ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Д.В. Сокольский атындағы
«Жанармай, катализ және электрохимия институты» АҚ

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
АО «Институт топлива, катализа и
электрохимии им. Д.В. Сокольского»

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
JSC «D.V. Sokolsky institute of fuel, catalysis
and electrochemistry»

SERIES
CHEMISTRY AND TECHNOLOGY

3 (447)

MAY – JUNE 2021

PUBLISHED SINCE JANUARY 1947

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of chemistry and technologies scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of chemistry and technologies in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of chemical sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Химия және технология сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Химия және технология сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді химиялық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия химии и технологий» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Socia1 Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество в глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по химическим наукам для нашего сообщества.

«ҚР ҰҒА Хабарлары. Химия және технология сериясы»
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ66VPY00025419** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *химия және жаңа материалдар технологиясы саласындағы басым ғылыми зерттеулерді жариялау.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19, 272-13-18
http://chemistry-technology.kz/index.php/en/arhiv

Редакцияның мекенжайы: 050100, Алматы қ., Қонаев к-сі, 142, «Д. В. Сокольский атындағы отын, катализ және электрохимия институты» АҚ, каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

«Известия НАН РК. Серия химии и технологий».
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ66VPY00025419,** выданное 29.07.2020 г.

Тематическая направленность: *публикация приоритетных научных исследований в области химии и технологий новых материалов.*

Периодичность: 6 раз в год.
Тираж: 300
Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19, 272-13-18
http://chemistry-technology.kz/index.php/en/arhiv

Адрес редакции: 050100, г. Алматы, ул. Кунаева, 142, АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского», каб. 310, тел. 291-62-80, факс 291-57-22, e-mail:orgcat@nursat.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

News of the National Academy of Sciences of the Republic of Kazakhstan.
Series of chemistry and technology
ISSN 2518-1491 (Online),
ISSN 2224-5286 (Print)

Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ66VPY00025419,** issued 29.07.2020.

Thematic scope: *publication of priority research in the field of chemistry and technology of new materials*
Periodicity: 6 times a year.
Circulation: 300

Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19; 272-13-18, *http://chemistry-technology.kz/index.php/en/arhiv*

Editorial address: JSC «D.V. Sokolsky institute of fuel, catalysis and electrochemistry», 142, Kunayev str., of. 310, Almaty, 050100, tel. 291-62-80, fax 291-57-22, e-mail: orgcat@nursat.kz

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS
OF THENATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES CHEMISTRY AND TECHNOLOGY
ISSN 2224-5286
Volume 3, Number 447 (2021), 99 – 103 **https://doi.org/10.32014/2021.2518-1491.58**

UDC 541.138.537.311.6

N.A. Vysotskaya[1*], B.N. Kabylbekova[1], D.D. Asylbekova[1], R.S. Spabekova[1], E.G. Lukin[2]
[1]M. Auezov South Kazakhstan University, Shymkent, Kazakhstan
[2]LLC «Chemical technologies», Moscow, Russia.
E-mail: vysockaya42@mail.ru

SOME FEATURES OF ELECTRODEPOSITION OF METALS FROM ELECTROLYTES WITH SURFACTANTS

Abstract: For a long time, the use of various surfactants in the composition of simple electrolytes by researchers to improve the quality of metal coatings with cadmium and zinc has been an urgent task.Surfactants contribute to the grinding of the coating structure, the elimination of their porosity and the appearance of anti-corrosion properties of coatings. For example, cadmium electroplated coatings require corrosion resistance, since they are operated in tropical climates, in underground tunnels. Zinc coatings are widely used in building structures and roofing, on electrified railways and high-voltage power lines, in the mining industry and water pipes, as well as for galvanizing the body material in modern all-terrain vehicles to pass in hard-to-reach places without being subjected to corrosion.

The object of our research is the process of electrodeposition of cadmium and zinc from simple acidic electrolytes with surfactants, which are thiourea derivatives of dialkyl-phosphorous acids in the current density range of 0.5-3.5 A /dm², at room temperature. To confirm the quality of the obtained electroplating, we used a JSM-6490LV scanning electron microscope with INSA Energu energy–dispersion microanalysis and HKL-Basicc structural analysis systems with a useful magnification of 300000.

Key words: anticorrosive properties, electroplating, surfactants, thiourea derivatives.

Introduction.

The corrosion process of destruction of protective metal coatings of zinc, cadmium occurs mainly in an atmosphere with high humidity and it becomes electrochemical, since at more than 70% humidity, the corrosion products of these coatings are a porous film that acts rapidly on the corrosion process due to the penetration of moisture through the pores to the surface of the protected product. The rate of corrosion of metal coatings is determined to a greater extent by the presence of moisture in the surrounding atmosphere. Metal structures that are operated under various conditions must be durable, not only having high mechanical strength, but also be chemically resistant, i.e. they must be protected from atmospheric and other types of corrosion [1].

The peculiarity of the mechanism of protection of metal structures with cadmium and zinc is also of great importance. At electrodeposition potentials close to the potential of a metal substrate (steel product), zinc and cadmium coatings protect the product mainly by electrochemical means [2]. The formation of short-circuited galvanic cells of the following types occurs: Me-Zn, Me-Cd, in which zinc and cadmium are soluble electrodes-anodes.

To impart high protective properties to metal coatings: density, porosity, high corrosion resistance, various surfactants are introduced into the compositions of their electrolytes, which contribute to the deposition of high-quality coatings. Such surfactants can be various organic and inorganic substances. The possibility of modifying zinc metal coatings with nanoparticles is known from the literature [3, 4]. Of particular interest are surfactants-thiourea derivatives of dialkyl phosphorous acids containing sulfur and phosphorus, potassium and calcium salts of disulfonic acids [5], nickel and tin salts [6], dextrin, gelatin, joiner's glue [7, 8].

The components of cadmium and zinc sulfuric acid electrolytes are their sulfuric acid salts, with the addition of other salts that increase their electrical conductivity and pH of the electrolyte, as well as universal additives that improve the quality of metal coatings [9-11].

The purpose of our research was to test surfactants in simple acidic electrolytes of cadmium plating and galvanizing surfactants that can create high-quality cadmium and zinc electroplating coatings on the protected surface of the product that resist corrosion destruction.

Materials and method.

Metallic cadmium and zinc coatings on a steel base were obtained in an electrolysis bath with an electrolyte of the composition (g/l): cadmium sulfate-50, ammonium sulfate-30, aluminum sulfate-30, surfactant-0.5-1.5; zinc sulfate 170, aluminum sulfate 90, sodium sulfate-20, surfactant-0.5-1.5. Reagents of the brand "chemical pure". Surfactant (conventional name BGU-17) is a thiourea product of the oil synthesis of dialkyl phosphorous acids - $[R_2POHC(S)(NH_2)_2]$, which has a high adsorption capacity and good solubility in acidic electrolyte. The cathodes are steel plates of the ST 3 brand, anodes made of electrolytic cadmium and zinc, the microstructure of the obtained cadmium and zinc coatings from electrolytes without surfactants and with surfactants for comparison was studied on a scanning electron microscope of the JSM-6490LV brand.

Steel samples-cathodes were subjected to mechanical treatment with emery paper, degreased with soda, washed with distilled water, dried with alcohol, and weighed on an electronic balance. The current strength was calculated over the surface of the steel cathodes and a given current density (from 0.5 to 3.5 A/dm^2). The current output (VT) was determined from the difference in the mass of cadmium and zinc deposited and calculated theoretically according to Faraday's law. The porosity and thickness of the coatings were determined by the method described in the source [12].

The production of electroplated coatings was carried out on an installation consisting of an electrolyzer, an ammeter, a rheostat, and a direct current source with a total voltage of 220V.

Results and discussion. Tables 1 and 2 show the quality indicators of zinc and cadmium coatings obtained from electrolyte without surfactant.

Table 1- Quality of zinc coatings in electrolyte without surfactants

pH	Ik, A/dm^2	t, °C	BTZn, %	Appearance of the zinc coating	Coating thickness, microns
3,5-3,8	0,5	20	92,4	Dark gray, coarse crystalline, porous	11,82
3,5-3,8	1,5	20	92,6	Dark gray, coarse crystalline, porous	10,26
3,5-3,8	2,5	20	92,9	Dark gray, coarse crystalline, porous	12,10
3,5-3,8	3,5	20	91,8	Dark, flakes off at the edges	10,21

Table 2-Quality of cadmium coatings in an electrolyte without surfactants

pH	Ik, A/dm^2	t, °C	BTZn, %	Appearance of the cadmium coating	Coating thickness, microns
3,2-3,5	0,5	20	91,9	Gray, coarse-crystalline, porous	10,62
3,2-3,5	1,5	20	92,7	Light gray, coarse crystalline, porous	11,94
3,2-3,5	2,5	20	93,4	Light gray, coarse crystalline, porous	10,02
3,2-3,5	3,5	20	91,5	Gray with burnt	11,61

The quality of zinc and cadmium coatings does not meet the required quality indicators. The coatings are coarse-crystalline, dark or gray, at higher current densities they peel off at the edges, forming burns. The share of points volume in the total coverage is quite high.This structure of zinc and cadmium coatings does not contribute to their effective protection of the product from corrosion. Through the pores, it is possible to penetrate the aggressive environment to the surface of the product and its destruction. The current output is low (91-93%).

Tables 3 and 4 show the quality indicators of zinc and cadmium coatings obtained from electrolytes with surfactants.

Table 3- Quality of zinc coatings in electrolyte with surfactant

pH	Ik, A/dm^2	t, °C	BTZn, %	Appearance of the zinc coating	Coating thickness, microns
3,5-3,8	0,5	20	97.1	Light gray, fine-grained,non-porous	12,62
3,5-3,8	1,5	20	97,9	Light gray, fine-grained, non-porous	13,06
3,5-3,8	2,5	20	98,4	Light gray, fine-grained, non-porous	14,10
3,5-3,8	3,5	20	98,8	Light gray, loose, slightly porous	12,61

Table 4- Quality of cadmium coatings in electrolyte with surfactant

pH	Ik, A/dm^2	t, °C	BTZn, %	Appearance of the cadmium coating	Coating thickness, microns
3,2-3,5	0,5	20	97,4	Light, dense, non-porous	12,11

3,2-3,5	1,5	20	98,6	Light, dense,non-porous	13,1 6
3,2-3,5	2,5	20	98,1	Light, dense, non-porous	13,35
3,2-3,5	3,5	20	97,3	Light, dense, with a tint	11,30

The tables show that the presence of surfactants in the electrolyte affects the quality of zinc and cadmium coatings, the coatings are lighter, fine-grained, non-porous. The current output is significantly higher (98%).

When comparing the quality indicators of zinc and cadmium coatings (Tables 1-4), it is possible to make an assumption about the effectiveness of the surfactant used in the electrolyte in the studied range of current density and temperature.

To confirm the above assumptions, the figures show electronic images of the quality of the coatings.

Figures 1 and 2 show electronic images of zinc and cadmium coatings obtained from an electrolyte without surfactants at a current density of 2 A / dm².

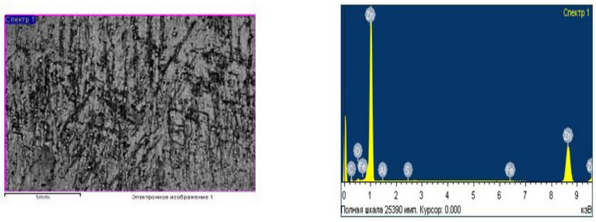
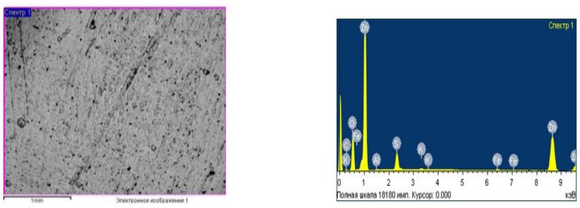


Figure 1-Zinc coating in a galvanizing electrolyte without surfactants

The coarse-crystalline structure of the zinc coating can be seen in the image. The coating is dark, visible porosity, roughness. Such a coating can not effectively protect the metal product from corrosion.

Figure 2 shows the structure of a cadmium coating obtained from an electrolyte without surfactants.



Picture 2 - Cadmium coating in electrolytic cadmium plating without surfactants

The coating structure is coarse-grained, with visible pores.

Figures 3 and 4 show a picture of the quality of zinc and cadmium coatings obtained from an electrolyte with surfactants at a current density of 2 A / dm^{2}.

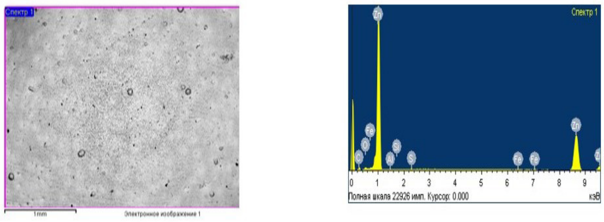


Figure 3-Zinc coating in a galvanizing electrolyte with surfactant

The coating is much lighter, fine-grained, pores are practically not visible. A significant improvement in the quality of the zinc coating is seen.

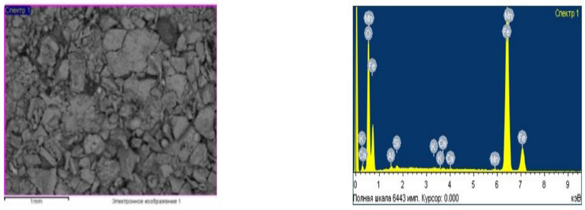


Figure 4-Cadmium coating of an electrolyte with surfactants

We observe in the image a nonporous, light coating of cadmium.

As previously noted [1] during the electrodeposition of zinc and cadmium from sulfuric acid electrolytes, in the absence of additional agents, large-crystal, in some cases at high current densities, loose coatings are released on the cathode, which are not of value for electroplating.

The situation changes radically with the introduction of certain organic compounds into the electrolytes, in our case, surfactants of a thiourea nature (which is confirmed by the results of research). Surfactants contribute to the shielding of the surface of the metal product, contributing to the deposition of fine-grained, non-porous coatings of zinc and cadmium.

Conclusions.

1. Comparative analysis of obtaining galvanic coatings of zinc and cadmium from acidic electrolytes without surfactants and with surfactants, showed the positive effect of the additive under study.
2. Energy dispersive microanalysis of the structure of cadmium coatings confirmed the positive effect of the investigated surfactant (Figures 3 and 4).

ӘОЖ 541.138.537.311.6

Н.А. Высоцкая[1*], Б.Н. Кабылбекова[1], Д.Д. Асылбекова[1], Р. Спабекова[1], Е.Г. Лукин[2]
[1]М.Әуезов атындағы Оңтүстік-Қазақстан университеті, Шымкент,, Қазақстан;
[2]ЖШС «Химиялық технология», Мәскеу, Ресcей.
E-mail:vysockaya42@mail.ru

БЕТТІК АКТИВТІ ЗАТТАРЫ БАР ЭЛЕКТРОЛИТТЕРДЕН МЕТАЛДАРДЫҢ ЭЛЕКТРЛІК ШӨГУІНІҢ КЕЙБІР ЕРЕКШЕЛІКТЕРІ

Аннотация. Ұзақ уақыт бойы зерттеушілердің метал жабындарының сапасын кадмий және мырышпен жақсартуүшін қарапайым электролиттердің құрамында әртүрлі беттік активті заттарды қолдануы өзекті мәселе болып келді.Беттік белсенді заттар жабындардың құрылымын ұнтақтауға, олардың кеуектілігін жоюға және жабындардың коррозияға қарсы қасиеттерінің пайда болуына ықпал етеді.Мысалы кадмийлі гальваникалық жабындар коррозияға төзімділікті қажет етеді, өйткені олар тропикалық климатта, жерасты туннельдерінде қолданылады.Мырыш жабындары құрылыс құрылымдары мен шатырларда, электрленген теміржолдарда және жоғары вольтты электр желілерінде, тау-кен және су құбырларында, сондай-ақ жетуге қиын жерлерде жүретін, коррозияға ұшырамайтын заманауи жол талғамайтын көліктердің шанақ материалын мырыштау үшін кең қолданылады.

Біздің зерттеу объектіміз - бөлме температурасында, 0,5-3,5 А/дм^2 ток тығыздығының интервалында, диалкилфосфор қышқылдарының тиомочевина туындылары болатын, кадмий мен мырыштың қарапайым қышқыл электролиттерінен беттік белсенді заттармен электрлік шөгу процесі болып табылады. Алынған гальваникалық жабындардың сапасын растау үшін біз INSAEnergu энергия дисперсиялық микроанализ жүйесі бар JSM-6490LV сканерлеуші электрондық микроскопты және пайдалы үлкейтуі 300,000 болатын HKL -Basicc құрылымдық талдау жүйелерін қолдандық.

Түйін сөздер: коррозияға қарсы қасиеттер, гальваникалық жабын, беттік активті заттар, тиомочевиналық туындылар.

Н.А. Высоцкая[1*], Б.Н. Кабылбекова[1], Д.Д. Асылбекова[1], Р. Спабекова[1], Е.Г. Лукин[2]
[1]Южно-Казахстанский университет им. М.Ауэзова, Шымкент, Казахстан;
[2]ТОО «Химические технологии», Москва, Россия.
E-mail: vysockaya42@mail.ru

НЕКОТОРЫЕ ОСОБЕННОСТИ ЭЛЕКТРООСАЖДЕНИЯ МЕТАЛЛОВ ИЗ ЭЛЕКТРОЛИТОВ С ПАВ

Аннотация. С давних пор использование исследователями различных ПАВ в составе простых электролитовдля улучшения качества металлических покрытий кадмием, цинком является актуальной задачей. ПАВ способствуют измельчению структуры покрытий, устранению их пористости и возникновению антикоррозионных свойств покрытий. К примеру, кадмиевым гальваническим покрытиям необходима коррозионная стойкость, так как они эксплуатируются в условиях тропического климата, в подземных штольнях. Цинковые покрытия широко используются в строительных конструкциях и кровле, на электрофицированных железных дорогах и линиях высоковольтных электропередач, в горнорудной промышленности и водопроводных трубах, а также для оцинкования кузовного материала в современных вездеходах для прохождения в трудно доступных местах, не подвергаясь коррозии.

Объектом наших исследований является процесс электроосаждения кадмия и цинка из простых кислых электролитов с ПАВ, представляющем собой тиомочевинные производные диалкилфосфористыхкислот в интервале плотности тока 0,5-3,5 А/дм^2, при комнатной температуре. Для подтверждения качества полученных гальванопокрытий нами использован растровый электронный микроскоп марки JSM-6490LV с системами энергодисперсионного микроанализа INSA Energu и структурного анализа HKL –Basicc полезным увеличением 300 000.

Ключевые слова: антикоррозионные свойства, гальванопокрытия, ПАВ, тиомочевинные производные.

Information about the authors:

Vysotskaya Nadezhda Andreevna - The Candidate of chemical sciences, associate professor of the Chair of "Chemistry and General Chemical Technology" of the Non-profit joint stock company «M. Auezov South Kazakhstan university»

Kabylbekova Balzhan Nurmanovna - The Candidate of technical sciences,associate professor of the Chair of "Chemistry and General Chemical Technology" of the Non-profit joint stock company «M. Auezov South Kazakhstan university».

Asylbekova DinaDuisenbekovna -The Candidate of chemical sciences, associate professor of the Chair of «Chemistry and General Chemical Technology» of the Non-profit joint stock company «M. Auezov South Kazakhstan university».

Spabekova Rosa Spabekovna - The Candidate of chemical sciences, associate professor of the Chair of "Chemistry and General Chemical Technology" of the Non-profit joint stock company «M. Auezov South Kazakhstan university».

Lukin Evgeniy Georgievich - The Engineer of the technical production association in Moscow, Russia. He has been more than 300 scientific papers, 60 of which are patents and copyright certificates.

REFERENCE

[1] Liner V.I., Kudryavtsev N.T. Fundamentals of electroplating.-M.: Metallurgizdat, 1989.-382s.

[2] Kubasov V.A., Zaretsky S.A. Fundamentals of electrochemistry.-M .: Chemistry, 2010.-167p.

[3] Tseluikin V.N. Composite coatings modified with nanoparticles: structure, properties. // Russian nanotechnologies.-2014.V.9, No. 1-2.-P.25-35.

[4] Skobina L.M., Burdina E.I., Sokolenko A.I. Influence of the electrolyte composition on the efficiency of N-methylperolidine during electrodeposition of cadmium, structure and technological properties of coatings // Physicochemistry of surfaces and protection of materials.-2012.T.48, No. 4.-P.385-390.

[5] Shevchenko T. Yu., Meshcheryakov V. A., Solovyova N. D. Composite electrochemical coatings based on zinc //Coatings and surface treatment: tez. dokl. 9 of the International Conference. - M., 2012. - p. 132-133

[6] Pat. 248952 RF Method of applying a cadmium coating on metal parts in a cadmium plating electrolyte. / Volynsky V.V., Tyugaev V.N., Grishin S.V., Klyuev S, L., Chipiga N.; publ: 10.08.2013.

[7] Kudryavtsev V.N. Practical work on applied electrochemistry.-M.: Chemistry, 1990.-302s.

[8] Vysotskaya N.A.,Kabylbekova B.N.,Bekzhigitova K.A. Spabekova R.C., Kurbanbekov K.T., Ormanova G.K., LukinE.G. (2019)Protective zinc coatings from acid electrolyte of zinc-plating. News of the National Academy of Sciences of the Republic of Kazakhstan.Series of geology and technical sciences. Volume 3,Number 435 (2019), PP.122-127. https://doi.org/10.32014/2019.2518-170X77 ISSN 2224-5278 (Print)

[9] Kravchenko D.V. Development of the process of electrodeposition of cadmium coatings from sulfate-ammonia electrolyte in the presence of TsKN-04 and TsKN-04S / diss.kan.tekh.nauk.-2018.-115s.

[10] Nikiforova A.A., Smirnov K.N., Kravchenko D.V., Arkhipov E.A., Zakirova L.I., Vinogradov S.S. Applicability of sulphate-ammonium electrolyte of cadmium plating with additives TsKN-04 for the aviation industry / Aviation materials and technologies. -2015, No. 4 (37) .- P.53-60.

[11] Arkhipov E.A., Grigoryan N.S., Shuvalov D.A., Zhirukhin D.A., Smirnov K.N., Vagramyan T.A. Universal additive for acidic electrolytes of cadmium plating // Electroplating and surface treatment. -2018, Vol.26.No.4.-P.21-30.

[12] Zaitsev O.S. Chemistry. Laboratory workshop and collection of problems.-M., Moscow State University, 2020.-399s.

NEWS
OF THENATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES CHEMISTRY AND TECHNOLOGY
ISSN 2224-5286
Volume 3, Number 447 (2021), 103 – 110 **https://doi.org/10.32014/2021.2518-1491.59**

UDC 678.03:546.26; 677.4
IRSTI 61.67.33

B.T. Yermagambet[1,2], M.K. Kazankapova[1,2], A.T. Nauryzbayeva[1], Zh.M. Kassenova[1,2]
[1]«Institute of Coal Chemistry and Technology» LLP, Nur-Sultan, Kazakhstan;
[2]«KazTechCoal» Scientific and Production Association LLP, Nur-Sultan, Kazakhstan;
E-mail: coaltech@bk.ru

SYNTHESIS OF CARBON NANOFIBERS BASED ON HUMIC ACID AND POLYACRYONITRILE BY ELECTROSPINNING METHOD

Abstract. The article describes a method for obtaining carbon nanofibers (CNFs) based on humic acid from oxidized coal of the Maikuben basin and polycarlonitrile (PAN) by electrospinning in laboratory conditions. The value of the interelectrode voltage was 20-25 kV. The elemental composition was determined and the surface morphology of the studied sample was studied, the type of modification of the carbon fiber was revealed. As a result of energy dispersive X-ray spectroscopy and scanning electron microscopy (SEM), the chemical composition of the initial CNF (C-48.73%) and the diameter of carbon fibers, which ranged

МАЗМҰНЫ – СОДЕРЖАНИЕ – CONTENTS

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics. Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyrightholder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect. The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации
в журнале смотреть на сайте:

www:nauka-nanrk.kz

http://chemistry-technology.kz/index.php/en/arhiv

ISSN 2518-1491 (Online), ISSN 2224-5286 (Print)

Редакторы: *М.С. Ахметова, Р.Ж. Мрзабаева, Д.С. Аленов*
Верстка на компьютере *В.С. Зикирбаева*

Подписано в печать 12.06. 2021.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
10,2 п.л. Тираж 300. Заказ 3.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19