ABSTRACT AND REFERENCES

APPLIED PHYSICS

AN IMPROVED TECHNOLOGY OF A COMPLEX INFLUENCE ON PRODUCTIVE LAYERS OF OIL AND GAS WELLS (p. 4-9)

Oleg Kravchenko, Dmitriy Velighotskiy, Andrey Avramenko, Ruslan Habibullin

The research focuses on an advanced technology of improving the collector properties of the bottom-hole zone in the productive horizons of oil and gas wells. The technology is based on a complex hydrogenic and thermal gas-chemical treatment of the wells.

The bottom-hole zone of the wells is directly exposed to a multi-step thermal gas and chemical process that releases gas, including hydrogen, and hot acids such as nitric and hydrochloric (in some cases it is hydrofluoric).

Hydrogen, discharged at the initial stage of the thermal chemical process, improves the permeability of the reservoir and facilitates filtering chemically active components into the layer. In order to specify and improve these processes, the study suggests a mathematic modeling of how a mixture of gases (H_2, CO_2, NO, and NO_2) influences gas permeability in the carbonate core.

The suggested computer model facilitates precise calculation of thermal gas dynamic as well as heat and mass exchange characteristics of the process in the layer bottom-hole zone at all the stages of its treatment. The model makes it possible to choose the most effective modes of processing and reduce the consumption of expensive reagents.

This technology was applied in the treatment of wells in which hydrocarbon reserves would usually be referred to the category of "problematic extraction" for a number of reasons—water cutting of the layer, high content of asphalt, resin and paraffin deposits, or low permeability, etc. The research findings have confirmed a high productivity of the devised technological approach.

Keywords: oil well, hydrogen, activation, permeability, collector, anomalous properties, bottom-hole zone.

References

1. Kravchenko, O. V., Velighotskiy, D. A., Matsevitiy, Y. M., Simbirskiy, A. V. (2006). Patent 102501, Ukraine, IPC E21B 43/24 (2006.01), E21B 43/25 (2006.01) Way complex hydrogen and thermobarochemical influences on at well bottom a zone of a productive layer. The applicant and assignee Scientific and technical concern " Institute of problems of mechanical engineering " NAS Ukraine. № and 201303001. Filed 11.03.2013. Publication Date 10.07.2013. Text № 23.
2. Lebedev, N. N. (1971). Chemistry and technology of the main organic and oil-chemical synthesis. Moscow: Chemistry, 840.
3. Svetlitskiy, V. M., Demchenko, P. N., Zaritskiy, B. V. (2002). Challenges of wells' productivity increase. Kiev: Palivoda, 228.
4. Voitenko, Y. I., Kravchenko, O. V., Velighotskiy, D. A. (2013). About an opportunity of change filtrational and durability properties of dense breeds – collectors on meso-and nanolevel at explosive and thermobarochemical influence. Works of the international scientific – practical conference « Prospects of use of alternative and renewed energy sources in Ukraine (REU 2013) », 13–18.
5. Scherbina, K. G. (1999). Chemical-physical bases of high-temperature influence on a zone of bottom well hydroreaction structures. Kiev: Open Society « Ukrainian oil-and-gas institute », 34.
6. Yaremiychuk, R. S., Svetlitskiy, V. M., Saviuk, G. P. (1993). Increasing wells' productivity when developing and running paraffin-base oilfields. Kiev: Ukrgiproniineft, 225.
7. Kravchenko, O. V. (2013). Hydrogen activation during increase of permeability oil-gas breeds. Eastern-European Journal of Enterprise Technologies, 1/6 (61), 21–25. Available at: http://journals.uran.ua/eejet/article/view/9189/7984
8. Fernandes, P. D., Oliveira, T. J., Souza, S. D. et. all. (2012). Simulation of Transient Pressure Behavior for a Well With a Finite- Conductivity Vertical Fracture. 5th Latin American CFD Workshop, Applied to the oil and gas industry, 1–22.
9. Imperial College Consortium on Pore-scale Modelling. Available at: http://www3.imperial.ac.uk/earthscienceandengineering/research/perm/porescalemodelling
10. Malek, K., Coppens, M. O. (2003). Knudsen self- and Fickian diffusion in rough nanoporous media. Journal of Chemical Physics, 110 (5), 2801–2811. doi: 10.1063/1.1584652

INVESTIGATION OF THE THERMAL EFFECT OF THE CLEANING FLUID JET ON THE OIL SEDIMENT IN THE TANK (p. 10-14)

Vladimir Lipovoy

When unloading the tank, a part of oil products stays on the inner surfaces, structures, in the form of solid (stuck) layer. In addition, some of them remain in the pipes, valves and pumps of cargo and stripping systems. Impurities, paraffin, asphalt-resinous inclusions, exfoliated corrosion products settle at the tank bottom. As a result, an unpumped residue is formed, the amount of which varies widely and depends on several factors such as physicochemical properties of oil products, transportation temperature, technical condition of the cargo system, etc. The residue is a mixture of oil products, and when cleaning tanks, there is a fire-dangerous situation that may result in fire, explosion or environmental pollution of territories.

The problem of identifying the impact of factors on man-made risks of environmental pollution by harmful substances that are formed as a result of use and repair of tanks with oil products is a scientific basis for improving environmental safety and reliable security of human life near such objects.

It was found that the temperature difference of the oil residue layer and cleaning fluid does not exceed 1.5^{0}C, even with the increased by several orders of magnitude layer thickness.

The temperature difference will be even less for the above values of oil residue layer thicknesses, determined from experimental data.

The results allow to model and calculate the evaporation rate of oil residues and forecast the size of pollution zone and man-made risks, associated with these processes.

Keywords: heat transfer process, oil residue, tank with oil products, fire and explosion hazard, environmental hazards, man-made risks.

References

1. Akimov, V. A., Lapin, V. L., Popov, V. M., Puchkov, V. A., Tomakov, V. I., Falee, M. I. (2002). Nadezhnost' tehnicheskih sistem i tehnogennyj risk. Moscow: ZAO FID "Delovoj jekspress", 368.
2. Kacman, F. M. (2003). Zashhita ot korrozii neftjanyh rezervuarov-aktual'naja zadacha sovremennosti. Zhurnal Neftegaz, 11, 17–19.
3. Shavlovskij, S. S. (1979). Osnovy dinamiki strui pri razrushenii gornogo massiva. Moscow: Nauka, 174.
4. Golikov, V. A., Anfinogentov, V. V. (2011). Tehnologija nauchnogo issledovanija po sovershenstvovaniju predremontnoj podgotovki tankov neftenalivnyh sudov. Problemy sbalansirovannosti mirovogo rynka morskoj torgovli, 47–52.
5. Anfinogentov, V. V. (2010). Opredelenie kolichestva tehnologicheskogo ostatka mazutov posle vygruzki tankera. Sudovozhdenie: collection of scientific papers, 19, 8–13.
6. Udjanskij, N. N., Lipovoj, V. A., Larin, A. N., Kardenov, S. A. (2014). Zadacha teploobmena pri strujnoj ochistke rezervuarov ot ostatkov nefteproduktov. Vestnik Kokshetauskogo tehnicheskogo instituta Ministerstva po chrezvychajnym situacijam Respubliki Kazahstan, 1(13), 52–55.
7. Gimaletdinov, G. M., Sattarova, D. M. (2006). Sposoby ochistki i predotvrashhenija nakoplenija donnyh otlozhenij v rezervuarah. Neftegazovoe delo: scientific and technical journal, 1, 40–52.
8. Golikov, V. A., Anfinogentov, V. V. (2011). Opredelenie racional'nogo rezhima processa mojki gruzovogo otseka tankera. Problemi tehniki: Scientific Production Journal, 2, 87–95.
9. Nazarov, V. P. (2005). Problemy i metody obespechenija zryvobezopasnosti predprijatij neftegazovogo kompleksa. Vestnik Akademii Gosudarstvennoj protivopozharnoj sluzhby, 4, 209.

10. Nazarov, V. P., Kirshev, A. A. (2012). Fire danger of the hydraulic cleaning of oil products tanks. Internet magazine “Technology technospheric security”, 3 (43), 1–9. Available at: http://agps-2006.narod.ru/ttb/2012-3/20-03-12.ttb.pdf
11. Korshak, A. A., Klimko, V. I.; Lipskii, V. K. (Ed.) (2011). Vybor optimal’nyh rezhimov jekspluatacii magistral’nyh truboprovodov. Proceeding of VII international Scientific and Technical Conference. Nadezhnost’ i bezopasnost’ magistral’nogo truboprovodno-go transporta. Polotsk State University. Novopolock, 77.
12. Tarnovskij, D. M. (2012). Profilaktika nakoplenija pirofornyh otlozhenij v tehnologicheskom oborudovanii s nefteproduktami. Proceeding of VI international Scientific and Technical Conference. Obespechenie bezopasnosti zhiznedejatel’nosti : problemy i perspektivy. Part. 1. Minsk: KII, 151–153.
13. Golikov, V. A., Mamkichev, N. A., Popov, V. G. (2000). Linejnaja matematicheskaja model’ dinamiki ochistki vozduha ot himicheskih zagrjaznitelej v central’nom kondicionere. Collection of scientific papers of Admiral Makarov Ukrainian State Marine Technical University, 2 (368), 24–29.
14. Zimon, A. D. (1974). Adgezija zhidkosti i smachivanie. Moscow: Himija, 413.
15. Makushok, E. M. (1974). Mehanika trenija. Minsk: Nauka i tehnika, 256.
16. Fuks, G. I. (2003). Vjazkost’ i plastichnost’ nefteproduktov. Moscow-Izhevsk: Institut komp’juternyh issledovanij, 328.
17. Hnykin, V. F. (1969). Razrushenie gornyh porod gidromonitornymi strujami na otkrytyh razrabotkah. Moscow: Nauka, 150.
18. Isachenko, V. P., Osipova, V. A., Sukomel, A. S. (1981). Teploperedacha. Moscow: Jenergoizdat, 417.
19. Tananajko, Ju. M., Voroncov, E. G. (1975). Metody rascheta i issledovanija plenochnyh processov. Kiev: Tehnika, 311.
20. Basmanov, A. E., Mihajljuk, A. A. (2009). Vzaimodejstvie vodjanoj strui so stenkoj rezervuara pri ego ohlazhdenii v uslovijah pozhara. Problemy pozharnoj bezopasnosti, 25, 14–19.
21. Mojka gruzovyh tankov i toplivnyh cistern tankerov. Tipovaja tehnologija, tehnicheskie trebovanija: RTM31.2006-78 (1980). Official edition, 78.
22. Sistemy podogreva zhidkih gruzov morskih neftenalivnyh sudov. Pravila i normy proektirovanija: RD5.5524-82 (1984). Official edition, 105.

THE STUDY OF THE AMOUNT OF HEAT RELEASE IN THE SINTER CHARGE LAYER (p. 14-18)

Anton Mnyh

Based on the data on the chemical composition of charge at the sinter plant MK “Zaporizhstal” (Ukraine), dependencies, allowing to determine the amount of released and absorbed heat energy per unit volume of the sintered charge by the layer height from the average diameter of the material particles were obtained in the paper.

Equations, allowing to calculate the amount of heat energy, released and absorbed per unit volume of the charge as a result of the combustion of the fuel particles and exo- and endothermic reactions, proceeding therein are presented.

The results allow a close approach to the problem of the optimization of the thermal regime of the agglocharge sintering process on the author’s model, based on finite element method, which takes into account the internal heat release per unit volume, as well as determination of polydisperse charge layer formation laws for rational distribution of fuels and chemical components by the height of the agglomerated layer.

Keywords: average charge diameter, heat energy, drum feeder, agglomeration, segregation, polydisperse charge.

References

1. Bazilevich, S. V., Vegman, E. F. (1967). Aglomeraciya. Moscow: Metalurgiya, 368.
2. Sigov, A. A., Shurhal, V. A. (1969). Aglomeracioniy process. Kiev: Tehnika, 232.
3. Brazjnikov, S. G., Berman, U. A., Belocerkovskiy Y. L. (1970). Teplotehnika okuskovaniya gelozorudnogo sirya. Moscow: Metalurgiya, 343.
4. Frolov, U. A. (2005). Teplotehnicheskoe issledovanie processa aglomeracii I sovershenstvovanie tehnologii I tehniki proizvodstva aglomerata. Ekaterinburg, 49.
5. Dmitrieva, E. G. (2009). Sovershenstvovanie technologii I oborudovaniya dlya proizvodstva aglomerata. Stal, 2, 4–6.
6. Vatkin, A. A. (2008). Metod prognozirovaniya prochnosnih svoistv aglomerata. Chernaya metalurgiya, 3, 44–47.
7. Kalashnikov, S. N. (2002). Matematicheskoe modelirovanie teplovih procesov v metalurgicheskih agregatah na osnove ob’ektnoy technologii. Novokuznetsk, 278.
8. Eliseev, A. A. (2006). Issledovanie teplo-massoobmenih procesov pri aglomeracii shihty. Cherepovec, 165.
9. Bokovikov, B. A. (2010). Matematicheskaya model obzigovoy konveernoy mashini kak instrument dlya optimizacii teplovoy shemi agregata. Stal, 9, 84–87.
10. Mnyh, A. S. (2014). Issledovanie himicheskogo sostava frakciy aglomeracionnoy shihty dlya usloviy kombinata “Zaporijstal”. Teoriya I praktika metalurgii, 3-6, 35–38.
11. Mnyh, A. S. (2014). Reshenie zadachi raspredeleniya temperaturi v edinichnom ob’eme aglomeracionogo sloya motodom konechnih elementov s uchetom vnutrenih istochnikov tepla. Zbirnyk naukovih prac DDTU (tehnichni nauky), 2 (25), 47–51.
12. Mnyh, A. S. (2014). Sintez trehmernoy modeli teplovogo regima procesa spekaniya aglomeracionoy shihty. Visnyk KrNU (zbirnyk naukovih prac), 38, 44–47.
13. Korotich, V. I. (1978). Osnovy teorii I tehnologii podgotovki syr’a k domennoy plavke. Moscow: Metalurgiya, 208.
14. Minakov, N. S., Arykov, G. A., Kolokolcev, B. I. (1996). Issledovanie vliyaniya gazodinamicheskogo regima na pokazateli procesa aglomeracii pri spekanii shihty v visokom sloe. Stal, 6, 6–11.
15. Tarasov, P. V. (2006). Osnovnie zakonomernosti soprotivleniya I gazopronicaemosti zernistogo sloya. Stal, 3, 12–15.

DEVELOPMENT OF EXPRESS-EVALUATION METHOD OF WATER BIOLOGICAL PROPERTIES (p. 18-25)

Natalia Glukhova

The paper deals with experimental methods for studying the biological properties of water. The existing problems of theoretical and experimental study of the anomalous water properties that are not consistent with the known theoretical models were considered. The crucial importance of water structure features for normal functioning of living organisms was shown. Since the standard classical methods of physical-chemical analysis do not provide the possibility of implementing experimental evaluation of specific biological properties of water, a method for registering images of the gas discharge flow of liquid-phase objects in an electromagnetic field with the subsequent software image processing based on cluster analysis was proposed as an alternative. The following tasks were set and solved in the paper: allocation of patterns in gas discharge water glow images, digital processing of image samples, construction of image classification methods and algorithms. Bezdek-Dunn algorithm (Fuzzy ISODATA algorithm, FCM algorithm) was used for the fuzzy image clustering. The effectiveness of the proposed research method was tested on real data samples for waste and natural water samples. The characteristic features of the gas discharge glow of natural water as the coherent material, which provides a significant response to an external impact in the form of an electromagnetic field were determined. The obtained results of the extraction of specific parameters from the structural features of the gas discharge glow images show the effectiveness of algorithms for fuzzy clustering of water samples with different biological properties.

Keywords: gas discharge glow, water quality, digital image processing, cluster analysis.

References

1. Kuharski, R. A., Rossky, P. J. (1985). A Quantum Mechanical Study of Structure in Liquid H2O and D20. The Journal of Chemical Physics, 82 (11), 5164–5177. doi: 10.1063/1.448641
2. Habershon, S, Thomas, E. Markland, D. E. (2009). Competing Quantum Effects in the Dynamics of a Flexible Water Molecule. The Journal of Chemical Physics, 131 (2), 234–241. doi: 10.1063/1.3167790
3. Krasnobryzhev, V. G., Couric, M. V. (2010). Kvantovye effekty v prirodnoy vode. Kvantovaya Magiya, 7 (4), 4132–4138.
4. Zeidler, A. (2011). Oxygen as a Site Specific Probe of the Structure of Water and Oxide. Materials Physical Review Letters, 107 (14). doi: 10.1103/physrevlett.108.259603

5. Reiter, G. F., Aniruddha, D. Y. Sakurai, I. M., Krishnan, V. G., Paddison, S. J. (2013). Anomalous Ground State of the Electrons in Nanoconfined Water. Physical review letters, 111 (3). Available at: http://journals.aps.org/prl/abstract/10.1103/PhysRevLett.111.036803 doi: 10.1103/physrevlett.111.036803
6. Mayers, J., Reiter, G. (2012). Spurious indications of energetic consequences of decoherence at short times for scattering from open quantum systems. AIP Advances, 2 (3), 032137. Available at: http://scitation.aip.org/content/aip/ journal/adva/2/3/10.1063/1.4746093 doi: 10.1063/1.4746093
7. Tedeschi, A. (2014). On the coherent water's edge. Conference on the Physics, Chemistry and Biology of Water. Available at: http://www.waterconf.org/participants-materials/abstracts/Tedeschi.docx
8. Kuryk, M. V., Pisotska, L. A, Glukhova, N. V., Horova, A. I., Borysovska, O. A., Pavlishyn, A. V. (2013). Kirlianohrafichne otsinyuvannya biodostupnosti rechovyny. Medychna informatyka ta inzheneriya, 2, 37–41.
9. Arani, R., Bono, I., Del Giudice, E., Preparata, G. (1995). Qed coherence and the thermodynamics of water. Condensed matter physics; statistical physics; atomic, molecular and optical physics, 9, 510–532.
10. Bono, I., Emilio Del Giudice, Luca Gamberale, Marc Henry. (2012). Emergence of the Coherent Structure of Liquid Water. Water, 4 (4), 510–532. doi: 10.3390/w4030510
11. Johannson, B. (2014). Do quantum state oscillations in natural drinking water benefit human health? Conference on the Physics, Chemistry and Biologi of Water. Available at: http://www.waterconf.org/participants-materials/abstracts/Johansson.pdf
12. Ignatov, I., Mosin, O. (2012). Water in the Human Body is Informational Bearer about Longevity. Sofia, Bulgaria. Available at: http://www.medicalbiophysics.dir.bg/en/longevity.html
13. Marinov, M., Ignatov, I. (2008). Color Coronal (Kirlian) Spectral Analysis. Color Observation with Visual Analyzer, International. Medical Congress EUROMEDICA, European Academy of Natural Sciences, Hanover.
14. Thirumaal, A. (2005). Kirlian Photography...a novel concept. Homoeo Times, 2, 14–22.
15. Pesotskaya, L. A, Glukhova, N. V, Lapytskyy, V. N. (2013). Analyz yzobrazhenyy kyrlyanovskoho svechenyya kapel vody. Naukovyy visnyk Natsionalnoho hirnychoho universytetu, 1, 91–96.
16. Glukhova, N. V., Pisotska, L. A., Horova, A. I. (2014) Sposib ekspres-otsinky stanu ridynno-faznoho obyekta. Patent 86701 (Ukraine).
17. Pesotskaya, L. A, Lapytskyy, V. N., Botsman, K. I., Gerashenko, S. V. (2007) Sposib otsinky enerhoinformatsiynoho stanu ridynno faznoho ob'yektu i prystriy dlya yoho zdiysnennya. Patent 22212 (Ukraine).
18. Everitt, B. S., Leese, L. S., Stahl, M. D. (2011). Cluster Analysis. 5th Edition, Wiley, 346.
19. Nock, R., Nielsen, F. (2006). On Weighting Clustering. IEEE Trans. on Pattern Analysis and Machine Intelligence, 28 (8), 1–13.
20. Bezdek, J. C. (1981). Pattern Recognition with Fuzzy Objective Function Algorithms. Plenum New York, 284. doi: 10.1007/978-1-4757-0450-1

INDUSTRIAL RESEARCH TESTS ON UTILIZING PRODUCTION WASTE IN FERROSILICON SMELTING (p. 25-28)

Olena Protsenko, Timofei Shukovskyj, Sergey Borysenko

Utilization of batch materials with a significant amount of small fraction in ferroalloy smelting worsens the technical and economic indices of the working ovens, exceeds the norm of the pollutant emissions in the atmosphere, and aggravates further processing (or utilizing) of the dust waste.

The paper presents the findings of industrial research tests on ferrosilicon smelting by the method of electro-slag remelting in which the batch contains bricks of dust waste (aspiration dust as well as dust captured by gas treatment equipment).

We have determined that the main constituents of dust waste bricks are very similar to those of batch materials, which proves expediency of utilizing dust waste in ferrosilicon (FeSi) smelting. We have devised a technological scheme and tried utilization of dust bricks in electro-slag remelting for FeSi smelting. The tests have proved that the obtained quality of ferrosilicon FeSi45 meets world standards. The instrumental measuring of dust emissions in the atmosphere enabled us to determine interdependence between the emissions and the technical and economic indices of smelting (the smelting time and the output).

The industrial research tests have proved that using dust bricks in the batch reduces dust emissions by 10 % to 25 % and makes it possible to utilize dust waste.

Keywords: dust, waste, bricks, ferrosilicon (FeSi) smelting, direct current (DC) ovens, environmental safety.

References

1. Ryss, M. A. (1985). Proizvodstvo ferrosplavov. M.: Metallurgiya, 344.
2. Zhunusov, A. K., Sembaev, N. S. (2011). Proektirovanie ferrosplavnykh tsekhov. Pavlodar: Kereku,107.
3. Zubov, V. L., Gasik, M. I. (2002). Elektrometallurgiya ferrosilitsiya. Dnepropetrovsk: Sistemnye tekhnologii, 704.
4. Borysenko, S. L., Borysenko, O. S., Hovorunov, P. P., Korostyl'ov, S. Yu., Shukstul's'kyy, B. I. (2004). Patent №66958 Ukrayiny, MPK S22S33/04, S22S38/02. Sposib vyrobnytstva ferosylitsiyu z shykhty, shcho mistyt' vidkhody vyrobnytstva ferosplaviv. № 2004020952; zayavl. 10.02.2004; opubl. 15.06.2004, Byul. № 6.
5. Nurmaganbetov, Zh. O., Maksimov, E. V., Abdrahmanov, E. S. (2013). Vyplavka vysokouglerodistogo ferrohroma iz othodov proizvodstva. Vestnik KazNTU, 6, 217–221.
6. Gasik, M. (2013). Handbook of Ferroalloys: Theory and Technology. 1st Edition. Butterworth-Heinemann, Elsevier, 536.
7. Zhukovskii, T. F. Protsenko, O. L., Borisenko S. L. (2014). Vnedrenie tekhnicheskikh i prirodookhrannykh reshenii po snizheniyu vybrosov oksidov ugleroda i pyli v atmosferu SVD OOO Firma «EKINA». Vestnik NTU «KhPI», 27, 64–71.
8. Bizhanov, A. M., Podgoretskii, G. S., Kurunov, I. F. (2013). Opyt primeneniya briketov ekstruzii (breksov) dlya vyplavki ferrosilikomargantsa. Metallurg, 2, 44–49.
9. Zhukovskii, T. F., Protsenko, O. L. (2013). Briquetting of wastes from the production of ferrosilicon. Eastern-European Journal of Enterprise Technologies, 1/8 (61), 4–8. Available at: http://journals.uran.ua/eejet/article/view/9403/8162
10. Sal'nikov, V. G., Mustafina, P. M., Mustafina, G. M., Tanat, A. Kh. (2012). Puti povysheniya energoeffektivnosti raboty ferrosplavnykh pechei. Vestnik PGU, seriya energeticheskaya, 1, 2, 101–106.

CRITICAL PARAMETERS SHIFT IN CLASSICAL FLUIDS UNDER THE INFLUENCE OF NANOPARTICLE ADDITIVES (p. 29-33)

Sergiy Artemenko

The last decade has brought a growing number of studies about nanofluids as perspective working fluids with abnormally high thermal conductivity and a huge potential for intensifying heat and mass transfer. Despite the abundance of published research papers on nanofluid heat and mass transfer, the critical properties of these systems have been hardly considered at all. The key factors that determine the thermodynamic properties and the phase behavior of working fluids are the critical point for pure liquids and the critical lines for binary mixtures.

Therefore, we have devised a thermodynamic model for estimating the impact of nanoparticles upon the shift of the critical point and the balance line between fluid and steam for traditional working fluids. Using the model, we have estimated the shift of the critical point for a classical working fluid—carbon dioxide—with additives of structured carbonic materials (nanotubes, fullerenes, and graphene flakes) and metal oxides (titanium and silicon dioxides as well as zinc and copper oxides).

The research findings prove a positive shift of the critical temperature and density of the system point with increasing density of nanoparticle material.

Knowing the critical point is as important as taking into account the characteristics of heat and mass transfer because addition of nanostructured materials changes both the thermal and dynamic surface of nanofluids and the topology of their phase behavior.

Keywords: nanofluid, critical point, nanotubes, fullerenes, graphene, titanium dioxide, zinc oxide.

References

1. Maxwell, J. A. (1891). Treatise on Electricity and Magnetism, London : Oxford university press. (Reprinted by Dover Publications, New York, 1954)

2. Happel, J. (1958). Viscous flow in multiparticle systems: slow motion of fluids relative to beds of spherical particles, AIChE Journal, 4 (2), 197–201. doi: 10.1002/aic.690040214
3. Hamilton, R. L., Crosser, O. K. (1962). Thermal conductivity of heterogeneous two-component systems. Industrial & Engineering Chemistry Fundamentals, 1 (3), 187–191. doi: 10.1021/i160003a005
4. Ahuja, A. S. (1975). Augmentation of heat transport in laminar flow of polystyrene suspensions. I. Experiments and results. Journal of Applied Physics, 46 (8), 3408–3416. doi: 10.1063/1.322107
5. Das, S. K., Choi, S. U. S., Yu, W., Pradeep, T. (2007). Nanofluids: science and Technology, New Jersey: Wiley, 146.
6. Choi, S. U. S., Eastman, J. A. (1995). Enhancing thermal conductivity of fluids with nanoparticles, in Proc. of International Mechanical Engineering Congress and Exhibition, San Francisco, CA, 12–17.
7. Eastman, J. A., Choi, S. U. S., Li, S., Yu, W., Thompson, L. J. (2001). Anomalously increased effective thermal conductivities of ethylene glycol-based nanofluids containing copper nanoparticles. Applied Physics Letters, 78 (6), 718–720. doi: 10.1063/1.1341218
8. Wang, X., Xu, X., Choi, S. U. S. (1999). Thermal Conductivity of Nanoparticle – Fluid Mixture. Journal of Thermophysics and Heat Transfer, 13 (4), 474–480. doi: 10.2514/2.6486
9. Putnam, S. A., Cahill, D. G., Braun, P. V., Ge, Z., Shimmin, R. G. (2006). Thermal conductivity of nanoparticle suspensions. Journal of Applied Physics, 99 (8), 084308. doi: 10.1063/1.2189933
10. Keblinski, P., Eastman, J. A., Cahill, D. G. (2005). Nanofluids for thermal transport, Materials Today, 8 (6), 36–44. doi: 10.1016/s1369-7021(05)70936-6
11. Lee, J. H., Lee, S. H., Choi, C. J., Jang, S. P., Choi, S. U. S. (2010). A review of thermal conductivity data, mechanisms and models for nanofluids. International Journal of Micro-Nano Scale Transport, 1 (4), 269–322. doi: 10.1260/1759-3093.1.4.269
12. Yu, W., France, D. M., Routbort, J. L., Choi, S. U. S. (2008). Review and comparison of nanofluid thermal conductivity and heat transfer enhancements. Heat Transfer Engineering, 29 (5), 432–460. doi: 10.1080/01457630701850851
13. Ozerinc, S., Kakac, S., Yazıcıoglu, A. G. (2010). Enhanced thermal conductivity of nanofluids: a state of the art review, Microfluidics and Nanofluidics, 8 (2), 145–170. doi: 10.1007/s10404-009-0524-4
14. Wang, X. Q., Mujumdar, A. S. (2007). Heat transfer characteristics of nanofluids: a review. International Journal of Thermal Sciences, 46 (1), 1–19. doi: 10.1016/j.ijthermalsci.2006.06.010
15. Chandrasekar, M., Suresh, S. (2009). A review on the mechanisms of heat transport in nanofluids. Heat Transfer Engineering, 30 (14), 1136–1150. doi: 10.1080/01457630902972744
16. Godson, L., Raja, B., Lal, D. M., Wongwises, S. (2010). Enhancement of heat transfer using nanofluids: an overview, Renewable and Sustainable Energy Reviews, 14 (2), 629–641. doi: 10.1016/j.rser.2009.10.004
17. Sergis, A., Hardalupas, Y. (2011). Anomalous heat transfer modes of nanofluids: a review based on statistical analysis. Nanoscale Research Letters, 6 (1), 391–427. doi: 10.1186/1556-276x-6-391
18. King, C., Pendlebury, D. A. (2013). Research fronts 2013. Available at: http://sciencewatch.com/sites/sw/files/sw-article/media/research-fronts-2013.pdf
19. Sarkar, J. A critical review of heat transfer correlations of nanofluids (2011). Renewable and Sustainable Energy Review, 15 (6), 3271–3277. doi: 10.1016/j.rser.2011.04.025
20. Yu, W., Xie, H. (2012). A review on nanofluids: preparation, stability mechanisms, and applications. Journal of Nanomaterials, 2012, 435873–435890. doi: 10.1155/2012/435873
21. Murshed, S. M. S., Leong, K. C., Yang, C. (2008). Investigations of thermal conductivity and viscosity of nanofluids, International journal of thermal science, 47 (5), 560–568. doi: 10.1016/j.ijthermalsci.2007.05.004
22. Eastman, J. A., Choi, S. U. S., Li, S., Yu, W., Thompson, L. J. (2001). Anomalously increased effective thermal conductivities of ethylene glycol-based nanofluids containing copper nanoparticles, Applied Physical Letters, 78 (6), 718–720. doi: 10.1063/1.1341218
23. Botha, S. S., Ndungu, P., Bladergroen, B. J. (2011). Physicochemical properties of oil-based nanofluids containing hybrid structures of silver nanoparticles supported on silica. Industrial & Engineering Chemistry Research, 50 (6), 3071–3077. doi: 10.1021/ie101088x
24. Hwang, Y., Lee, J. K., Lee, C. H., Jung, Y. M., Cheong, S. I., Lee, C. G. (2007). Stability and thermal conductivity characteristics of nanofluids, Thermochimica Acta, 455 (1-2), 70–74. doi: 10.1016/j.tca.2006.11.036
25. Pang, C., Won Lee, J., Kang, Y. (2015). Review on combined heat and mass transfer characteristics in nanofluids, International journal of thermal science, 87, 49–67. doi: 10.1016/j.ijthermalsci.2014.07.017
26. Nine, M. J., Munkhbayar, B., Rahman, M. S., Chung, H., Jeong, H. (2013). Highly productive synthesis process of well dispersed Cu2O and Cu/Cu2O nanoparticles and its thermal characterization, Materials Chemistry and Physics, 141 (1), 636–642. doi: 10.1016/j.matchemphys.2013.05.032
27. Baby, T. T., Ramaprabhu, S. (2011). Synthesis and nanofluid application of silver nanoparticles decorated grapheme. Journal of Materials Chemistry, 21 (26), 9702–9709. doi: 10.1039/c0jm04106h
28. Baby, T. T., Ramaprabhu, S. (2011). Experimental investigation of the thermal transport properties of a carbon nanohybrid dispersed nanofluid, Nanoscale, 3 (5), 2208–2214. doi: 10.1039/c0nr01024c
29. Nikitin, D., Mazur, V. (2012). Thermodynamic and phase behavior of fluids embedded with nanostructured materials, International Journal of Thermal Sciences, 62, 44–49. doi: 10.1016/j.ijthermalsci.2012.02.021
30. Span, R., Wagner, W. (1996). A new equation of state for carbon dioxide covering the fluid region from the triple-point temperature to 1100 K at pressures up to 800 MPa. Journal of Physical and Chemical Reference Data, 25 (6), 1509–1596. doi: 10.1063/1.555991

FEATURES OF SCHEMATIC AND PHYSICAL AND TOPOLOGICAL DESIGN OF ANALOG INTEGRATED COMPARATORS (p. 34-39)

Stepan Novosyadlyy

In practice, devices, which form either voltage with opposite polarity at the output at almost equal absolute values or voltage with the same polarity are the most widely used. The first option is typical for using as a comparison circuit of operational amplifier (OP), and the second – in using specialized integrated circuits. In the second case, the output voltages of the comparator are consistent in magnitude and polarity with the signals, used in digital technology.

Based on the above, we can say that the input signal of the comparator is of the analog nature, and output – digital. Consequently, comparators often act as elements of communication between analog and digital devices, i.e. act as analog-digital converters (ADC).

Due to the fact that both analog and digital signals are used in modern telecommunication systems, we have both analog and digital comparators, respectively. Digital comparator differs from analog in that it is designed to compare two numbers that are given in the form of binary codes.

Keywords: operational amplifier, single-limit analog comparator and Schmitt trigger, C-MOS.

References

1. Koledov, J. A., Volkov, V. A., Dokuchaeva, N. K. (1992). Design and technology mikroschem. Moscow: Higher School, 231.
2. Chistyakov, Y. D. (1986). VLSI technology. Moscow: Mir, 453.
3. Aynspruk, N. U. (1988). Gallium arsenide microelectronics. Moscow: Mir, 554.
4. Di Lorenzo, A. V., Kandeluola, D. D. (1988). Field-effect transistors on gallium arsenide. M.: Radio and Communications, 489.
5. Watanabe, N., Asada, K., Kani, K., Otsuki, T. (1988). VLSI Design. Moscow: Mir, 304.
6. Novosyadlyy, S. P. (2010). Sub-nanomykron technology structures LSI. Ivano-Frankivsk: City NV, 456.
7. Novosyadlyy, S. P. (2003). Physical and technological bases submicron VLSI. Ivano-Frankivsk: Simyk, 52–54.
8. Novosyadlyy, S. P. (2002). Radiation technology in the formation, submicron VLSI structures. Metal-physics and new technologies, 7, 1003–1013.
9. Novosyadlyy, S. P. (2002). Formation of silicon epitaxial structures for the combined VLSI. Metal-physics and new technologies, 24/3, 353–365.
10. Berezin, A. S., Mogalkin, A. R. (1992). Technology design IC. Moscow: Dis, 254.
11. Alexeenko, A. G. (2002). Bases microcircuitry. Moscow: Lab. knowledge bases, 286.
12. Pavlov, V. M., Nochin, V. M. (2001). Circuitry analog circuits. Moscow: Gor. mic appliances, 320.

COMPARISON OF TWO METHODS OF RADIOTHERAPY BASED ON 3D COMPUTER SIMULATION(p. 40-44)

Oleh Ovsiienko, Mykola Budnyk

With the development of radiotherapy (RT), linear electron accelerators have almost replaced cobalt machines. Therefore, treatment planning methods and techniques of dose delivery to the tumor have changed. Comparison of different methods of RT based on computer simulation was carried out in the paper. On the example of a real patient, it is shown that intensity-modulated RT has certain advantages compared to 3D conformal RT.

Simulation has shown that it is better to use the intensity-modulated RT technique in irradiation of tumors in the neck area since using 3D conformal RT increases treatment duration and dose, i.e. the load on critical organs.

Thus, the minimum dose, received by various targets (tumor bed GTV, clinical target volume CTVmod, and clinical target volume along with surrounding lymph nodes CTV1mod) at intensity-modulated RT is lower by 7.9 %, 28 % and 35.4 % respectively, than at 3D conformal RT. Therefore, radiation dose decreases differently, namely, the larger the target the greater the reduction. So, when planning treatment, it is necessary to weigh positive and negative effects for a particular patient since selecting irradiation technique is always a compromise between saving critical organs and the optimal dose distribution in different targets.

Keywords: linear accelerator, radiotherapy, 3D computer simulation.

References

1. Kondrychyna, S. N., Balashov, T. (2001). Fundamentals radiotherapy. PetrSU. Petrozavodsk, 44.
2 Sydnev, D. A (2005). Physic and technical fundamentals of radiation diagnostics and radiation safety. Polygraph, Kyiv, 204.
3. Report on the United Work Group of IMRT (2001). 880–914.
4. Van Dyk, J., Battista, J. J. (2000). Cobalt-60: An Old Modality, A Renewed Challenge, 2–6.
5. Hong, T. S., Ritter, M. A., Tomé, W. A., Harari, P. M. (2005). Intensity-modulated radiation therapy: emerging cancer treatment technology. British Journal of Cancer, 92 (10), 1819–1824.
6. Langer, M., Leong, J. (1987). Optimization of beam weight under dose-volume restrictions. International Journal of Radiation Oncology*Biology*Physics 13 (8), 1255–1260. doi: 10.1016/0360-3016(87)90203-3
7. Ezzell, G. A. (1996). Genetic and geometric optimization of three-dimensional radiation therapy treatment planning. Medical Physics, 23 (3), 293–305. doi: 10.1118/1.597660
8. Spirou, S. V., Chui, C. S. (1998). A gradient inverse planning algorithm with dose volume constrains. Medical Physics, 25 (3), 321–333. doi: 10.1118/1.598202
9. ICRU 50 (1993). Prescribing, Recording and Reporting Photon Beam Therapy. Bethedsa, MD: International Commission on Radiation Units and Measurements.
10. Gregoire, V., Levendag, P., Ang, K. K. (2003). CT-based delineation of lymph node levels and related CTVs in the node-negative neck: DAHANCA, EORTC, GORTEC, NCIC,RTOG consensus guidelines. Radiotherapy & Oncology, 69, 227–236. doi: 10.1016/j.radonc.2003.09.011
11. Garden, A. S., Morrison, W. H., Rosenthal, D. I., Chao, K. S. C., Ang, K. K. (2004). Target coverage for head and neck cancers treated with IMRT: review of clinical experiences, Seminars in Radiation Oncology, 14 (2), 103–109. doi: 10.1053/j.semradonc.2003.12.004
12. Bentzen, S. M., Rosenthal, D. I., Weymuller, E. (2007). Increasing toxicity in non-operative head and neck cancer treatment: Investigations and interventions. International Journal of Radiation Oncology*Biology*Physics, 69 (2), 79–82. doi: 10.1016/j.ijrobp.2007.04.080
13. Withers, H. R., Taylor, J. M., Maciejewski, B. (1988). Treatment volume and tissue tolerance. International Journal of Radiation Oncology*Biology*Physics, 14 (4), 751–759. doi: 10.1016/0360-3016(88)90098-3

STABLE SOUND WAVE GENERATION IN WEAKLY IONIZED AIR MEDIUM (p. 45-51)

Maxim Chizhov, Maxim Eingorn, Vladimir Kulinskii, Vladimir Marenkov

Results of experimental and theoretical research of the laboratory prototype of “diaphragmless” non-thermal electroacoustic transducer of original design, working as a broadband acoustic monopole are discussed.

Radiation patterns of acoustic emission, current-voltage characteristic of corona discharge at the given electrode geometry were investigated, based on which a theoretical scheme for calculating the acoustic emission power depending on the magnitude of the potential difference between the electrodes was built. The calculation of the basic characteristics of the loudspeaker was performed within the quasi-stationary approximation using a standard three-component hydrodynamic model of weakly ionized gas, supplemented by the equations of chemical kinetics.

It is shown that the sound generation process is a scalar effect, arising due to the gas ionization degree modulation.

The theoretical model, developed in the paper is the basis for a detailed simulation of sound generation processes, and possible improvement of the proposed design of so-called “ionic loudspeaker”.

Keywords: sound wave generation in weakly ionized air medium, ionic loudspeaker, acoustic monopole, diaphragmless loudspeaker.

References

1. McLachlan, N. W. (1934). Loud speakers. Theory, performance, testing and design. Oxford: The Clarendon Press, 399.
2. Krichtafovitch, I. A., Karpov, S. V., Jewell-Larsen, N. E. (2008). EFA Loudspeakers. Proc. ESA Annual Meeting on Electrostatics, Paper A2, 1–7.
3. Kiichiro, M. (1973). Sound sources with corona discharges. The Journal of the Acoustical Society of America, 54 (2), 494–498. doi: 10.1121/1.1913605
4. Lim, M. K. (1981). A corona-type point source for model studies in acoustics. Applied Acoustics, 14 (4), 245–252. doi: 10.1016/0003-682x(81)90020-7
5. Bastien, F. (1987). Acoustics and gas discharges: applications to loudspeakers. Journal of Physics D: Applied Physics, 20 (12), 1547–1557. doi: 10.1088/0022-3727/20/12/001
6. Béquin, Ph., Montembault, V., Herzog, Ph. (2001). Modelling of negative point-to-plane corona loudspeaker. The European Physical Journal – Applied Physics, 15 (01), 57–67. doi: 10.1051/epjap:2001167
7. Béquin, Ph., Castor, K., Herzog, Ph., Montembault, V. (2007). Modeling plasma loudspeakers. The Journal of the Acoustical Society of America, 121 (4), 1960–1970. doi: 10.1121/1.2697201
8. Mazzola, M. S., Molen, G. M. (1987). Modeling of a dc glow plasma loudspeaker. The Journal of the Acoustical Society of America, 81 (6), 1972–1978. doi: 10.1121/1.394762
9. Fransson, F., Jansson, E. V. (1971). Properties of the stl-ionophone transducer. Quarterly Progress and Status Report, 6 (2), 27–30.
10. Fransson, F. J. (1975). Stl–ionophone: Transducer properties and construction. The Journal of the Acoustical Society of America, 58 (4), 910–915. doi: 10.1121/1.380743
11. Chizhov, M. V., Yn, C. M. (2011). Ukrainian declarative patent for an invention 96912. Device for generating acoustic waves; H04R 23/00/– № a 2011 07018; Statement 03.06.2011; Published 25.08.2011, bulletin № 16
12. Bondar, H., Bastien, F. (1986). Effect of neutral fluid velocity on direct conversion from electrical to fluid kinetic energy in an electro-fluid-dynamics (efd) device. Journal of Physics D: Applied Physics, 19 (9), 1657–1663. doi: 10.1088/0022-3727/19/9/011
13. Kawamoto, H., Yasuda, H., Umezu, S. (2006). Flow distribution and pressure of air due to ionic wind in pin-to-plate corona discharge system. Journal of Electrostatics, 64 (6), 400–407. doi: 10.1016/j.elstat.2005.10.023
14. Dyakov, A. F., Bobrov, Yu. K., Sorokin, A. V., Yurgelenas.,Yu. V. (1999). Fizicheskie osnovyelektricheskogo proboya gazov. MEI.
15. Raizer, Y. P. (1991). Gas Discharge Physics. Springer, corrected edition.
16. Aleksandrov, N. L., Konchakov, A. M., Napartovich, A. I., Starostin, A. N. (1989). Novel mechanism of sound amplification in a weakly ionized gas. JETP, 68, 933–936.

17. Elinson, M. I., Vasil'ev, G. F. (1958). Field Emission. Gos. ed. Sci. lit, Moscow.
18. Latham, V. (1995). High Voltage Vacuum Insulation: Basic Concepts and Technological Practice. Academic Press, 1 edition.

LONGITUDINAL RESONANCE VIBRATIONS IN DETERMINING DYNAMIC VISCOELASTIC PROPERTIES OF TEXTILE MATERIALS (p. 52-58)

Svetlana Demishonkova

The study presents a method for estimating dynamic viscoelastic properties of textile materials. The method allows solving the problem of express analyzing of the properties of fabrics for sewing products with predictable consumer indices. The suggested direct determining of the angle of mechanical loss due to the simplified algorithm of technical playback does not require measuring vibration amplitudes. The fabric elasticity module is determined by measuring longitudinal resonance vibrations. The suggested method is especially convenient in measuring phasal angles for low frequency vibrations as well as angles of phasal shift in the range (-π/2; π/2) for harmonic vibrations. The maximal errors for the dynamic elasticity module E(t) and the damping decrement δ do not exceed ±1,5 % and ±2,5 % respectively. The obtained findings enable a rational choice of textile materials for industrial sewing.

Keywords: viscoelastic properties, elasticity module, damping decrement, mechanical loss angle, vibration amplitude.

References

1. GOST 20812-84 1. Plasmasi. Opredelenie dinamicheskogo modulya sdviga i tangensa ugla mehanicheskih poter metodom svobodnih krutilnih kolebaniy (1992). Enter. 01.01.1992. Moscow: Izd standartov, 27.
2. GOST 19873-84 2. Plasmasi. Rezonansniy metod opredeleniya dinamicheskih moduley uprugosti I koeficientiv poteri pri kolebaniyah konsolno zakreplenogo obrazca (1992). Enter. 1994-01-01. Moscow: Izd standartov, 32.
3. Mogahzy, Y. E. (2009). Engineering textiles, Integrating the design and manufacture of textile products. The Textile Institute, Woodhead Publishing Limited, Cambridge England, 538.
4. Frontczak-Wasiak, I., Snycerski, M., Stempień, Z., Suszek, H. (2004). Measuring Method of Multidirectional Force Distribution in a Woven Fabric. Fibres & Textiles in Eastern Europe, 12/2 (46), 48–51.
5. Darja, R., Tatjana, R., Alenka, P.-U. (2013). Alenka Auxetic Textiles. Acta Chim. Slov., 60, 715–723.
6. Malkin, A. Ja., Askadskij, A. A., Kovriga, V. V. (1978). Metody izmerenija mehanicheskih svojstv polimerov. Moscow: Himija, 336.
7. Kostrytskiy, V. V. (1990). Methodica i isputatelnaya ystanovka dlya issledovaniya polymernich materialov. Zavodskaya Laboratory, 56 (5), 98–102.
8. Shi Y., Jiang Y. Realistic (2007). Rendering of Knitwear. Journal of Information and Computing Science, 2, 153-160.
8. Shi, Y., Jiang, Y. (2007). Realistic Rendering of Knitwear. Journal of Information and Computing Science, 2 (2), 153–160.
9. De Carvalho, L. H., Cavalcante, J. M. F., d'Almeida, J. R. M. (2006). Comparison of the mechanical behavior of plain weave and plain weft knit jute fabric-polyester-reinforced composites Polymer. Polymer-Plastics Technology and Engineering, 45 (7), 791–797. doi: 10.1080/03602550600611933
10. Kononova, O., Krasņikovs, A., Dzelzītis, K., Kharkova, G., Vagel, A., Eiduks, M. (2011). Modelling and Experimental Verification of Mechanical Properties of Cotton Knitted Fabric Composites. Estonian Journal of Engineering, 17 (1), 39–50. doi: 10.3176/eng.2011.1.05
11. Kokoshvyly, S. M. (1978). Methodu dinamicheskich isputaniy zhёstkyh polymernich materialiv. Riga: Zynatne, 182.
12. Lutsik, R. V., Mentkovskiy, Y. L., Cold, V. P. (1992). Vzaymosvyaz deformatsyonno-relaksatsyonih and teplomassoobmennih procesiv. Kiev: High School, 183.
13. Perepechko, I. I. (1973). Akustycheskye metodi isledovaniya polymerov. Moscow: Chemistry, 296.
14. Ferry, J. (1963). Vyazkouprugie svoystva polymerov. Moscow: IL, 536.
15. Demishonkova, S. A., Pushnov, R. V., Kostritsky, V. V., Artemenko, L. F. (2003). Pristriy dlya vimiru vlastivostey materialiv sho dempfiryut pri vilnih colivanyah. stalemate. 2002042904 Ukraine: IPC G01H1/10/ applicant and owner KNUTD. №53238; applications. 11.04.2002; prints. 15.01.2003, Bull. № 1.
16. Davis, V. M., Macosko, C. W. (1977). A Forsed Torsional Oscillator for Dynamic Mechanical Measurements. Polymer Engineering and Science,17 (1), 32–37. doi: 10.1002/pen.760170106
17. Worth, R. A. (1986). The Dynamic Properties of Glassfiber-reinforced polypropylene subjected to pure bending. Polymer Engineering and Science, 26 (19), 1293–1296. doi: 10.1002/pen.760261902
18. Demishonkova, S. A., Kostritsky, V. V., Artemenko, L. F., Skiba, M. E. (2008). Metodi interpretacii vyazcopruznih vlastivostey polimernih, shkiryanih ta tekstilnih materialov. Bulletin KNUTD, 4, 5–18.
19. Demishonkova, S. A., Artemenko, L. F., Kostritsky, V. V. (2013). Prognozuvanya vyazcopruznih vlastivostey tekstilnih materialov. Bulletin KNUTD, 3, 7–12
20. Kenyh, J. (1982). Noveyshye instrumental`ny'j methodi isledovaniya structure polymerov. Moscow: Mir, 264.

THE INFLUENCE OF AN OBJECT SURFACE ON MEASURING GEOMETRIC DIMENSIONS IN DIGITAL OPTICAL MICROSCOPY (p. 59-64)

Olga Markina, Olena Syngaivska, Volodymyr Maslov, Nataliya Kachur

The paper presents experimental findings on measuring metrological parameters of LOMO projections obtained with an atomic force microscope. The research has proved that gauge-producing technologies that consist in mechanical mirror cutting result in flood coating. The floods obscure the position of the marker point in the program of the coordinates that outline object dimensions. We have determined that, with equal deviations from the focus, the biggest measurement error is observed while using a LOMO gauge on the projection. The experiment has proved that, under the same conditions of the experiment, a gauge on LOMO transmission (photolithography technology) and a 2D Bruker projection gauge, which is produced by means of electronic lithography, cause much smaller measurement errors. This should be taken into account while choosing a microscope focus gauge.

Keywords: micrometer object, digital optical microscopy, geometric dimensions.

References

1. Gorelik, S. L., Kats, B. M., Kivrin, V. I. (1980). Televizionnyie izmeritelnyie sistemyi. Svyaz, 168.
2. Porev, V., Markina, O., Aginskyy, Y. (2013). Television information measurement systems for linear dimension measuring. Eastern-European Journal of Enterprise Technologies, 2 (10), 59–62. Available at: http://journals.uran.ua/eejet/article/view/12757/10630
3. Markina, O. (2014). Sposib Markinoyi VimIryuvannya MIkroperemIschen. 22.10.2013, assignee. Patent 89021. 10 Apr. 2014. Print.
4. Yakimets, S., Tibin, S. (2010). Povyishenie tochnosti izmereniya diametra slitka kremniya televizonnyim metodom. Visnik KDPU Im. Mihayla Ostrogradskogo, 1 (60), 66–69.
5. Lvov, V., Andrieiev, A. (2010). Quasiinvariant Automatic Control Digital Systems of Inertia Objects. MaterIali MIzhnarodnoYi KonferentsIYi TCSET'2010. LvIv-Slavsko, UkraYina, 79.
6. Vvedenskiy, S., Zaharchenko, A., Troitskiy, V. (2005). Izmernie submikronnyih razmerov. Opticheskiy mikroskop s nekogerentnyim osvescheniem. Elektronika: Nauka, Tehnologiya, Biznes, 1, 59–61.
7. Gavrilenko, V., Novikov, Y., Rakov, A., Todua, P. (2008). Test-ob'ektyi s pryamougolnyim i trapetsievidnyim profilyami relefa dlya rastrovoy elektronnoy i atomno-silovoy mikroskopii. Nanoindustriya, 4, 24–30.
8. Heather, P., Germer, T., Cresswell, M., Allen, R., Dixson, R., Bishop, M. (2007). Modeling and Analysis of Scatterometry Signatures for Optical Critical Dimension Reference Material Applications. Proceedings of the 2007 International Conference on Frontiers of Characterization and Metrology for Nanoelectronics. NIST in Gaithersburg, 392–396.
9. Germer, T. (2007). Effect of line and trench profile variation on specular and diffuse reflectance from a periodic structure. Journal of the Optical Society of America A, 24, 696–701. doi: 10.1364/josaa.24.000696
10. Lytvyn, P. (2014). Probe Microscopy in Practical Diagnostic: 3D Topography Imaging and Nanometrology. Functional Nanomaterials and Devices for Electronics, Sensors and Energy Harvesting. Switzerland: Springer International Publishing, 179–219. doi: 10.1007/978-3-319-08804-4_10