ABSTRACT AND REFERENCES

APPLIED PHYSICS. MATERIALS SCIENCE

FRONT SURFACE TEXTURE FORMATION OF THE SOLAR CELL BY THE POROUS SILICON TECHNOLOGY (p. 4-9)

Valerij Yerokhov, Anatoliy Druzhynin, Olga Ierokhova

The prospects of forming textures of different formats by electrochemical porous silicon technologies for obtaining front functional layers of solar cells are shown. Creating a schematic model of different types of porous silicon for textures depending on the current form has allowed to simulate the experimental process of texture formation. In the pore formation process, one of the most important characteristics is current density distribution, which depends on many parameters and affects the porous silicon element type formation. With the increase and distribution of current density on the pore bottom surface, we obtain the usual bell-shaped kind of pores. By applying zigzag mode to the bell-shaped current, we can get two-layer porous silicon, where macroporous silicon can be filled or partially filled with microporous silicon. Thus, coral-like, columnar and drop-shaped textures based on porous silicon as an element of an effective and profitable coverage were experimentally obtained. The texture formation process should be the best adapted to the processes of formation of silicon solar cells. Analysis of integrated reflection coefficients in the range of 400–1000 nm for textures with columnar and drop-shaped pores shows their high efficiency compared with other textures, especially in the infrared.

Keywords: porous silicon, texture, electrochemical etching, solar cell, photovoltaic converter.

References

1. Saadoun, M., Fethi Boujmil, M., Aouida, S., Ben Rabha, M., Bessais, B. (2011). Porous silicon-based microtexturing of textured monocrystalline silicon solar cells. Physica Status Solidi (C), 8 (6), 1869–1873. doi: 10.1002/pssc.201000090
2. Yerokhov, V. Yu., Melnyk, I. I. Porous silicon in solar cell structures: A review of achievements and modern directions of further use (1999). Renewable and Sustainable Energy Reviews, 3 (4), 291–322. doi: 10.1016/s1364-0321(99)00005-2
3. Ou, W., Zhao, L., Diao, H., Zhang, J. (2011). Optical and electrical properties of porous silicon layer formed on the textured surface by electrochemical etching. Journal of Semiconductors, 32 (5), 056002. doi: 10.1088/1674-4926/32/5/056002
4. Huang, Y. M., Ma, Q.-L., Meng, M. (2011). Porous silicon based solar cells. Materials Science Forum, 663-665, 836–839. doi: 10.4028/www.scientific.net/msf.663-665.836
5. Zhang, X. G. (2001). Electrochemistry of Silicon and Its Oxides. Kluwer Academic, Horwell, MA, 537.
6. Salman, K. A., Omar, K., Hassan, Z. (2011). The effect of etching time of porous silicon on solar cell performance Superlattices and Microstructures, 50 (6), 647–658. doi: 10.1016/j.spmi.2011.09.006
7. Jerohov, V. Ju., Selemonavichus, A. A. (2008). Patent № 36642. Ukrai'na, MKV H 01 L 31/05. Sposib oderzhannja poverhnevoi' mul'tytekstury. NU "L'vivs'ka politehnika". Zajavka № a 2007 13213 vid 27.11.2007. Rishennja na vydachu patentu Ukrai'ny na vynahid vid 10.11.2008. Bjul. № 21.
8. Foil, H., Christophersen, M., Carstensen, J., Hasse, G. (2002). Formation and application of porous silicon. Materials Science and Engineering R, 39, 93–141.
9. Yerokhov, V., Hezel, R., Nagel, H., Melnyk, I., Semochko I. (2000). Development of profitable Methods of Texturing for Silicon Solar Cells. 16th European Photovoltaic Solar Energy Conference and Exhibition. Glasgow, UK. VA2-15.
10. Jerohov, V. Ju., Druzhynin, A. O. (2010). Patent № 92962, Ukrai'na, MKV H 01 L 31/05. Sposib oderzhannja poverhnevoi' funkcional'noi' nanotekstury. Nacional'nyj Universytet "L'vivs'ka politehnika", Rishennja na vydachu patentu Ukrai'ny na vynahid vid 27.12.2010. Bjul. № 24.

THE METHOD OF AUTOMATIC DETERMINATION OF ARC SIZING MACHINING PROCESS STABILITY (p. 9-13)

Gregory Savelenko

The concept of process stability of arc sizing machining on electrical-discharge machines is discussed and some of the results of our research in this area are given in the paper. The main purpose of the study is to develop and validate the automatic method for determining the stability of the process under consideration. Dependencies, which determine the affiliation of the instantaneous values of the arc voltage with arc zones are given. The values of the obtained coefficients allow to judge the state of the process and, consequently, control it.

Using modern electrical discharge machining control systems allows to process materials with higher energy efficiency and less resource consumption.

A solution to the problem of finding the arc sizing machining process stability is proposed in the paper.

The present method allows to automate the process of finding and maintaining the tool electrode feed rate in the near-to-quasi-optimal zone by the process performance.

The research results can be used by designers in the field of tool electrode feed automation during electrical discharge machining of metals.

Keywords: arc voltage, arc zone, process stability, arc sizing machining.

References

1. Nosulenko, V. I. (2005). Razmernaya obrabotka metallov elektricheskoy dugoy. Elektronnaya obrabotka materialov, 1, 8–17.
2. Gutkin B. G. (1971) Avtomatizatsiya elektroerozionnykh stankov. Lviv: Mashinostroyeniye, 160.
3. Nosulenko, V. I., Sisa, O. F. (2006). Stalist protsesu rozmirnoyi obrobky metaliv elektrychnoyu duhoyu ne profilovanym elektrodom. Zbirnyk naukovykh prats KNTU, 15, 148–153.
4. Bokov, V. M., Sisa, O. F. (2013). Obroblyuvanist materialiv elektrychnoyu duhoyu : monohrafiya, Kirovohr. nats. tekhn. un-t., Kirovohrad, Imeks, 172.
5. Sobinov, O. H. (2006). Modelyuvannya shvydkosti znimannya materialu pry tekhnolohichnomu protsesi rozmirnoyi obrobky duhoyu. Zbirnyk naukovykh prats KNTU, 17, 247–252.
6. Savelenko, G. V. (2013). Obosnovaniye algoritma raboty ekstremalnogo regulyatora podachi elektroda-instrumenta na stankakh razmernoy obrabotki dugoy. Avtomatizirovannoye proyektirovaniye v mashinostroyenii. Novokuznetsk: Izdatelskiy tsentr SibGIU, 115–122
7. Finkelnburg, V., Mekker, G. (1961). Elektricheskiye dugi i termicheskaya plazma, Moscow, 371.
8. Nosulenko, V. I. (2006). O fizicheskoy prirode, ob obshchem i otlichiyakh, tekhnologicheskikh vozmozhnostyakh elektricheskikh razryadov i klassifikatsii sposobov elektrorazryadnoy obrabotki metallov. Elektronnaya obrabotka materialov, 1, 4–14.
9. Pokhodnya, I. K., Gorpenyuk, V. N., Milicheno, S. S (1990). Metallurgiya dugovoy svarki: Protsessy v duge i plavleniye elektrodov, Kiyev: Nauk. Dumka, 224.
10. Khrenov, K. K. (1949). Elektricheskaya svarochnaya duga, Moscow; Kiev: Mashgiz, 204.
11. Lankin, Yu. N. (2011). Pokazateli stabilnosti protsessa dugovoy svarki plavyashchim elektrodom, Avtomat. svarka, 1, 7–15.
12. Orlov, A. I. (2004). Matematika sluchaya: Veroyatnost i statistika – osnovnyye fakty: ucheb, posobiye. Moscow: MZ-Press, 110.
13. Shafranskiy, L. G., Orlov, L. N., Abrashin, A. V. (1972). Otsenka ustoychivosti dugi peremennogo toka, Avtomat. svarka, 4, 18–19.
14. Yazovskikh, V. M., Belenkiy, V. Ya., Krivonosova, Ye. A. (1996). Metod otsenki stabilnosti goreniya dugi: pat. 2063316 Ros. Federatsiya: MPK V 23 K 31/12, V 23 K 9/073; zayavitel i patentoobladatel Permskiy gos. tekhn. univ-t., №94037567/08; zayavl. 07.10.1994; opubl. 10.07.1996
15. Yazovskikh, V. M., Shumyakov, V. I., Boronenkov, V. N. (1998). Estik mation of the welding electrodes quality by the computer analyses of oscillograms of welding current and voltage, Proc. Of the 8th Intern. conf. "Computer technology in welding", Paris, 10.
16. Yazovskikh, V. M., Belenkiy, V. Ya., Krotov, L. N., Letugin, I. Yu. (1997). Metodika otsenki stabilnosti goreniya svarochnoy dugi toka, Svaroch. pr-vo, 4, 18–20.
17. Yermolayev, Yu. O. (2011). Modernizatsiya elektromekhanichnoyi chastyny pryvoda podachi elektroeroziynoho verstata dlya rozmirnoyi obrobky duhoyu. Zvit pro NDR. KNTU, № derzhreyestratsiyi 0111U007656. Kirovohrad, 34.
18. Yermolayev, Yu. O., Savelenko, H. V. (2004). Rozrobka SAU elektromekhanichnoho pryvodu verstata typu "DUHA" na bazi "ESHYM–1". Zbirnyk naukovykh prats KNTU, 15, 270–273.

19. Savelenko, H. V., Yermolayev, Yu. O. (2014). Doslidzhennya robochoho protsesu rozmirnoyi obrobky duhoyu na verstati z elektromekhanichnym pryvodom. Kompyuterno-intehrovani tekhnolohiyi: osvita, nauka, vyrobnytstvo. Naukovyy zhurnal, Lutsk, vydavnytstvo LNTU, 14, 164–169.
20. Yermolayev, Yu. O., Velykyy, P. M., Savelenko, H. V. (2007). Doslidzhennya SAU protsesu ROD na verstati z elektromekhanichnym pryvodom. I. Osnovni faktory, shcho vplyvayut na protses. Zbirnyk naukovykh prats KNTU, Kirovohrad: KNTU, 19, 270–273
21. POR P. D. R. ARM Cortex-M4 32b MCU+ FPU, 225DMIPS, up to 2MB Flash/256+ 4KB RAM, USB OTG HS/FS, Ethernet, 17 TIMs, 3 ADCs, 20 comm. interfaces, camera & LCD-TFT. [Computer software] (2014). Available at: http://www.st.com/web/en/resource/technical/document/datasheet/DM00071990.pdf

DIAGNOSTICS OF PROCESSES OF WEAR OF MATERIALS OF BALL-TUBE MILLS (p. 14-20)

Eugene Prokhorenko, Vyacheslav Klepikov, Volodymyr Lytvynenko, Pavel Khaymovich, Nikola Shul'gin, Andriy Morozov

Changes in material hardness of balls, which are used as the working body of ball-tube mills was investigated. Both new balls and balls with different operation time were examined. Hardness of not only the surface layer, but also over the entire depth was studied. These measurements were carried out to find the wear-out areas. It was found that areas with a reduced hardness, where ball material destruction occurs, are formed on the surface during operation. To determine the changes in the material properties, an ultimate strength was tested. Its values in different parts of the ball with the time change were found. It was revealed that the discontinuity surface structure is the same for all areas and the entire time interval. This indicates the absence of phase transitions of ball materials during operation. Diagnostics of the surface structure by the electron beam was conducted. This work allows to forecast the destruction rate of balls during their use and identify priorities for improving their performance.

Keywords: material hardness, tube mill ball structure, radiation diagnostics.

References

1. Voinov, O. P., Polonik, V. S. (2012). Building of caldrons and development of energy is in Ukraine. Energy and electrification: Scientifically production magazine, 5, 41–45.
2. Prokhorenko, E. M., Klepikov, V. F., Lytvynenko, V. V., Bazaleev, M. I., Bryukhovetskaya, O. E., Morozov, A. I., Zakharchenko, A. A., Safonov, I. Ya, Kolesnikova, V. V. (2012). IF- radiometry, as instrument of control of equipment of energygenerating objects. News of Donetsk mountain institute, 1 (30), 353–360.
3. Klepikov, V. F., Annopol'skiy, D. A., Babushkina, S .I., Lytvynenko, V. V., Melyakova, E. A, Prokhorenko, E. M., Sagaydachnyy, M. A. (2014). Prospects of the use of radiation methods of cleaning of smoke gases and diagnostics of equipment for fuel of preparation. Compressor and power engineer, 2 (36), 34–38.
4. Kesova, L. A. (2009). Influence of the system ardor of preparation on the fire-box mode of caldron at highly concentrated ardor to the serve on gas-rings. Energy and electrification: Scientifically production magazine, 5, 41–45.
5. Levit, V. T. (1991). Ardor preparation on thermal power-stations. Moscow: Energoatomizdat, 384.
6. Proskurovsky, D. I., Rotshtein, V. P., Ozur, G. E., Ivanov, Y. F., Markov, A. B. (2000). Physical foundations for surface treatment of materials with low energy, high current electron beams. Surface and Coatings Technology, 125 (1-3), 49–56. doi: 10.1016/s0257-8972(99)00604-0
7. Zou, J. X., Zhang, K. M., Dong, C., Qin, Y., Hao, S. Z., Grosdidier, T. (2006). Selective surface purification via crater eruption under pulsed electron beam irradiation. Applied Physics Letters, 89 (4), 1904–1913. doi: 10.1063/1.2234306
8. Hao, S. Z., Wu P. S., Zou, J. X., Grosdidier, T., Dong, C. (2007). Microstructure evolution occurring in the modified surface of 316L stainless steel under high current pulsed electron beam treatment. Applied Surface Science, 253 (12), 5349–5354. doi: 10.1016/j.apsusc.2006.12.011
9. Zou, J. X., Grosdidier, T., Zhang, K. M., Dong, C. (2009). Cross-sectional analysis of the graded microstructure in an AISI D2-steeltreated with low energy high-current pulsed electron beam. Applied Surface Science, 255 (9), 4758–4764. doi: 10.1016/j.apsusc.2008.10.123
10. GOST 7524-89 (1989). Balls the steel grindings for ball mills Entered. 01.02.1989-01-02. Moscow: publishing house of standards, 26.

EXTRACTION OF PETROL PRODUCTS FROM WATER BY MAGNETITE-BASED SORBENTS (p. 20-24)

Vyacheslav Radovenchyk, Marina Romanenko, Sofia Hrynchuk, Anastasiia Hlushchenko

The results of studying the effectiveness of petroleum extraction from water by their sorption on magnetite particles are given. It was found that magnetite particles, obtained by chemical condensation have the high dispersion ability, which prevents their practical use in industrial processes. It is possible to significantly change the particle size distribution of the magnetite mixture by treating them with petroleum products followed by ignition at high temperatures. The main factors, affecting particle size distribution of the mixture after such treatment is dose of petroleum products, the temperature and duration of mixture ignition. It was determined that the optimum ignition temperature is 300 °C, at which the largest number of aggregates with sizes of 30–40 microns is produced. Particle size distribution is significantly affected by the ignition duration that we associate with the residual content of petroleum products that do not manage to decompose under short ignition duration and act as a binder for magnetite particles. At low doses (ratio of petroleum products: magnetite within 0.083–0.025), there was no significant effect on the particle size distribution of the treated mixture. In certain circumstances, the number of sorption: ignition cycles does not affect the particle size distribution of the mixture, allowing to form filtering media with stable hydraulic and sorption properties.

Keywords: sewage, petroleum products, sorption, dynamic mode, magnetite, ignition.

References

1. Bilyavskii, H. O., Padun, M. M., Furdui, S. S. (1995). Fundamentals of General Ecology. Lybed, 368.
2. Acceptance of Wastewater Enterprises in the Kyiv City Sewer System (2003). KSCA, 20.
3. Acceptance of Wastewater in Municipal enterprises and Departmental Sewage System Settlements of Ukraine (2002). State Construction of Ukraine, 55.
4. Mark D., Owen, Hawkins, T. (2014). Light-Activated Nanotechnology for Drinking Water Purification.Aquananotechnology. Global Prospects. Taylor & Francis Group, LLC, 467–471.
5. Omowunmi, A. S., Nian, D., Idris, Y., Okello, V. (2014). Nanostructured Membranes for Water Purification. Nanotechnology Applications for Clean Water (Second Edition), 95–108. doi: 10.1016/b978-1-4557-3116-9.00006-8
6. Delle Site, A. (2001). Factors Affecting Sorption of Organic Compounds in Natural Sorbent/Water Systems and Sorption Coefficients for Selected Pollutants. A Review. Journal of Physical and Chemical Reference Data, 30 (1), 187. doi:10.1063/1.1347984
7. Singh, V., Kendall, R. J., Hake, K., Ramkumar, S. (2014). Crude Oil Sorption by Raw Cotton. Industrial & Engineering Chemistry Research, 52 (18), 6277–6281. doi: 10.1021/ie4005942
8. Magarshak, Y., Kozyrev, S., Vaseashta, A. K. (2009). Silicon Versus Carbon. Fundamental Nanoprocesses, Nanobiotechnology and Risks Assessment. The NATO Science for Peace and Security Programme – Springer Science+Business Media B. V., 390–399.
9. Zhulina, E. B., Birshtein, T. M., Skvortso, A. M. (2004). Biopolymers. John Wiley & Sons, Inc., 19 (4), 805–821.
10. Gomelia, M. (2001). The Use of ferromagnets for Volumetric Water Purification from Oil. Ecological Technologies and Resource Conservation, 37–40.
11. Gomelia, M. (2003). Removal of Oil from Water Using Magnetite Modified by Amines. Ecological Technologies and Resource Conservation, 45–47.
12. Radovenchyk, Ya., Romanenko, M., Chernyak, V. (2013). Use of Magnetite Particles in the Purification of Wastewater from Oil. Visnyk NTU "KhPI", 159–164.
13. Radovenchyk, Ya., Romanenko, M., Chorna, K. (2014). Use of Magnetite in the Purification of Wastewater from Oil. Chemical Engineering, Ecology and Resource Conservation, 65–69.
14. Parfentev, F., Pusset, L. (1957). Physical Basis of Magnetic Sound Recording. Moscow, 323.
15. Purvinskii, O., Shyshkov, A., Protasov, E. (1991). Magnetic Gravity Separation of Gold Materials. Moscow, 98–99.

FIBER-OPTIC GYROSCOPES BASED ON PHOTONIC-CRYSTAL FIBERS (p. 25-31)

Haider Ali Muse

Over the last few decades optical fibers have been widely deployed in navigation industries owing to their special performance as the best light guidance. Fiber-optic gyroscope is one of the applications of optical fibers dependent mainly on the Sagnac effect. It is of important applications in the field of space navigation. In the Fiber-optic gyroscope, an optical fiber is used as the medium of propagation for the light. A long fiber cable is winded into loops in order to increase the effective area of the system. Two beams are again propagating through the fiber in opposite directions. Due to the Sagnac effect, the beam travelling against the rotation experiences a slightly shorter path delay than the other beam. The resulting differential phase shift is measured through interferometry, thus translating one component of the angular velocity into a shift of the interference pattern which is measured photometrically.

Keywords: fiber optical gyroscope, photonic crystal fiber, Sagnac effect.

References

1. Overview of Fiber Optic Sensors. Available at: http://www.bluerr.com/images/ Overview_of_FOS2.pdf (Last accessed: 8.02.2012).
2. Knight, J. C., Birks, T. A., Russell, P. S. J., Atkin, D. M. (1996). All-silica single-mode optical fiber with photonic crystal cladding. Optics Letters, 21 (19), 1547–1549. doi: 10.1364/ol.21.001547
3. Chau, Y.-F., Liu, C.-Y., Yeh, H.-H., Tsai, D. P. (2010). A comparative study of high birefringence and low confinement loss photonic crystal fiber employing elliptical air holes in fiber cladding with tetragonal lattice. Progress In Electromagnetics Research B, 22, 39–52. doi: 10.2528/pierb10042405
4. Ortigosa-Blanch, A., Knight, J. C., Wadsworth, W. J., Arriaga, J., Mangan, B. J., Birks, T. A., Russell, P. S. J. (2000). Highly birefringent photonic crystal fibers. Optics Letters, 25(18), 1325–1327. doi: 10.1364/ol.25.001325
5. Chen, D., Shen, L. (2007). Ultrahigh Birefringent Photonic Crystal Fiber With Ultralow Confinement Loss. IEEE Photonics Technology Letters, 19 (4), 185–187. doi: 10.1109/lpt.2006.890040
6. Agrawal, A., Kejalakshmy, N., Chen, J., Rahman, B. M., Grattan, K. T. (2008). Golden spiral photonic crystal fiber: polarization and dispersion properties. Optics Letters, 33 (22), 2716–2718. doi: 10.1364/ol.33.002716
7. Yang, S., Zhang, Y., Peng, X., Lu, Y., Xie, S., Li, J., Chen, W., Jiang, Z., Peng, J., Li, H. (2006). Theoretical study and experimental fabrication of high negative dispersion photonic crystal fiber with large area mode field. Optics Express, 14 (7), 3015–3023. doi: 10.1364/oe.14.003015
8. Ju, J., Jin, W., Demokan, M. S. (2001). Design of single-polarization single mode photonics crystal fibers. J. Lightwave Technol., 24, 825–830.
9. Kubota, H., Kawanishi, S., Koyanagi, S., Tanaka, M., Yamaguchi, S. (2004). Absolutely Single Polarization Photonic Crystal Fiber. IEEE Photonics Technology Letters, 16 (1), 182–184. doi: 10.1109/lpt.2003.819415
10. Knight, J. C., Skryabin, D. V. (2007). Nonlinear waveguide optics and photonic crystal fibers. Optics Express, 15 (23), 15365–15376. doi: 10.1364/oe.15.015365
11. Mortensen, N. A., Nielsen, M. D., Folkenberg, J. R., Petersson, A., Simonsen, H. R. (2003). Improved large-mode-area endlessly single-mode photonic crystal fibers. Optics Letters, 28 (6), 393–395. doi: 10.1364/ol.28.000393
12. Folkenberg, J. R., Nielsen, M. D., Mortensen, N. A., Jakobsen, C., Simonsen, H. R. (2004). Polarization maintaining large mode area photonic crystal fiber. Optics Express, 12 (5), 956–960. doi: 10.1364/opex.12.000956
13. Dobb, H., Kalli, K., Webb, D. J. (2004). Temperature-insensitive long period grating sensors in photonic crystal fibre. Electronics Letters, 40 (11), 657–658. doi: 10.1049/el:20040433
14. Dong, X., Tam, H. Y., Shum, P. (2007). Temperature-insensitive strain sensor with polarization-maintaining photonic crystal fiber based Sagnac interferometer. Applied Physics Letters, 90 (15), 151113. doi: 10.1063/1.2722058
15. Wadsworth, W. J., Knight, J. C., Reeves, W. H., Russell, P. S. J., Arriaga, J. (2000). Yb3+-doped photonic crystal fibre laser. Electronics Letters, 36 (17), 1452–1453. doi: 10.1049/el:20000942
16. Chen, D. (2007). Stable multi-wavelength erbium-doped fiber laser based on a photonic crystal fiber Sagnac loop filter. Laser Physics Letters, 4 (6), 437–439. doi: 10.1002/lapl.200710003
17. Broderick, N. G. R., Monro, T. M., Bennett, P. J., Richardson, D. J. (1999). Nonlinearity in holey optical fibers: measurement and future opportunities. Optics Letters, 24 (20), 1395–1397. doi: 10.1364/ol.24.001395
18. Dudley, J. M., Taylor, J. R. (2009). Ten years of nonlinear optics in photonic crystal fibre. Nature Photon, 3 (2), 85–90. doi: 10.1038/nphoton.2008.285
19. Yablonovitch, E., Gmitter, T., Leung, K. (1991). Photonic band structure: The face-centered-cubic case employing nonspherical atoms. Physical Review Letters, 67 (17), 2295–2298. doi: 10.1103/physrevlett.67.2295
20. Birks, T. A., Atkin, D. M., Shepherd, T. J., Russell, P. S. J., Roberts, P. J. (1995). Full 2-D photonic bandgaps in silica/air structures. Electronics Letters, 31 (22), 1941–1943. doi: 10.1049/el:19951306
21. Knight, J. C., Birks, T. A., Russell, P. S. J., Atkin, D. M. (1996). All-silica single-mode optical fiber with photonic crystal cladding. Optics Letters, 21 (19), 1547–1549. doi: 10.1364/ol.21.001547
22. Ho, H. L., Hoo, Y. L., Jin, W., Ju, J., Wang, D. N., Windeler, R. S., Li, Q. (2007). Optimizing microstructured optical fibers for evanescent wave gas sensing. Sensors and Actuators B: Chemical, 122 (1), 289–294. doi: 10.1016/j.snb.2006.05.036
23. Bock, W. J., Chen, J., Eftimov, T., Urbanczyk, W. (2006). A Photonic Crystal Fiber Sensor for Pressure Measurements. IEEE Transactions on Instrumentation and Measurement, 55 (4), 1119–1123. doi: 10.1109/tim.2006.876591
24. Fu, H. Y., Tam, H. Y., Shao, L.-Y., Dong, X., Wai, P. K. A., Lu, C., Khijwania, S. K. (2008). Pressure sensor realized with polarization-maintaining photonic crystal fiber-based Sagnac interferometer. Applied Optics, 47 (15), 2835–2839. doi: 10.1364/ao.47.002835
25. Moon, D. S., Kim, B. H., Lin, A., Sun, G., Han, Y.-G., Han, W.-T., & Chung, Y. (2007). The temperature sensitivity of Sagnac loop interferometer based on polarization maintaining side-hole fiber. Optics Express, 15 (13), 7962. doi: 10.1364/oe.15.007962
26. Kim, G., Cho, T., Hwang, K., Lee, K., Lee, K. S., Han, Y.-G., Lee, S. B. (2009). Strain and temperature sensitivities of an elliptical hollow-core photonic bandgap fiber based on Sagnac interferometer. Optics Express, 17 (4), 2481–2486. doi: 10.1364/oe.17.002481
27. Kim, H.-M., Kim, T.-H., Kim, B., Chung, Y. (2010). Enhanced transverse load sensitivity by using a highly birefringent photonic crystal fiber with larger air holes on one axis. Applied Optics, 49 (20), 3841–3845. doi: 10.1364/ao.49.003841
28. Dong, B., Hao, J., Liaw, C.-Y., Xu, Z. (2011). Cladding-Mode Resonance in Polarization-Maintaining Photonic-Crystal-Fiber-Based Sagnac Interferometer and Its Application for Fiber Sensor. Journal of Lightwave Technology, 29 (12), 1759–1763. doi: 10.1109/jlt.2011.2140313
29. Kim, D.-H., Kang, J. U. (2004). Sagnac loop interferometer based on polarization maintaining photonic crystal fiber with reduced temperature sensitivity. Optics Express, 12 (19), 4490–4495. doi: 10.1364/opex.12.004490
30. Frazão, O., Baptista, J. M., Santos, J. L., Roy, P. (2008). Curvature sensor using a highly birefringent photonic crystal fiber with two asymmetric hole regions in a Sagnac interferometer. Appl. Opt., 47 (13), 2520–2523. doi: 10.1364/ao.47.002520
31. Andronova, I. A., Malykin, G. B. (2002). Physical problems of fiber gyroscopy based on the Sagnac effect. Physics-Uspekhi, 45 (8), 793–817. doi: 10.1070/pu2002v045n08abeh001073
32. Shinde, Y. S., Kaur Gahir, H. (2008). Dynamic Pressure Sensing Study Using Photonic Crystal Fiber: Application to Tsunami Sensing. IEEE Photonics Technology Letters, 20 (4), 279–281. doi: 10.1109/lpt.2007.913741
33. Kumar, V. V. R., George, A., Reeves, W., Knight, J., Russell, P., Omenetto, F., Taylor, A. (2002). Extruded soft glass photonic crystal fiber for ultrabroad supercontinuum generation. Optics Express, 10 (25), 1520. doi: 10.1364/oe.10.001520
34. Ebendorff-Heidepriem, H., Warren-Smith, S. C., Monro, T. M. (2009). Suspended nanowires: fabrication, design and characterization of fibers with nanoscale cores. Optics Express, 17 (4), 2646. doi: 10.1364/oe.17.002646
35. Jiang, X., Euser, T. G., Abdolvand, A., Babic, F., Tani, F., Joly, N. Y., Travers, J. C., Russell, P. S. J. (2011). Single-mode hollow-core photonic crystal fiber made from soft glass. Optics Express, 19 (16), 15438–15444. doi: 10.1364/oe.19.015438
36. Jha, R., Villatoro, J., Badenes, G. (2008). Ultrastable in reflection photonic crystal fiber modal interferometer for accurate refractive index sensing. Applied Physics Letters, 93 (19), 191106:1–191106:3. doi: 10.1063/1.3025576
37. Jha, R., Villatoro, J., Badenes, G., Pruneri, V. (2009). Refractometry based on a photonic crystal fiber interferometer. Optics Letters, 34 (5), 617–619. doi: 10.1364/ol.34.000617
38. Cárdenas-Sevilla, G. A., Finazzi, V., Villatoro, J., Pruneri, V. (2011). Photonic crystal fiber sensor array based on modes overlapping. Optics Express, 19 (8), 7596–7602. doi: 10.1364/oe.19.007596

39. Zhang, Y., Li, Y., Wei, T., Lan, X., Huang, Y., Chen, G., Xiao, H. (2010). Fringe visibility enhanced extrinsic Fabry-Perot interferometer using a graded index fiber collimator. IEEE Photonics Journal, 2 (3), 469–481. doi: 10.1109/jphot.2010.2049833
40. Tuchin, V. V., Skibina, Ju. S., Beloglazov V. I. et. al. (2008). Sensornye svojstva fotonno-kristallicheskogo volnovoda s poloj serdcevinoj. Pis'ma v ZhTF, 34 (15), 63–69.
41. Russell, P. J. (2006). Photonic-Cristal Fibers. Journal of Lightwave technology, 24 (12), 4729–4749.
42. Fedotov, A. B., Kononov, S. O., Koletovatova, O. A. et. al. (2003). Volnovodnye svojstva i spektr sobstvennyh mod polyh fotonno-kristallicheskih volokon. Kvantovaja jelektronika, 33 (3), 271–274.
43. Chen, W. (2010). Ring-core photonic crystal fiber interferometer for strain measurement. Optical Engineering, 49 (9), 094402. doi: 10.1117/1.3488045
44. Mogilevtsev, D., Birks, T. A., Russell, P. S. J. (1999). Localized function method for modeling defect modes in 2-D photonic crystals. Journal of Lightwave Technology, 17 (11), 2078–2081. doi: 10.1109/50.802997

INFLUENCE OF MICROWAVE ELECTROMAGNETIC TREATMENT ON PROPERTIES OF EPOXY COMPOSITES (p. 32-37)

Petro Stukhliak, Olexandr Golotenko, Alexandr Skorokhod

Epoxy oligomers, containing reactive epoxy and hydroxyl groups, are widely used as binders to form composite materials (CM) with high performance. Improving the physical and mechanical properties, including adhesive strength and residual stresses of CM for protective coatings on their basis is achieved by introducing dispersed mineral fillers of different physical nature to the epoxy binder at the optimal content and external physical field treatment. Research on using electro-physical treatment methods of materials and products have shown the efficiency of using the power of the microwave (MW) electromagnetic (EM) oscillations.

The purpose of the paper is to determine the influence of the nature and content of the coarsely dispersed fillers in epoxy material on the adhesive strength and residual stresses in combination with their microwave electromagnetic treatment.

A study of the adhesive strength of plasticized epoxy binder after the MW electromagnetic field treatment before introducing a hardener was performed. It was first found that the best time of MW electromagnetic field treatment of plasticized epoxy matrix is 30 seconds, which leads to the maximized adhesive strength by 35 % due to improved cross-linking, caused by forming free radicals that interact intensively with hydroxyl centers on the metal base surface. It was proved that introducing coarsely dispersed fillers in the polymer matrix, followed by MW electromagnetic treatment allows to improve physical and mechanical properties of epoxy composites. It was revealed that composite materials, filled with SiC and B4C exposed to MW electromagnetic field within 60 seconds have the maximum adhesion characteristics. Introducing such fillers allows to further increase the adhesive strength by 25 % and 12 %, respectively, compared with the unfilled epoxy matrix.

Keywords: oligomer, polyethylenepolyamine, composite, adhesive strength, residual stresses, dispersed filler.

References

1. Kerber, M. L. Vinogradov, V. M. Golovkin, G. S. (2008). Polimernye kompozitsionnye materialy: struktura, svoystva, tekhnologiya. SPb: Profesiya, 560.
2. Xantos, M. (2010). Functional fillers for plastics, 2nd edition. Weinhem: Wiley-VCH, 531.
3. Stukhlyak, P. D., Buketov, A. V., Dobrotvor, I. G. (2008). Epoksykompozytni materialy, modyfikovani energetychnymy polyamy. Ternopil: Zbruch, 208.
4. Mehdizadeh, M. (2004). Microwave/RF methods for detection and drying of residual waterin polymers. Proceedings of the Fourth World Congress on Microwave and Radio Frequency Applications. Austin, Texas, 32.
5. Mykhaylyshyn, Y. A. (2009). Spetsyalnye polimernye kompozitsyonnye materialy. SPb: Nauchnye osnovy i tekhnologii, 660.
6. Bogdanova, Y. G. (2010). Adgeziya i yeyo rol' v obespichenii prochnosti polimernykh kompozitov. Moscow: Nauchno-obrazovatelnyy tsentr po nanotekhnologiyam, 68.
7. Kadyrin, L. B. (2000). Issledovanie mekhanicheskikh svoystv napolnenykh kompozitsiy i polibetonov na osnove smesey furanovykh i epoksidnykh smol. Plast.massy, (7), 33–34.
8. Savchuk, P. P., Kastornov, A. G. (2009). Struktura ta funktsional'ni vlastyvosti epoksydnykh komposytiv, napovnenykh vysokodyspernymy chastynkamy. Poroshkova metalurgiya, 9/10, 81–87.
9. Fedorov, V. V., Bilyj, L. M. (2006). Doslidzhennya vplyvu pryrody napovnyuvachiv na reologichni vlastyvosti epoksydnikh kopozytsiy. Naukovi notatky, 17, 406–411.
10. Zubov, P. I., Sukhareva, L. A. (1982). Struktura I svoystva polimernykh pokrytiy. Moscow: Khimiya, 256.
11. Varga, Cs., Miskolczi, N., Bartha, L. et al. (2010). Modification of the mechanical properties of rubbers by introducing recycled rubber into the original mixture. Global NEST Journal, 12 (4), 352–358.
12. Gunaratne, R. D., Day, R. J. (2004). Microwave and conventional mechanical & thermal analysis of the reactions in epoxy vinyl ester resins. Proceedings of the Fourth World Congress on Microwave and Radio Frequency Applications. Austin, Texas, 39.
13. Feldman, N. Y. (2009). Osobennosti provedeniya termicheskikh protsessov v SVCH-elektromagnitnom pole. Sovremennaya elektronika, 5, 64–67.
14. Kalganova, S. G. (2009). Elektrotekhnologiya neteplovoy modifikastyy polimernykh materialov v SVCH elektromagnitnom pole. Avtoreferat disertatsyy doktora tekhnicheskikh nauk, 34.
15. Kablov, V. F., Keybal, N. A., Provotorova, D. A., Mitchenko, A. E. (2014). Vliyanie mikrovolnovogo izlucheniya na prochnosnye svoystva elastomernykh kompozitsyj na osnove nepredelnykh kauchukov. Sovremennye problem nauki I obrazovaniya, 5.
16. Buketov, A. V., Stukhlyak, P. D. Kalba, Y. M. (2005). Fizyko-khimichni protsesy pry formuvanni epoksykompozytnykh materialiv. Ternopil: Zbruch, 182.
17. Zhou, J., Shi, C., Mei, B., Yuan, R., Fu, Z. (2003). Research on the technology and the mechanical properties of the microwave processing of polymer. Journal of Materials Processing Technology, 137 (1-3), 156–158. doi:10.1016/s0924-0136(02)01082-8
18. Yue, C. Y., Looi, H. C. (1995). Influence of thermal and microwave processing on the mechanical and interfacial properties of a glass/epoxy composite. Composites, 26 (11), 767–773. doi:10.1016/0010-4361(95)98197-s
19. Chaowasakoo, T., Sombatsompop, N. (2007). Mechanical and morphological properties of fly ash/epoxy composites using conventional thermal and microwave curing methods. Composites Science and Technology, 67 (11-12), 2282–2291. doi:10.1016/j.compscitech.2007.01.016

DETERMINING THE FIRE RESISTANCE PROPERTIES OF TIMBER, PROTECTED BY GEOCEMENT-BASED COATINGS (p. 38-41)

Anastasiya Kravchenko, Sergii Guzii

Flame spread during combustion of natural and synthetic materials is a factor, determining the fire intensity and dynamics, therefore it is important to ensure fire protection of building structures.

Timber is becoming more and more widely used in construction due to many advantages. However, because of dangerous shortcomings such as flammability and smoke generation, timber fire protection is required. The best effect is achieved through the use of geocement-based intumescent coatings applied to the timber surface.

The basic fire-resistant properties including flammability, smoke generation and flame spread on the surface of the timber, protected by a geocement-based coating, were defined.

The test for determining the flammability group of timber, protected by a geocement-based coating has shown flame-retardant properties of the material, namely, the weight loss – 4.4 %, and the maximum temperature of the combustion gases – 185 °C. The test for determining the smoke-generation ability has shown that in the combustion mode – 84.9 m^2/kg, in the smoldering mode – 256.4 m^2/kg, and flame spread index on the timber surface was 56.7. After tests for determining the fire properties, the investigated material refers to flame-retardant material with moderate smoke generation and low index of flame spread on the surface. Using timber, protected by a geocement-based coating in construction is effective and safe.

Keywords: intumescent coating, fire resistance, geotsement, timber, flammability, smoke generation, flame spread index.

References

1. Zhartovskii, V. M., Tsapko Yu. V. (2006). Profilaktyka gorinnya cellulozovmisnyh materialiv. Teoriya i practika. Kyiv:UkrNDIPB MNS Ukrainy, 256.
2. Anderson, Ch. E., Dziuk, JR, J., Mallow, W. A., Buckmaster, J. (1985). Intumescent Reaction Mechanisms. Journal of Fire Science, 3 (3), 161–194. doi: 10.1177/073490418500300303

3. Korolchenko, A. Ya., Trooshkin D. V. (2005) Pozharnaya opasnost stroitelnyh materialov. Moskva: Pozhnauka, 232.
4. Belikov, A. S., Shalomov V. A., Ragimov S. Yu., Udyanskiy, M. M. (2013). Povyshenie urovnya pozharnoi bezopasnosti za schet primineniya vspuchivayouschihsiya ognezashitnyh kompozicii. Problemy pozharnoi bezopasnosti, 34, 30–39.
5. Bartholmai, M., Schriever, R., Bartholmai, M., Schartel, B. (2003). Influence of external heat flux and coating thickness on the thermal insulation properties of two different intumescent coatings using conecalorimeter and numerical analysis. Fire and Materials, 27 (4), 151–162. doi: 10.1002/fam.823
6. Wladyka-Przybylak, M. (2000). Combustion characteristics of wood protected by intumescent coatings and the influence of different additives on fire retardant effectiveness of the coatings. Molecular crystals and liquid crystals science and technology. Section A. Molecular crystals and liquid crystals, 354 (1), 449–456. doi: 10.1080/10587250008023638
7. Pushkareva, K. K., Gonchar, O. A., Borisova, A. I. (2010). Efectyvni teploizolyazchiini materialy na osnovi luzhnyh alumosilicatnyh system. Zbirnyk naukovyh prazch WAT «UkrNDIVognetryviv im. A.S. Berezchnogo», 110, 582–586.
8. Krivenko, P. V., Pushkareva, K. K., Suhanevich, M. V. (1997). Rozrobka phizyko–himichnyh osnov napravlenogo syntezu neorganichnyh viyazhuchih v systemi Na_2O-Al_2O_3-SiO_2-H_2O dlya otrymannya ekologichno-bezpechnyh spuchuvanyh materialiv. Budivnizctvo Ukrainy, 2, 46–49.
9. Krivenko, P. V., Guzii, S. G., Kyrychok, V. I., Manak, Ya. (2013). Doslidzhennya reologichnyh vlastyvostey modyphikovanyh geocementiv. Budivelni materialy, vyroby ta sanitarna tehnika, 48, 89–93.
10. Guzii, S. G., Krivenko, P. V., Kravchenko, A. V., Manak, Ya. (2013). Doslidzhennya stadiinosti phazovyh perehodiv viyazhuchoi systemy skladu $Na_2O\times Al_2O_3\times 6SiO_2\times 20H_2O$ v intervali temperature 150–1050 °C. Budivelni materialy, vyroby ta sanitarna tehnika, 49, 13–20.
11. Kravchenko, A. V. (2014) Analysis of causes degradation of materials of discrete devices of computer systems. Technology audit and production reserves, 3/5(17), 40–42. doi: 10.15587/2312-8372.2014.27934

DEVELOPMENT OF TECHNOLOGY OF OBTAINING MICROCRYSTALLINE CELLULOSE FROM FLAX FIBRES (p. 42-46)

Valerii Barbash, Julia Nagorna

The process of obtaining microcrystalline cellulose from flax fibers was investigated. The effect of chelating agents on the mineral content in the flax cellulose was studied. The influence of the elemental composition of flax cellulose on the content of metal cations after chelating treatment was determined. It was found that metal cations are the most extractable in alkaline and acidic media at pH=3 and pH=12. The process of bleaching flax cellulose that does not contain hazardous chlorine compounds was investigated and optimal bleaching scheme, that allows to achieve the required whiteness at low content of non-cellulose components, including minerals, was found. The main technical parameters of the bleached flax cellulose hydrolysis were determined.

For the production of microcrystalline cellulose from flax fibers, it is recommended to use the following scheme for processing flax fibers: soda pulping – bleaching according to the scheme with chelating treatment in an acidic medium – two-stage peroxide bleaching – hydrolysis. Using the proposed scheme allows to obtain microcrystalline cellulose that meets regulatory requirements and can be used in the chemical industry.

Keywords: microcrystalline cellulose, flax fiber, chelating treatment, bleaching, hydrolysis.

References

1. Kharazov, V. G. et. al. (Eds.) (2003). Technology of pulp and paper production. In 3 volums. (Raw materials and semi-finished production). Part 2: Production of semi-finished products. SPb.: University of Technology, 633.
2. Shlieout, G., Arnold, K., Müller, G. (2002). Powder and Mechanical Properties of Microcrystalline Cellulose With Different Degrees of Polymerization. AAPS PharmSciTech, 3 (2), 45–54. doi: 10.1208/pt030211
3. Ardizonne, S., Dioguardi, F. S., Mussini, T., Mussini, P. R., Rondinini, S., Vertova, A. (1999). Microcrystalline cellulose powders: structure feitures and water sorption capabitity. Cellulose, 6, 57–69.
4. Sarymsakov, A. A. (2004). Dispersed microcrystalline Pulp and hydrogels based on it. Chemistry of plant raw materials, 2, 11–16;
5. Xiong, R., Zhang, X., Tian, D., Zhou, Z., Lu, C. (2012). Comparing microcrystalline with spherical nanocrystalline cellulose from waste cotton fabrics. Cellulose, 19 (4), 1189–1198. doi: 10.1007/s10570-012-9730-4
6. Barbash, V., Trembus, I., Nagorna, J. (2012). Obtaining pulp from corn stalks. Chemistry & Chemical Technolology, 1, 83–87.
7. Ivanov, S. Y. (2003). Technology cellulose. Cooking liquor pulping and bleaching: teaching practical manual. SPb., 41.
8. Segeda, A. S. (2003). Analitichna himiya. Yakisny i kilkisny analiz. By: TSUL, 311.
9. Kocheva, L. S. (2002). New Methods of obtaining mykrokrystallycheskoy cellulose. Chemistry and Technology substances. Kazan, 140.
10. Torlopov, M. A. (2007). Sulphation powder materials received by degradation of cellulose titanium tetrachloride. Chemistry for sustainable development, 4, 491–496.
11. Frolova, S. B. (2007). Preparation of powder materials degradation of cellulose Lewis acids and their modification. Chemistry of plant raw materials, 3, 63–67.
12. Frolova, S. V. (2008). Destruktsyya drevesnoy Lewis acid cellulose and cellulose Getting poroshkovoy. Journal of Applied Chemistry, 1, 152–156;
13. Barbash, V. A. (2012). Effect of pretreatment flax fibers for performance cellulose. Eastern-European Journal of Enterprise Technologies, 4/6 (70), 4–8. doi: 10.15587/1729-4061.2014.25934
14. Pazukhin, G. A. (2002). Reagents for pulp bleaching. St. Petersburg, 110.
15. Li, Z., Court, R., Velliveau, M., Crowell, M., Murphy, R., Gibson, A., Wajer, M., Ni, Y. (2005). Using magnesium hydroxide as the alkali source in peroxide bleaching at Irving. Pulp & Paper Canada, 6, 24–27.

ASSESSMENT OF HYDROPHOBIC SHEEPSKIN FUR VELOUR QUALITY (p. 47-53)

Nataliia Khliebnikova, Natalia Omelchenko, Anatoliy Danylkovych

We have determined the scope of dimensional quality indicators for sheepskin fur velour according to the desirability scale on the basis of specifications and technical documentation, expert assessments, scientific publications and research findings. On the basis of dimensionless parameters of quality, we have calculated desirability functions for individual quality indicators and a complex quality indicator for hydrophobic sheepskin fur velour produced according to a new technology. We have also compared its qualities to those of fur velour obtained by means of traditional technology.

In terms of the growing necessity to satisfy the Ukrainian consumer, we have attempted to predict the possibility of using hydrophobic sheepskin fur velour in conditions of high humidity.

It is determined that a complex quality indicator for hydrophobic fur velour is significantly higher than a complex quality indicator for fur velour produced according to a typical technology, especially after its exposure to rain.

Before the test, the hydrophobic fur velour was rated as excellent. The impact of rain on the hydrophobic fur velour has lead to a slight decrease of the complex quality indicator. It is rated as good, which is close to excellent. After exposure to rain, fur velour finished with alkene-maleic composition completely satisfies consumer needs and can be used in wet conditions, low temperatures, and dynamic loads.

It is determined that a perspective direction in making high-quals ity sheepskin fur velour for sheepskin products involves using a techs nology of its finish with alkene-maleic composition, which is aimed at better operating, hygiene, and aesthetic properties. This will specify new directions and spheres of using sheepskin fur velour, expand the assortment, raise the competitiveness of sheepskin products of Ukraiǂ nian origin, and shape the export potential, which is conditioned by the free trade zone, Agreement on association with EU, and modern world integration processes.

Keywords: complex quality indicator, hydrophobic sheepskin fur velour.

References

1. Holodiuk, H. I. (2013). Kompleksna otsinka yakosti farbuvalnoi kompozytsii i pokryttiv na osnovi alkidnykh smol, Tovaroznavchyi visnyk, 6, 38–45.
2. Azgaldov, G. G. (1982). Teoriya i praktika ocenki kachestva tovarov, Moskow: Ekonomika, 250.
3. Kostrovskaya, T. V. (2006). Razrabotka metodiki avtomatizirovannoj ocenki komfortnosti obuvi po pokazatelyam fiziko-mexanicheskix svojstv paketov materialov verxa, RGB, 160.
4. Kutakh, K. M. (2014). Implementing quality management system at enterprises. Technology Audit and Production Reserves,

1/5(15), 24–26. Available at: http://journals.uran.ua/tarp/article/view/21725/19230
5. Hunkalo, A. V., Shpak, O. I. (2014). Improvement of the products quality level by competent experts. Technology Audit and Production Reserves, 4/1 (18), 36–38. doi: 10.15587/2312-8372.2014.26368
6. Kozar, O. P., Mokrousova, O. R. (2013). Eco-friendly technologies of leather manufacturing using natural minerals montmorilonite and zeolite. Technology Audit and Production Reserves, 6/2(14), 11–16. Available at: http://journals.uran.ua/tarp/article/view/19499/17168
7. Palahniuk, Yu. V., Slitiuk, O. O. (2009). Rozrobka nomenklatury erhonomichnykh pokaznykiv yakosti odiahu. Eastern-European Journal of Enterprise Technologies, 3/6(39), 26–29. Available at: http://journals.uran.ua/eejet/article/view/20393/18021
8. Khimicheva, H. I. (2013). Quality control of the leather semi-finished product at the tanning stage. Eastern-European Journal of Enterprise Technologies, 3/3(63), 34–36. Available at: http://journals.uran.ua/eejet/article/view/14679/12448
9. Suprun, N. P., Osypenko, N. I., Ostrovetska, Yu. I. (2012). Analitychnyi ohliad asortymentu ta kompleksna otsinka yakosti trykotazhnykh poloten. Tovaroznavstvo ta innovatsii, 4, 116–124.
10. Zhuravskyi, V. A., Kasian, E. Ye., Danylkovych, A. H. (1996). Tekhnolohiia shkiry ta khutra, DALPU, 743.
11. Danylkovych, A. H., Khliebnikova, N. B., Mokrousova, O. R., Petko, K. I. (2009). Patent na KM No. 38472 Ukraina. Kompozytsiia dlia hidrofobizatsii vorsovoi shkiry, khutrianoho veliuru, shubnoi ovchyny i vyrobiv z nykh, zaiavl. 08.08.08, opubl. 12.01.09, Biul. No. 1.
12. GOST 28509-90. Ovchiny` nevy`delanny`e (2006). Texnicheskie usloviya, FGUP «Standartinform», 13.
13. Khliebnikova, N. B., Omelchenko, N. V., Danylkovych, A. H. (2014). Spozhyvni vlastyvosti hidrofobizovanoho khutrianoho veliuru z ovchyny v umovakh pidvyshchenoi volohosti.
14. Krasnov, B. Ya., Bernshtejn, M. M., Gvozdev, Yu. M. (1979). Kompleksnaya ocenka kachestva obuvny`x materialov, Lyogkaya industriya, 80.
15. Chajkovskaya, A. E., Polishhuk, L. V., Galy`k, I. S., Semak, B. D. (1989). Kompleksnaya otcenka kachestva tekstil`ny`x materyalov, Texnika, 254.
16. Galy`k, I. S., Koz`mich, D. I., Semak, B. D. et. al. (1991). Optimizaciya assortimenta i kachestva tekstil`ny`x materialov, Texnika, 174.
17. Axnazarova, S. L., Kafarov, V. V. (1985). Metody` optimizacii e`ksperimenta v ximicheskoj texnologii, Moskow, Vy`ssh. shk., 2, 318.
18. Danylkovych, A. H., Khliebnikova, N. B., Omelchenko, N. V. (2014). Selecting the nomenclature of quality indicators of hybrophobized fur velour by expert method. Eastern-European Journal of Enterprise Technologies, 5/3 (71), 34–39. doi: 10.15587/1729-4061.2014.27613

STUDIES OF SENSITIVITY OF SAMPLES OF NANOCOMPOSITE MATERIALS BASED ON OPAL MATRICES TO MAGNETIC FIELDS (p. 54-60)

Boris Hlopov, Aleksandr Shpak, Yaroslav Kovalyuk

The properties of samples of metamaterials based on opal matrices with filling their nanoporosities by clusters of different magnetic and non-magnetic metal or magnetic crystallites were investigated.

A method for assessing susceptibility of the developed composite materials to magnetic fields when exposed to external electromagnetic fields was developed. Designed and manufactured process equipment, consisting of the field-forming system, power generator, power source, throttle cooling system and certified and calibrated measuring instruments is shown.

Experimental results of the external electromagnetic field exposure on metamaterials as nanocomposites, representing discrete nanostructured environment with obtaining substantial electric “response”, in turn, leading, in particular, to the multiplication effect for applied electromagnetic fields in the field-forming system of the process test equipment at frequencies below 1010 kHz are given. It was experimentally confirmed that the values of the magnetic field parameters in the field-forming system of process test equipment change in the frequency range of up to 1010 kHz. Experimental characteristics of spatial multiplication of magnetic fields in the layout area of composite materials when exposed to external electromagnetic fields are provided. It was found and experimentally confirmed that external electromagnetic field exposure on nanocomposite samples in a limited space of the working chamber of the field-forming system leads to an effective increase in the magnetic field value in the local region of the spatial volume of up to 120 kA/m.

Keywords: metamaterials, equipment, nanocomposites, opal matrix, multiplizieren, electromagnetic fields, precursor, metal cluster, erasing of information.

References

1. Sarychev, A. K., Shalaev, V. M. (2007). Eltctrodynamics of metamaterials. World Scientific and Imperial College Press, 200. doi: 10.1142/9789812790996
2. Samoilovich, M. I. (Ed.) (2007). Nanomaterialy. III. Fotonnye kristally i nanokompozity na osnove opalovyh matritc. Moscow: Tehnomash, 303.
3. Rinkevich, A. B., Ustinov, V. V., Samoilovich, M. I., Belianin, A. F., Kleshcheva, S. M., Kuznetcov, E. A. (2008). Nanokompozity na osnove opalovyh matritc s 3D-structuroi, obrazovannoi magnitnymi nanochastitcami. Tehnologia i konstruirovanie v elektronnoi apparature, 4, 55–63.
4. Samoilovich, M. I., Bovtun, V., Rinkevich, A. B., Belianin, A. F., Kleshcheva, S. M., Kempa, M., Nuzhnyi, D. (2010). Prostranstvenno-neodnorodnye materially na osnove reshotchatyh upakovok nanospfer SiO2. Inzhenernaia fizika, 6, 29–38.
5. Hlopov, B. V., Samoilovich, M. I., Bovtun, V. (2013). Issledovanie effekta multiplikatcii elektromagnitnyh polei v ustroistvah beskontaktnogo stiraniia informatsii s elektronnyh nositelei s ispolzovaniem nanokompozitov na osnove opalovyh matritc. Nano i mikrosistemnaia tehnika, 7, 6–13.
6. Rinkevich, A. B., Kuznetsov, E. A., Perov, D. V., Ryabkov, Y. I., Samoylovich, M. I., Klescheva, S. M. (2014). Microwave Dielectric Properties of Ceramic and Nanocomposite Titanates of Transition Metal. J Infrared Milli Terahz Waves, 35 (10), 860–870. doi:10.1007/s10762-014-0088-6
7. Rinkevich, A. B., Samoilovich, M. I., Klescheva, S. M., Perov, D. V., Burhanov, A. M., Kuznetsov, E. A. (2014). Millimeter-Wave Properties and Structure of Gradient Co-Ir Films Deposited on Opal Matrix. IEEE transactions on nanotechnology, 13 (1), 3–9. doi: 10.1109/tnano.2013.2273565
8. Ustinov, V. V., Rinkevich, A. B., Perov, D. V., Samoilovich, M. I., Kleshcheva, S. M. (2012). Anomalous magnetic antiresonance and resonance in ferrite nanoparticles embedded in opal matrix. Journal of Magnetizm and Magnetic Materials, 324, 78–82. doi: 10.1016/j.jmmm.2011.07.051
9. Hlopov, B. V., Samoilovich, M. I., Mitiagin, A. Iu. (2013). Ispolzovanie metamaterialov na osnove opalovyh matritc v sistemah stiraniia informatcii na magnitnyh nositeliah. Nanoinzheneriia, 4, 29–34.
10. Samoilovich, M. I., Belianin, A. F., Kleshcheva, S. M. (2012). Fazovye prevrashchenia kremnezema v mezhsfericheskih nanopolostiah opalovyh matritc. Rossiiskii himicheskii zhurnal, LVI (3-4), 155–162.
11. Rinkevich, A. B., Burhanov, A. M., Samoilovich, M. I., Belianin ,A. F., Kleshcheva, S. M., Kuznetcov, E. A. (2012). 3D-nanokompozitnye metallodielektricheskie materially na osnove opalovyh matritc. Rossiiskii himicheskii zhurnal, LVI (1-2), 26–35.
12. Hlopov, B. V., Samoilovich, M. I., Mitiagin, A. Iu. (2013). Issledovanie prostranstvennogo multiplitcirovaniia impulsnogo magnitnogo polia obraztcami metamaterialov. Telekommunikatcii i transport, 1, 48–51.
13. Hlopov, B. V., Lobanov, B. S., Pikul, A. I. (2013). Metody povyshenia effektivnosti zashchity informatcii, hraniashcheisia na zhostkih magnitnyh diskah. Telekommunikatsii i transport, 4, 8–13.
14. Hlopov, B. V. (2012). Mnogovektornye magnitnye sistemy. XIII Mezhdunarodnaia nauchno-prakticheskaia konferentciia «Sovremennye informatcionnye i elektronnye tehnologii». Odessa, 137.
15. Patent RU № 2323491 ot 27.04.2008 g. (prioritet ot 16.05.2006 g.) Biul. № 12.
16. Kong, J. A. (2002). Electromagnetic wave interaction with stratified negative isotropic media. Progress In Electromagnetics Research, 35, 1–52. doi: 10.2528/pier01082101

COKING COAL MIXTURE WITH HIGH CONTENT OF WEAKLY COKING AND SULFUR COAL (p. 61-66)

Ludmila Butuzova, Ruslan Makovsky, Grigorij Kleshnya, Denis Milov, Juri Kaftan, Oksana Turchanina, Gennadij Butuzov

Analysis of the state of Ukrainian Coal Industry and modern tendencies compiling coal blends for coke plants clearly highlights the need to solve the problem of rational use of domestic coal. This work has shown an opportunity to expand the resource base of coking due to an increase in the blends the share of cheap low-quality domestic coal.

Experimental-industrial coking of unconventional coal blends containing a maximum of weakly coking components and caking Donetsk coal of reduced type have been carried out. It has been obtained the desulfurization effect (45–50 %) for cokes derived from

proposed coke mixtures Jrc+Glrc=50:50 and=70:30 in industrial environments. It is shown that the use of these mixtures as blends allows to obtain cokes suitable on the sulfur content – 0,95–1,14 wt % with high mechanical strength (P25=90,2–91,7 %). This coke can be used as a special kind of coke in many industries and as a coke for the domestic market. The addition of coal tar pitch in the proposed coal mixture can improve the strength properties of coke.

The use of low-quality domestic coal will, saving quality coal, significantly reduce the cost of coke.

Keywords: blend, sulphur content, tar pitch, box coking, coke composition, coking ability, strength, texture.

References

1. Lifshic M. M. (1954). Geneticheskaja klassifikacija uglej. Geologo-uglehimicheskaja karta Doneckogo bassejna. Moscow: Ugletehizdat, XIII, 127.
2. Ammosov, I. I. (1963). Geologija mestorozhdenij uglja i gorjuchih slancev SSSR. Vol. 1. Moscow: Gosudarstvennoe nauchno–tehnicheskoe izdatel'stvo literatury po geologii i ohrane nedr, 1210.
3. Dolgij, V. Ja., Krivchenko, A. A., Shamalo, M. D., Dolgaja, V. A. (2000). Soderzhanie obshhej sery v ugol'nyh plastah na shahtah Ukrain. Ugol' Ukrainy, 1, 44–46.
4. Bakaldina, A. P. (1969). Izvestija vysshih uchebnyh zavedenij. Geologija i razvedka, 6, 72.
5. Hamuljak, V. G. (2000). Vugillja – golovnyj energonosij. Ugol' Ukrayni, 8, 3–4.
6. Nesterenko, L. L., Beskina, G. I. (1955). Razrabotka voprosov teorii shihtovki i koksoobrazovanija. Otchet o rabote, fond UHINa, Kharkiv.
7. Zolotukhin, Y. A., Andreichikov, N. S. (2009). Coke quality for blast furnaces with coal-dust fuel. Steel in Translation, 39 (6), 470–474. doi:10.3103/s0967091209060084
8. Kurunov, I. F. (2001). The quality of coke and possibilities for reducing its consumption in blast-furnace smelting. Metallurgist, 45, 11-12, 444–458.
9. Ogarenko, Ju. (2010). Problemy vugil'noi' promyslovosti Ukrai'ny ta vykydy parnykovyh gaziv vid vydobutku j spozhyvannja vugillja. Kyiv: Nacional'nyj ekologichnyj centr Ukrai'ny, 51.
10. Rynok koksa i koksohimicheskie predprijatija Ukrainy. Rezul'taty 2011 goda (2012). Nacional'noe rejtingovoe agentstvo «Rjurik», 12.
11. Drozdnik, I. D. (2007). Potreblenie koksujushhihsja uglej Ukrainy. Problemy i perspektivy. Sb. trudov tret'ej ezhegodnoj konferencii «Ugol' SNG–2007». Alushta, 91–95.
12. Surgaj, N. S., Janko, S. V., Fishhenko, S. P., Tatarinov, A. A. (1997). Uroki istorii v ugol'noj promyshlennosti. Ugol' Ukrainy, 4, 3–5.
13. Drozdnik, I. D. (2005). K voprosu obespechenija metallurgicheskogo kompleksa koksujushhimisja ugljami neobhodimogo kachestva. Sb. Zbagachennja korisnih kopalin, 23 (64), 8–12.
14. Butuzova, L. F., Isaeva, L. N., Makovskij, R. V. et. al. (2008). Vlijanie dobavok plastika na processy termodestrukcii sernistyh uglej. Naukovi praci Donec'kogo nacional'nogo tehnichnogo universytetu. Ser.: Himija ta himichna tehnologija, 137 (11), 96–101.
15. Butuzova, L. F., Makovskij, R. V., Vetrov, I. V., Butuzov, G. N. Tehnologicheskie harakteristiki netradicionnyh koksovyh shiht na osnove uglej Donbassa. Naukovi praci Donec'kogo nacional'nogo tehnichnogo universytetu. Ser.: Himija ta himichna tehnologija, 19 (199), 107–116.
16. Butuzova, L. F., Makovskij, R. V., Kulakova, V. O., Vetrov, I. V. Vozmozhnosti upravlenija processami termicheskoj destrukcii netradicionnyh ugol'nyh shiht Donbassa putem vvedenija dobavok himicheskih veshhestv. Naukovi praci Donec'kogo nacional'nogo tehnichnogo universytetu. Ser.: Himija ta himichna tehnologija, 19 (199), 116–121.

EFFECT OF SUBSTITUTION BY ALUMINUM IONS AND HEAT TREATMENT CONDITIONS ON ELECTROCHEMICAL PROPERTIES OF CERAMICS WITH COMPOSITION Li_2O-Al_2O_3-Fe_2O_3 (p. 67-71)

Bogdan Deputat

Based on X-ray diffraction, electron microscopic and electrochemical studies, a comprehensive analysis of the solid solutions of lithium ferrites and lithium aluminates in a wide concentration range, depending on the cooling conditions on the final stage of solid-phase ceramic synthesis was carried out in the paper.

It was shown that the crystal structure and microstructure formations of solid solutions of lithium ferrites and lithium aluminates at the boundary of the metastable formations allow to obtain the system, suitable for electrochemical lithium intercalation with the necessary intercalation and electron-transport characteristics. This allows to construct a chemical lithium current source with the cathodes based on the obtained systems without additional processing techniques.

The resulting current sources with an operating voltage of ~2 V are characterized by a specific charge of ~300 A•h/kg and specific energy of ~625 W•h/kg.

Keywords: spinel, cathode material, specific capacity, conductivity, lithium current sources.

References

1. Machill, S., Rahner, D. (1995). In situ electrochemical characterization of lithium-alloying materials for rechargeable anodes in lithium batteries. Journal of Power Sources, 54 (2), 428–432. doi: 10.1016/0378-7753(94)02117-l
2. Gautier, J. L., Ahumada, R., Meza, E., Poillerat, G. (2001). LITHIUM Insertion into Li-Mn, Li-Fe and Li-Co oxides. Boletín de La Sociedad Chilena de Química, 46 (3), 1137–1148. doi: 10.4067/s0366-16442001000300016
3. Tang, S. B., Lai, M. O., Lu, L. (2008). Study on Li+-ion diffusion in nano-crystalline $LiMn_2O_4$ thin film cathode grown by pulsed laser deposition using CV, EIS and PITT techniques. Materials Chemistry and Physics, 111 (1), 149–153. doi: 10.1016/j.matchemphys.2008.03.041
4. Kim, S.-W., Pyun, S.-I. (2002). Analysis of cell impedance measured on the LiMn2O4 film electrode by PITT and EIS with Monte Carlo simulation. Journal of Electroanalytical Chemistry, 528 (1-2), 114–120. doi: 10.1016/s0022-0728(02)00900-2
5. Kachibaja, Je. I., Imnadze, R. A. (2002). Struktura i jelektrohimicheskie svojstva dopirovannyh kobal'tom litij-margancevyh shpinelej dlja perezarjazhaemyh litievyh istochnikov toka. Jelektrohimichnskaja jenergetika, 2 (1), 12–17.
6. Islam, M. S., Catlow, C. R. A. (1988). Lithium insertion into Fe_3O_4. Journal of Solid State Chemistry, 77 (1), 180–189. doi: 10.1016/0022-4596(88)90106-5
7. De Picciotto, L. A., Thackeray, M. (1986). Lithium insertion into the spinel LiFe5O8. Materials Research Bulletin, 21 (5), 583–592. doi: 10.1016/0025-5408(86)90113-3
8. Fu, Y.-P., Yao, Y.-D., Hsu, C.-S. (2006). Microwave-induced combustion synthesis of Li0.5Fe2.5−xAlxO4 powder and their characterization. Journal of Alloys and Compounds, 421 (1–2), 136–140. doi: 10.1016/j.jallcom.2005.08.089
9. Dar, M. A., Batoo, K. M., Verma, V., Siddiqui, W. A., Kotnala, R. K. (2010). Synthesis and characterization of nano-sized pure and Al-doped lithium ferrite having high value of dielectric constant. Journal of Alloys and Compounds, 493 (1-2), 553–560. doi: 10.1016/j.jallcom.2009.12.154
10. Mazur, M. P., Gasjuk, I. M., Deputat, B. Ja., Kajkan, L. S., Ugorchuk, V. V. (2011). Impedansnyj metod doslidzhennja vplyvu tehnologichnyh umov oderzhannja na pytomu providnist' aljuminij-zamishhenoi' litij-zaliznoi' shpineli. Metody ta prylady kontrolju jakosti, 27, 86–91.