and evaporation processes. The parametric analysis of the equations in dimensionless form is carried out. The article introduces the results of experimental research of aerosol disperse parameters.

UDC 535.37

Valiev R.R., Kuznetsova R.T., Cherepanov V.N.
QUANTUM MECHANICAL COMPUTATIONS FOR ELECTRON TRANSITIONS OF TETRAPHENYLPORPHYRIN DERIVATIVES TOGETHER WITH ETHYLENEDIAMINE TETRA-ACETIC ACID

Within the density functional theory with functional B3LYP in base 6-31G the equilibrium geometries of H2ATPP-EDTA molecule of the principle electron state was determined. Using the TDDFT tech-nique the authors modeled the electronic spectrum of absorbing H2ATPP-EDTA molecule in different solvents (ethanol, chloroform, dimethylsulfoxide) in PCM model in bases 6-31G, 6-31G(d), 6-31G(d,p). L-diagnostics was applied for identifying energy under-stated charge transfer transitions. Good fit of theoretical calculations to the experimental data was obtained.

UDC 534.2:539

Belomestnykh V.N., Soboleva E.G.
POISSON'S RATIOS OF ALKALI HALIDE CRYSTALS. P. I. LITHIUM HALOGENIDES

The authors studied the Poisson's ratios of lithium halogenide crystals at standard conditions and temperature change. It is ascer-tained that LiF crystal has negative values of Poisson's ratios in the directions <110, 110>, <111> and in isotropic state in the range from 260 K, 800 K, 1065 K to melting respectively.

UDC 621.315.592:536.24

Tsivinskaya Yu.S., Popov V.N.
CONTROL OF MASS TRANSFER PROCESSES WHEN OBTAINING POLYCRYSTALLINE SILICON BY BRIDGMAN METHOD

Using numerical simulation the authors study incoherent admix-ture distribution in a melt when obtaining polycrystalline silicon by Bridgman method. The article analyses the influence of azimuth-inho-mogeneous heating of a cup side wall on the displaced substance dis-tribution near crystallization front. The processes were considered in the range of parameters corresponding to real temperatures in growth furnace and melt, sizes and form of a cup. It follows from the results obtained that inhomogeneous melt heating changes the structure of convective currents which stimulate dissolved impurity edging to the cup walls in cases of plane or convex crystallization front.