

PHYSICAL AND TECHNOLOGICAL FEATURES OF FORMATION OF METALLIZATION OF SUBMICRON ARSENIDE-GALLIUM STRUCTURES IN LARGE-SCALE INTEGRATED CIRCUITS BY ION MILLING (p. 3-6)

Stepan Novosyadlyy, Taras Kindrat, Lubomyr Melnik, Vasiliy Varvaruk

In large-scale integrated circuits the size of chip is limited by the lithographic process capabilities and specified output of supplementaries, therefore the large scale integration level (10^5 - 10^7) implies high density of components with minimal topological elements decreasing. Since wiring in LSIC structures covers 50-75% of the chip surface, the primary task of structures minimizing is reducing the pitch of multilayer wiring.

A switch to production of LSIC submicron structures focuses the developers' attention on technological methods, ensuring maximum resolving power and formation of small elements (<0.5 mm) with high output of supplementaries.

The paper describes the principles of ion milling, methods of ion-beam processing in lithography, advantages and disadvantages as compared to other methods. It was shown that ion-beam milling is particularly efficient for profiling contact windows of multilayer wiring in LSIC structures. The LSIC structures based on GaAs (Gallium Arsenide) have been obtained with the second level of metallization performed by ion-beam etching using a photoresist mask. The efficiency of post-implantation annealing by ion-beam as compared to thermal annealing has been analyzed. Ohmic contacts with contact windows low resistance have been formed.

Keywords: Gallium Arsenide, ohmic contact, ion implantation, ion milling, ion-beam etching, multiple-charged implantation.

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ESTIMATION OF OPTIMAL SOUND-ABSORBING COVER FOR PREMISES WITH MULTI-TONE NOISE (p. 7-11)

Alexander Mamontov

Despite the wide spread of computing devices and mathematical optimization methods in various fields of knowledge, little attention is paid to optimization of solving the problems of labor safety. In the author's opinion the promising solution is developing the methods of sound-absorbing cover optimization based on non-linear programming, one of which has been the objective of the work. The method for estimation of the optimal cover in premises with multi-tone noise conditions is proposed in the paper. Different noise tones can be absorbed by different materials with the most suitable properties. The method is based on ran-

dom selection of surface area values of different materials, with further selection of the optimal cover. The paper gives the estimation algorithm and the obtained results using the Mathcad computer program.

The estimation results indicate the regularities of achieving the optimum and a significant economic effect. The proposed estimation method and algorithm can be used for taking labor safety measures for noise reduction, namely, sound-absorbing covers design for production facilities. The paper has a scientific novelty, based on random selection of materials surface area values, and practical significance based on economic effect and working conditions improvement.

Keywords: multi-tone noise; sound-absorbing cover; octave frequency band; spectrum limit; minimum cost.

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MODELING OF GAS-PHASE COMPRESSION OF CARBON COMPOSITES IN THERMOGRADIENT CONDITIONS (p. 12-14)

Victor Skachcov, Victor Ivanov, Tatyana Nesterenko, Yuri Mosejko

Properties of carbon-based composites depend on the structure of material, which is characterized by the arrangement of reinforcement filaments, their volume and porosity of material. Reduction of composites porosity is achieved by filling their porous structure with carbon using a method for the isothermal compression (thermal-gradient method).

Isothermal methods are usually applied for compressing thin-walled articles in flow reactors under two-sided admission of reagent gas. The thermal-gradient method is preferable for thick-walled articles, it is characterized by the alternating temperature field over the composite thickness, conditional changing of thermal conductivity coefficients of the porous composite and pyrolytic carbon.

The model of plate-shaped carbon composite has been considered, it has cylindrical pores, which are perpendicular to its surface. The pores surface is smooth and energetically homogeneous. When using the thermal-gradient method the outer side of composite is heated up to the temperature exceeding the temperature of reagent gas, passing over its inner side.

The reagent gas temperature in reactor is significantly lower the threshold value, typical for initial phase of homogeneous processes, and the volume of natural gas, diffusing into the composite porous structure, has quite a low value.

The system of equations has been proposed, describing the processes of temperature distribution on the thickened carbon composite taking into account the reagent gas diffusion into the porous structure of material, and deposition of pyrolytic carbon over the pore walls, which causes porosity reduction and thickness increase of this material.

Keywords: carbon composite, gas-phase compression, pyrolytic carbon, thermal-gradient.

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ESTIMATION OF SCINTILLATION COORDINATES IN GAMMA-CAMERA DETECTOR USING SPLINE APPROXIMATION METHOD (p. 15-19)

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Image formation in gamma-ray cameras is made by defining scintillation coordinates, produced by the absorption of gamma-quanta. By the present time different methods for scintillation coordinates defining have been developed based on previously measured and calculated amplitude-spatial features of a photodetector. The paper gives a method for estimating scintillation coordinates without any prior information. The method is based on approximation of the photodetector response surface, located at the output window of permanent scintillation detector, on the scintillation light distribution function. For the approximation bicubic smoothing splines were used, which weight coefficients are set based on statistical features of measurement results. The paper proposes the approximation algorithm, taking into account geometry of photodetectors distribution at the output window of detector in the points of trigonal lattice.

The algorithm can be applied in gamma cameras and other systems of gamma-rays imaging when using detectors such as gamma cameras. Relatively high computational intensiveness as compared to the Anger's method makes the proposed method more appropriate for off-line processing of accumulated data aimed at improving the image quality.

Keywords: gamma camera, response surface, spline approximation, bicubic spline.

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PROSPECTS OF APPLYING METAL MAGNETIC MEMORY METHOD TO DIAGNOSIS OF METALS (p. 20-24)

Oleg Malakhov, Alexander Kochergin, Dmitriy Devyatkin

The paper gives an information overview and analysis of metal magnetic memory method for metal stress-strain state assessment. The object of this research is an alternative approach to the study of metal constructions by changing their magnetic parameters. The physical basis of the method is the magneto-elastic effect. The purpose of the paper is the analysis of new method and search for the prospects of its further development, as well as setting targets for further research. The paper is written in the form of an analytical overview. It considers and explains structural transformations in metals under elasto-plastic deformation. Also, the empirical dependence of magnetization on magneto-elastic strain in metals has been shown, stresses magnetization increase in elastic range, its slight reduction when transition to plastic deformation and the effect of residual magnetization after unloading have been explained. The mathematical models of the MMM method have been presented. The paper gives brief theoretical principles of the method and preliminary assessment of the level of useful signal. The prospects of the method for diagnosis of metal pre-defect stress state have been estimated. The task of further researches has been set, such as development of computer models for testing the method, diagnostic samples and designs.

Keywords: metal magnetic memory, stress-strain state of metal, non-destructive control

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MECHANISM OF FRICTION SURFACE RENEWAL UNDER THE INFLUENCE OF MAGNETIC FIELD ON WORKING ENVIRONMENT MODIFIED BY DIAMAGNETIK (p. 24-28)

Michael Svirid, Igor Trofimov, Luidmyla Pryimak, Vjacheslav Paraschanov

The paper deals with the influence of magnetic treatment of motor oil on formation of wear resistance of friction pairs and gives the results of our research in this area. The main purpose of the research was studying the mechanism of the friction surfaces renewal caused by changes in the working environment, due to its treatment with magnetic field and modified diamagnetic additive. The complex was used for studying the tribological properties of fuels and lubricants, which has been specially modified, that allowed to move permanent magnets, getting uniform and non-uniform magnetic fields. Thus, material particles, produced from the wear of friction surfaces, have affected by the magnetic power lines of permanent magnet. It has been established that the renewal process in the magnetic field the most actively runs in the S-N-S-N direction and magnetic induction of 0.3 T. Definitely, when using the copper diamagnetic in the oil structure, under the influence of a magnetic field (MF) on the working environment while friction, the surface film thickness reaches 2,5-4,5 micrometer/km. The results of the research can be used in engineering improving reliability of parts of hydraulic systems. The research results can be applied by tribology and chemotology experts, as well as the experts in hydraulic and lubrication systems of ground and aviation equipment.

Keywords: magnetic field, lubricant, oil, friction, wear, renewal, working model, rider, modifier, copper.

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ESTIMATION OF MAGNETIC FIELD GENERATED BY TWO CONCENTRIC CIRCULAR CURRENTS (p. 28-31)

Leonid Lerman, Nataliia Shkoda, Sergii Shostak

The work considers two circular loops of different radii with a common center and plane. The magnetic field has been determined in a plane parallel to the loops plane and passing through the axis of the system symmetry. It is assumed that the field in the loops center reaches zero, and the distance to the observance plane is equal to the size of loops, it means that the field is estimated in the proximal area.

The method for estimating magnetic fields produced by two circular currents in their opposite directions has been presented. For determining the magnetic field induction produced by a flat closed loop at the random point the classical formula of the Biot-Savart-Laplace law is used. The basic formulae and results of numerical calculation of distribution of magnetic fields generated by such system are given. It is shown that the local maximum of magnetic induction vector arises along the axis of symmetry. These results can be used for magnetic carriers confinement during magnetic therapy.

Keywords: circular current, magnetic induction, field of a circular current, vector line integral.

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BLACK LIMIT. PART 11 (p. 31-36)

Sergey Yalovenko

New limitation is introduced – no body can be accelerated to the mass exceeding the mass of a black hole, in addition to the light velocity limitation. Based on this limitation, new formulae for the theory of relativity and extension of classical equations for mass, length, time can be obtained. Charge relativity has been shown. Formulae for charge and gravitation have been extended. The paper considers the extension of the theory of relativity based on the ether theory development, where crypton (strong wave) functions as a discrete element of super-fluid ether, elementary particles are represented as flat whirlpools, gravitation - as varying density of crypton (strong wave) created by flat whirlpools. The charge is presented as a sinusoid tail stretched by a whirlpool, not coiled and created by a dipole offset of the crypton (ether). The energy of particles is presented in the form of transformation of progressive wave energy into rotational whirlpool energy. It is shown that the gravitation of the black hole has flat form.

It is shown that spherical form of stellar explosion with further formation of a black hole transforms into conical one. The equation of gravitation can be written as follows: $F_{\text{gravitation}} (\rho_{\text{ether density}}) = [GMm] \times [1/(\rho_{\text{ether density}})^2] \times P(\alpha, \beta)$

Keywords: gravitation, black hole, whirlpool, crypton, ether density, flat conical explosion of a supernova.

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EFFECT OF INDUSTRIAL EXPLOSIONS ON THE STABILITY IN ROCK MASS WITH CAVITIES (p. 40-44)

Andriy Pasichnyk

The paper substantiates the conditions of seismic stability in the rock mass with cavities, on which protected objects are located, under constant seismic effects of mass explosions in quarries. Based on the ray-tracing method, a mathematical model of the interaction between longitudinal and transverse waves with a spherical cavity has been developed. An algorithm has been elaborated for determining the total static and dynamic loads along the spherical cavity perimeter from seismic explosion waves falling on the interface. The regularities of joint action of static loads have been determined, when located above the objects cavity, with allowance for the effect of the mass of cavity ceiling, the mass of the protected object above it and dynamic loads in the rock mass, and under the plane wave front fall on the cavity from different directions. The dependences of the change of total stresses referred to the incident wave stress at the interface of the rock mass and the cavity depending on the coordinate on its surface have been set. It has been established that the most dangerous points of cavity surface, in which destruction is likely to occur, are the cases when the seismic wave front falls on the cavity from the bottom directions typical for blasting operations in deep quarries. Under the arbitrary angles of the wave incidence on the cavity the stresses rearrange along the perimeter, which under different circumstances might lead to the mass breach and the fall of the protected objects, located above it, under the ground.

Keywords: explosion, dynamics, load, cavity, seismic safety, seismic wave, statics, stability.

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ELECTRON GAS PARAMETERS CHANGE INSIDE LANGMUIR LAYER IN ELECTRIC PROPULSION DEVICES (p. 36-39)

Shahram Roshanpur

Small size of electric propulsion thrusters comparatively with free path lengths of all the processes leads to the situation when electrons non-mirror reflection from near-the-surface potential barrier plays more role in electrons gas parameters change than collisions in the volume. The mathematic model of electrons non-mirror reflection from potential barrier on plasma border with surface or surrounding vacuum is represented. The expression is written for electrons velocity distribution in reflected flow in the form, which is analog to Landau collision integral. The boundary conditions for electrons are written, which must be used in mathematic modeling of processes in electric propulsion thrusters.

Keywords: electric propulsion thrusters, potential barrier, Landau integral, boundary conditions.

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