ABSTRACT AND REFERENCES

APPLIED PHYSICS

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 Novosyadliy, 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.

References

1. Novosyadlyy, S. P. (2010). Sub-structures and nano-mikron technology VIS. Ivano-Frankivsk NV, 254.
2. Shur, M. (1991) Modern instrumentation for arsenyde hallyya, 628.
3. Afanasiev, V. A. (1984) Equipment for heat treatment of PD pulse neutron technology, 12, 24-29.
4. Novosyadlyy, S. P. (2008). Technological features, the formation of layered nanostructures. Eastern European journal of advanced technology., 44(08), 32 - 38.
5. Novosyadlyy, S. P., Vivcharuk, V. M. (2008). Ion source to form layered structures. Carpathian Journal of Scientific Society, 1(08), 151 - 158.
6. Di Lorenzo, D., Kandeluola, D. D. (1988). Field-effect transistors on gallium arsenide. Principles and technology of LSI, 49.
7. Novosyadlyy, S. P., Vivcharuk, V. M., & Vertepnyh, S. M. (2009). Simulation submicron and nano-based TS. Eastern European Journal of Advanced Technologies, 117(09), 26-29.
8. Novosyadlyy, S. P., Vivcharuk, V. M. (2008). Multiply radical implantation in the formation of SOI-structures. Physics and Chemistry of Solids, 3(08), 659-667.
9. Novosyadlyy, S. P., Berezhansky, V. M. (2007). Multiply charged ion-implantation processing in the formation of pockets and metallization submicron VLSI structures. Metal Physics and the latest technology, 7(07), 857-866.
10. Awas, N. A., Naumov, J. E., Frolkin, V. T. (1999). Fundamentals of Microelectronics, 64-67.

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 random 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.

References

1. Iofe, V. K. Korol'kov, V. G. Sapozhkov, M. A. (1979). *Spravochnik po akustike*. M.: Svjaz'. 312 p.
2. Vyhodec, A. V. and others (1989). *Radioveshhanie i jelektroakustika*. M.: Radio i svjaz'. 430 p.
3. Sapozhkov, M. A. (1978). *Jelektroakustika*. M.: Svjaz'. 272 p.
4. Nikiforov, A. S. (2006). Zvukopogloshhajushhie i zvukoizoljacionnye materially. M.: Svjaz'. 322 p.
5. Dzjundzjuk, B. V. (2006). Ohrana truda. Sbornik zadach. Har'kov. 243 p.
6. Mamontov, A. V. (2010). Metodika rascheta optimal'nyh zvukopogloshhajushhih pokrytij pomeshhenij. *ASU i pribory avtomatiki: vseukrainskij mezhvedomstvennyj nauchno-tehnicheskij sbornik, Vyp. 150*, 82-88.
7. Mamontov, A. V., Stycenko, T. E. (2004). Snizhenie akusticheskogo shuma pri proizvodstve i jekspluatacii RJeS. *Radiotehnika: vseukrainskij mezhvedomstvennyj nauchno-tehnicheskij sbornik, Vyp. 139*, 163-166.
8. Den'dobrenko, B. N., Malika, A. S. (1980). *Avtomatizacija konstruirovanija RJeA*. M.: Vysshaja shkola. 384 p.
9. Akulich, I. L. (1993). Matematicheskoe programmirovanie v primerah i zadachah. M.: Vysshaja shkola. 275 p.
10. Gurskij, D., Turbina, E. (2006).Vychislenija v Mathcad -12. M.: Piter. 544 p.

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 t 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.

References

1. Poltorak, V. A., Voevodski, V. V. (1958). About the single chain mechanism of thermal disintegration for hydrocarbons. Lectures AS of USSR. Vol. 91, No 3, 589-591.
2. Kirkhard, P. P. (1975). Carbon aircraft brakes a description. 5th conference on Industrial Carbon and Graphite. – London : Industrial Chemical Society. Vol. 1, 4483.
3. Fitzer, E, Hutner, W., Manocha, L. (1979). Influence of process parameters on the mechanical properties of Carbon/carbon composites with pitch as matrix precursors. 14th Biennial Conference on Carbon. Extended Abstract and Program. – American Carbon Committee. 240-242.
4. Kolesnikov, S. A., Kostikov, V. I., Vasil'eva, A. M. (1991). Compression of carbon purveyances by pyrolysis of gas in the industrial stoves. Chemistry of hard fuel. No 6, 114-122.
5. Skachcov, V. A., Ivanov, V. I., Karpenko, V. D. (2004). Modelling and analysis of gas-phase compression methods for porous carbon-carbon composites Mathematical Modelling. No 2 (12), 47-51.
6. Gurin, V. A., Gurin, I. V., Fursov, S. G. (1999). A study of gas-phase compression by pyrocarbon of porous environments by a method radially motive pyrolysis zone. Questions of atomic science and technique. Vol. 4 (76), 32-45.
7. Allister, L. E., Taverna, A. R. (1976). A study of Composition – Construction Variations in 3D Carbon/carbon composites. Proc. ICCM-75. Vol. 1, 307-317.
8. Scachcov, V. A., Ivanov, V. I., Nesterenko, T. N., Grigorev, S. M., Shapovalov, R. A. (2000). A model of closeness forming for carbon composition materials. Mathematical Modelling. No 2 (5), 75-77.
9. Skachcov, V. A., Ivanov, V. I., Vodennikov, S. A., Mosejko, Yu. V. (2013). A study of gas-phase compression of carbon composites. East-European journal of advanced technologies. No 2/5 (62), 16-19.
10. Volkov, S. D., Stavrov, V. P. (1978). Statistical mechanics of composite materials. Minsk, BSU, 206 p., Bibliogr. : p. 203-205.
11. Awastht, S., Wood, J. L. (1988). Carbon/carbon composites for structural application. Advanced Ceramic Materials. Vol. 3, No 5, 449-451.
12. Thomas, C. R., Walker, E. J. (1997). Advanced Carbon/carbon composites for structural application. Carbon fibres their place in modern technology. No 19, 122-123.

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

Vladimir Plakhotnik, Oleg Malakhov

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 photodetecor 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.

References

1. Kalashnikov, S. D. (1985). Fizicheskie osnovy proiektirovaniia stsintilliatsionnykh gamma-kamier. *Moskow, USSR, Energoatomizdat*, 120.
2. Arlychev, M. A., Novikov, V. L., Sidorov A. V. et al. (2009). Dvukhdetektornyi odnofotonnyi emissionnyi gamma-tomograf. *Journal of Technical Physics*, v.59(10), 138-147.
3. Kamyshan, V. A., Pedash, V. Yu. Vosstsnovleniie tochiek vzaimodieistviia v tolstom PCH dietiektorie dlia gamma-tielieskopa – http://2010.ismart.kharkov.ua/presentations/19/kamyshan_ismart_2010.pdf - 29.04.2013 r.
4. Bronstein, A., Bronstein, M., Zibulevsky, M., Zeevi, Y. Y. (2001). High-energy photon detection in PET using adaptive non-linear parametric estimation algorithms. http://visl.technion.ac.il/projects/2001s10/ - 29.04.2013 r.
5. Plakhotnik, V. Yu., (2004). Issliedovaniie kharaktieristik prostranstviennykh raspriedielienii vychisliennykh koordinat stsintilliatsii v pozitsionno-chuvstvitielnom dietiektorie tipa gamma-kamiery. Naukovi pratsi Dohetskoho natsionalnoho tekhnichniho universytetu. Seriia: "Obchisliuvalna tekhnika ta avtomatyzatsiia". Vypusk 74. – *Donetsk, DonNTU*, 272 - 286.
6. Plakhotnik, V. Yu., Poliakov, G. A. (2010). Algoritmy vychislieniia koordinat stsintilliatsii v dietiektorie gamma-kamiery. *Journal of Nano- and Electronic Physics*, 2(1), 94-99
7. Knoll, G. F. et al. (1988) Light collection scintillation detector comt posited for neutron detection. *IEEE Trans. Nucl. Sci,* 35, 872–875.
8. Korn G., Korn T. (1978). Spravocnik po matiematikie (dlia nauchnykh rabotnikov i inzhienierov) – *Moskow, USSR: Nauka*, 832.
9. Gavriliuk, V. P., Diemin, A. V., Kolbasin, V. A. (2009) Algoritmy vosstanovlieniia izobrazheniia v gamma-kamierie. Stsintilliatsionnyie matierialy. Inzhenieriia, ustroistva, primienieniie. – *Kharkov: "ISMA",* 332
10. Shikin, Ie.V., Plis, A.I. (1996). Krivyie i povierkhnosti na ekranie kompiutera. Rukovodstvo po splainam dlia polzovatieliei. *Moskow, USSR: Dialog-MIFI,* 240.

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

References

1. Dubov, A. A. (2008). Metod magnitnoy pamyati metalla i pribori kontrolya. M. : ZAO "TISSO", 365.
2. Li-hong, Dong. The Application of metal magnetic memory testing to the field of the life estimation of remanufacturing blanks. Beijing.
3. Roskosz, M. (2010). The metal magnetic memory method in the diagnostics of power machinery component. Issue 1., vol. 43.
4. Roskosz, M. (2010). Metal magnetic memory testing of welded joints of ferritic and austenitic steels. NDE for safety: Defectoskopie.
5. Vlasov, V. T., Dubov, A. A. (2004).Fizicheskie osnovi metoda magnitnoy pamyati metalla. M.: ZAO "TISSO", 424.
6. Magnitouprugiy effect. Fizicheslie osnovi polucheniya informatsii. URL: http://cxembl.net/spravochnyie-materialyi/lekcii/magnito-uprugij-e-ffekt-fizicheskie-os/.
7. Craik, D. J. (1970). Magnetisation changes induced bei stress in a constant applied field. J. Appl. Phus., vol. 3, 1009-1016.
8. Atherton, D. L. (1983). Effect of stress on the magnetization of steel. JEEE Trans. Magn., mag. 19., vol. 5, 2012-2023.
9. Langman, R. A. (1987). The effect of stress on the magnetization of mild steel at moderate field strength. JEEE Trans. Mag., vol. 21, 1314-1320.
10. Kuleev, V.G. (1985). K problemi kontrolya magnitnogo sostoyaniya ferromagnitnoikh staley pri vozdeystvii na nikh magnitnikh poley i uprugikh nfpryazheniy v zareleevskoy oblasti. Defektoskopiya, 33-42.
11. Kuleev, V. G. (2007). Issledovanie prichin sutshestvennikh razlichiy velichin koertsitivnoy sili, ostatochnoy namagnichennosti i nachalnoy magnitnoy pronitsaemosti ferromagnitnikh staley v nagruzhennom sostoyaniyakh pri ikh plasticheskom rastyazhenii. FMM., t. 103. „№2, 136-146.
12. Tsarkova, T. P. (2009). Osobennosti magnitouprugogo effekta v plasticheski deformirovannikh ferromagnitnikh stalyakh v slabikh magnitnikh polyakh. FMM., t. 108., №3, 227-236.

13. Novikov, V. F. (2006). Zakonomernosti magnitouprugogo izmeneniya lokalnoy ostatochnoy namagnichennosti staley. Zavodskaya laboratoriya. Diagnostika materialov., t. 72., №2, 34-37.
14. Leng, Jiancheng. (2010). Characterization of the Elastic-plastic region based on magnetic memory effect. Chinese Journal of mechanical Engineering., vol. 23., №4, 1-5.
15. Kinser, E. (2003). Modeling the interrelating effects of plastic deformation and stress on magnetic properties of materials. Journal of Applied Physics., vol. 93(10), 626-628.

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 chemmotology 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.

References

1. Beluy, V. A., Ludemy, G. D., Myshkina, K. N. (1993). Tribology. Researches and suggestions: Experience of the USA and countries of the CIS [Tribologiya. Isledovaniya I predlozheniya: Opit USA I stran SNG]. M.: New York, 175.
2. Beluy, A. V., Karpenko, G. D., Myshkin, K. N. (1991). Structure and methods of forming of wearproof superficial layers [Struktyra I metodu formirovaniya iznosostoykih poverhnostnih sloev]. M.: Engineer, 45.
3. Rozman, G. A. (2001). Structure and properties of matter (train aid). [Stroenie I svoystva veschestva]. – Pskov, PGPI, 292.
4. Bolotov, A. N., Lochagin, N. V., Mikhalev, Yu. O. (2010). Role of the magnetic field at the friction of surfaces, oiled magnetic butter [Rol magnitnogo pola pri trenii poverhnostey, smazuvaemih magnitnum polem]. Friction and wear, T.9, №5, 870-877.
5. Lisikov, E. M. (2004). An increase of resource of triboconnection of the technical systems is by influence of the electrostatic field on lubricating materials [Pidvuschtna resyrsy tribospolychen tehnichnuh system shlahom vplivy electrostatichnogo pola na mastilni materialu]. Technique and technology of implementation of, travel and shifting construction-works on a transport [Tehnika ta tehnologoya vikonanya bydivelnuh, koliynuh ta perevantazhyvalnuh robit na transporti], №58, 5-10.
6. Tret'yakov, I. G., Korolenko, Yu. I. (1978). Influence electromagnetic treatment on antiwear properties of individual hydrocarbon connections. Questions of aviation chimmotologi [Vliyanie electromagnitnoy obrabotki na protivoiznosnue svoystva individualnuh yglevodorodnuh soideneniy. Voprosu aviacionnoy himmotologyi], №2, 141-144.
7. Podgorkov, V. V. (1990). To carry ability of magnetic liquids [Nesuschaya sposobnost magnitnuh zhidkostey]. Friction and wear, T.11, №2, 359-361.
8. Svirid, M. M., Kudrin, A. P., Kravec, I. A., Priymak, L. B., Borodiy, V. M. Pat.70877 Ukraine. GO1N 3/56 Device for research surfaces of friction in the permanent even and uneven magnetic field [Pristriy dla doslidzhtna poverhon tertya v postiynomu rivnomirnimy na nerivnomirnomu poli] – № u2012 70877; appl. 16.03.2012; publ. 25.06.2012, bull. №14.
9. Svirid, M. N., Kudrin, F. P., Priymak, L. B. (2012). Tribology parameters of steel in treated the magnetic field lubricating materials [Tribologicheskie parametru staley v obrabotanuh magnitnum polem smazuvayuschih materialah]. Problems tribology, №1, 22-24.
10. Akhmatov, A. S. (1963). Molekulyar physics of border friction [Molekularnaya phizika granichnogo treniya]. Moscow, Fiz. gizas, 472.

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.

References

1. Landau, L. D., Lifshitz E. M. (1982). Elektrodinamika sploshnyh sred: Teoreticheskaya fizika. V.8. *Moskwa: Nauka*, 624.
2. Ahiezer, A.I. (1981). Obschaya fizika. Elektricheskie I magnitnye yavleniya. *Kiev: Naukova Dumka*, 468.
3. Getman, A.V., Konstantinov, A.V. (2010). Analiticheskoo predstavlenie magnitnogo polya solenoid s pomoschu tsilindricheskih garmonik. *Elektrotehnika I Elektromehanika*, 5, 43–45.
4. Getman, A.V., Konstantinov, A.V. (2012). Cilindricheskie garmoniki skalyarnogo potenciala magnitnogo polya tokovoi obmotki elektromagnita. *Visnyk Natzionalnogo tehnichnogo universytetu, XIII*, (49), 66–72.
5. Kalantarov P. L., Ceitlin L. A. (1970). Raschet induktivnostei. *Moskwa: Energiya*, 180.
6. Cherkashin U. S. (2005). Vliyanie parazitnyh parametrov linii svyazi na vybor rejimov elektricheskoi tzepi. *Moskva: Elektrichestvo*, №5.
7. Elektrotehnicheskii spravochnik. Pod redakciei M.G. Chilikina. (1952). *Moskwa: Gosenergoizdat*, 143, 599, 609.
8. Osnovy electrotehniki. Pod redakciei K.A. Kruga I drudih. (1952). Moskva: *Gosenergoizdat*, 258.
9. Vergun, L.U., Gorbyk, P.P., Grechko, L.G., Dubrovin, I.V., Korduban, O.M., Lerman, L.B., Chekhun, V.F., Shpak, A.P. (2007). Nanokompozity medico–biologicheskogo naznacheniya na osnove ultradispersnogo magnetite. In book: Fiziko–himiya nanomaterialov I submolekulyarnyh struktur. V.1, P. 45–89.
10. Forsait Dj., Malkolm M., Mouler K. (1980). Mashinnye metody matematicheskih vychislenii. *Moscow, USSR: Mir*, 280.

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: $F_{gravitation}(\rho_{ether\ density})=[GMm]\times[1/(\rho_{ether\ density})^2]\times P(\alpha, \beta)$

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

References

1. Einshtein, A. (2000).Teorija otnositel'nosti. Nauchno-izdatel'skij centr "Reguljarnaja i haoticheskaja dinamika".
2. Feynman, R., Leyton, R., Syends, M. Feynmanovskie lekcii po fizike.
3. Yalovenko, S.N. (2009). Chjornyj predel. Teorija otnositel'nosti: novyj vzgljad. Materialy Mezhdunarodnoj nauchno-prakticheskoj konferencii «Aktual'nye problemy sovremennyh nauk-2009». Nauka I studia, № 21, 85.
4. Yalovenko, S.N. (2009). Teorija otnositel'nosti. Novyj vzgljad. Ural'skij nauchnyj vestnik. Nauchno-teoreticheskij i prakticheskij zhurnal, №5(20). ZhShS «Uralnauchkniga», 33.
5. Yalovenko, S.N. (2009). Chjornyj predel. Vestnik nacional'nogo tehnicheskogo universiteta "HPI", №8, 81.
6. Yalovenko, S.N. (2008). Chjornyj predel chast' 1. Vestnik nacional'nogo tehnicheskogo universiteta "HPI", 43, 144.
7. Yalovenko, S.N. (2009). Chjornyj predel. Teorija otnositel'nosti: novyj vzgljad. TOV izdatel'stvo «Fort».
8. Yalovenko, S.N. (2010). Chjornyj predel. Teorija otnositel'nosti: novyj vzgljad. Chast' 5. Mirovozzrenie. Materialy 6 Mezhdunarodnoj nauchno-prakticheskoj konferencii «Nauka i innovacii - 2010». Techniczne nauki Fizyka. Nauka I studia, №.13, 105.
9. Yalovenko, S.N. (2010). Chjornyj predel. Teorija otnositel'nosti: novyj vzgljad Materialy 6 Mezhdunarodnoj nauchno-prakticheskoj konferencii «Nauka: Teorija i praktika - 2010». Nauka I studia, № 7, 78.
10. Yalovenko, S.N. (2009). Black limit. Theory of relativity. New view. Nauchno-teoreticheskij i prakticheskij zhurnal. «Sovremennyj nauchnyj vestnik, №21 (77), 67.
11. Yalovenko, S.N. (2009). Razdel. Fizyka. Teoretyczna fizyka. Black limit. Theory of relativity. New view. Materialy 6 Mezhdunarodnoj nauchno-prakticheskoj konferencii «Nauka: Teorija i praktika». Nauka I studia, № 6, 17.
12. Yalovenko, S.N. (2010). Continuation of the theory of a relativity. Materialy 6 Mezhdunarodnoj nauchno-prakticheskoj konferencii «Nauchnyj progress na rubezhe tysjacheletij - 2010», 27.05-05.06.2010. Praga: «Education and Science», 10.

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.

References

1. Grishin, S. D., Leskov, L. V., Kozlov, N. P. (1975). Electricheskiye raketniye dvigateli, Moscow, USSR: Mashinostroyeniye, 273.
2. Oh, D. Y., Landau, D. (2011). A Simple Semi-Analytic Model for Optimum Specific Impulse Interplanetary Low Thrust Trajectories. *Proc. 32nd IEPC, Wiesbaden, Germany,* 22.
3. Shoji Kitamura, Yukio Hayakawa, Satomi Kawamoto. (2011). A Reorbiter for GEO Large Space Debris Using Ion Beam Irradiation. *Proc. 32nd IEPC, Wiesbaden, Germany,* 23.
4. Weis, S., Koch, N., Schirra, M., Lazurenko, A., van Reijen B., Haderspeck, J., Genovese, A., Holtmann, P. (2011). Architecture, Functional Features and Operational Characteristics of the HEMPT based Ion Propulsion System. *Proc. 32nd IEPC, Wiesbaden, Germany,* 30.
5. Hiroshi Nagano, Kenichi Kajiwara, Yukio Hayakawa, Toshiyuki Ozaki, Yukikazu Kasai. (2011). Optimization of the Operating Parameters for a 20 mN Class Ion Thruster. *Proc. 32nd IEPC, Wiesbaden, Germany,* 70.
6. Loyan, A. V., Maksymenko, T. A., Koshelev, N. N., Rybalov, O. P. (2011). Investigations of Low Power Hall Thruster SPT-20M on Increased Voltage Mode. *Proc. 32nd IEPC, Wiesbaden, Germany,* 633.
7. Hatef Dinparasti Saleh, Nesterenko, S. Yu. (2011). Mathematical Model of Acceleration Stage of Magnetic Inductive Pulsed Plasma Thruster. *Proc. 32nd IEPC, Wiesbaden, Germany,* 623.
8. Nesterenko, S. Yu. (2011). Elektrogazodinamika. Kharkiv, Ukarine: KhAI. Available: http://library.khai.edu/.
9. Lifshic, E. M., Pitayevskiy, L. P. (1979). Fizicheskaya kinetika. Moscow, USSR: Nauka.
10. Rossi, B., Olbert, S. (1974). Vvedeniye v fiziku kosmicheskogo prostranstva. Moscow, USSR: Atomizdat.

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.

References

1. Allard, P. (2002). Mesures sismiques dans Lenvironneet des tirs. Mines et carriors, 84, 49–51.
2. White, J. (1986). The excitation and propagation of seismic waves: Trans. from English. O. Pavlova and S. Goldin, Moscow, Nedra, 261.
3. Stevens, L. O'Brien, J. O'Brien, M. (2011). Seismic wave generation and propagation from complex 3D explosion sources. Monitoring Research Review: Ground-Based Nuclear Explosion Monitoring Technologies.
4. Karlheinz, A. (1997). Development of rules for the assessment of blasting vibration to buildings. Naturstein Ind., 33, № 8, 22–24.
5. Baron, R. (1994). Threshold values for blast damage assessment. Tunnels and Tunnelling, 26, № 5, 46-47.
6. Farnfield, R. A. (1993) Research into the effect of surface mine blasting on buldings: Long term, monitoring projects. Mining Eng., 152, № 380, 319-323.
7. Serhan Samir, J. (1995). Current seismic design criteria in the USA. Technol. for Competit. World: Proc. Amer. Power Conf. Chicago, III, 400–405.
8. Zviahilsky, E. (1999). Preventing failures earth's surface over abandoned mines. Coal of Ukraine, № 5, 23–25.
9. Pasichnyk, A. (2008). Conditions for stability of karst cavities in the rock mass under static loads. Modern resurces and energy safe technology of mining, Issue №2/2008(2), 102-110.
10. The influence of blasting on the surrounding quarries JSC "Mykolaiv" buildings and structures of settlements and develop recommendations for their seismic safe conduct: Report on R & D (final) / NNDIOP; № DR 0106U007694; Inv. № 0207U06084, Kyiv, 2006, 85.
11. Vorobyov, V. Kruchkov, A. Pasichnyk, A. Sidor, R. (2008). The study of the seismic activity of mass explosions at different times of the year when developing Peski deposits of gypsum. Journal of NTU "KPI". Series "Mining": Collected Essays, Issue 17, 25-34.
12. Vorobyova, L. Tkach, N. Pasichnyk, A. Zhukova, N. (2009). Patterns of interaction of seicmic explosion waves with an array of rock with emptines. Modern resurces and energy safe technology of mining, Issue №1/2009(3), 63-70.