

ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Satbayev University

NEWS

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Satbayev University

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

3 (441)

MAY – JUNE 2020

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences 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 geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар 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. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» 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 Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

Б а с р е д а к т о р ы
э. ғ. д., профессор, ҚР ҰҒА академигі

И.К. Бейсембетов

Бас редакторының орынбасары

Жолтаев Г.Ж. проф., геол.-мин. ғ. докторы

Р е д а к ц и я а л қ а с ы:

Абаканов Т.Д. проф. (Қазақстан)
Абишева З.С. проф., академик (Қазақстан)
Агабеков В.Е. академик (Беларусь)
Алиев Т. проф., академик (Әзірбайжан)
Бакиров А.Б. проф., (Қырғызстан)
Беспәев Х.А. проф. (Қазақстан)
Бишимбаев В.К. проф., академик (Қазақстан)
Буктуков Н.С. проф., академик (Қазақстан)
Булат А.Ф. проф., академик (Украина)
Ганиев И.Н. проф., академик (Тәжікстан)
Грэвис Р.М. проф. (АҚШ)
Ерғалиев Г.К. проф., академик (Қазақстан)
Жуков Н.М. проф. (Қазақстан)
Қожахметов С.М. проф., академик (Қазақстан)
Конторович А.Э. проф., академик (Ресей)
Курскеев А.К. проф., академик (Қазақстан)
Курчавов А.М. проф., (Ресей)
Медеу А.Р. проф., академик (Қазақстан)
Мұхамеджанов М.А. проф., корр.-мүшесі (Қазақстан)
Нигматова С.А. проф. (Қазақстан)
Оздоев С.М. проф., академик (Қазақстан)
Постолатий В. проф., академик (Молдова)
Ракишев Б.Р. проф., академик (Қазақстан)
Сейтов Н.С. проф., корр.-мүшесі (Қазақстан)
Сейтмуратова Э.Ю. проф., корр.-мүшесі (Қазақстан)
Степанец В.Г. проф., (Германия)
Хамфери Дж.Д. проф. (АҚШ)
Штейнер М. проф. (Германия)

«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

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

Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде
30.04.2010 ж. берілген №10892-Ж мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
<http://www.geolog-technical.kz/index.php/en/>

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2020

Редакцияның Қазақстан, 050010, Алматы қ., Қабанбай батыр көш., 69а.

мекенжайы: Қ. И. Сәтбаев атындағы геология ғылымдар институты, 334 бөлме. Тел.: 291-59-38.

Типографияның мекенжайы: «NurNaz GRACE», Алматы қ., Рысқұлов көш., 103.

Г л а в н ы й р е д а к т о р
д. э. н., профессор, академик НАН РК

И. К. Бейсембетов

Заместитель главного редактора

Жолтаев Г.Ж. проф., доктор геол.-мин. наук

Р е д а к ц и о н н а я к о л л е г и я:

Абаканов Т.Д. проф. (Казахстан)
Абишева З.С. проф., академик (Казахстан)
Агабеков В.Е. академик (Беларусь)
Алиев Т. проф., академик (Азербайджан)
Бакиров А.Б. проф., (Кыргызстан)
Беспаяев Х.А. проф. (Казахстан)
Бишимбаев В.К. проф., академик (Казахстан)
Буктуков Н.С. проф., академик (Казахстан)
Булат А.Ф. проф., академик (Украина)
Ганиев И.Н. проф., академик (Таджикистан)
Грэвис Р.М. проф. (США)
Ергалиев Г.К. проф., академик (Казахстан)
Жуков Н.М. проф. (Казахстан)
Кожамбетов С.М. проф., академик (Казахстан)
Конторович А.Э. проф., академик (Россия)
Курскеев А.К. проф., академик (Казахстан)
Курчавов А.М. проф., (Россия)
Медеу А.Р. проф., академик (Казахстан)
Мухамеджанов М.А. проф., чл.-корр. (Казахстан)
Нигматова С.А. проф. (Казахстан)
Оздоев С.М. проф., академик (Казахстан)
Постолатий В. проф., академик (Молдова)
Ракишев Б.Р. проф., академик (Казахстан)
Сейтов Н.С. проф., чл.-корр. (Казахстан)
Сейтмуратова Э.Ю. проф., чл.-корр. (Казахстан)
Степанец В.Г. проф., (Германия)
Хамфери Дж.Д. проф. (США)
Штейнер М. проф. (Германия)

«Известия НАН РК. Серия геологии и технических наук».

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

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

Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан №10892-Ж, выданное 30.04.2010 г.

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
<http://www.geolog-technical.kz/index.php/en/>

© Национальная академия наук Республики Казахстан, 2020

Адрес редакции: Казахстан, 050010, г. Алматы, ул. Кабанбай батыра, 69а.

Институт геологических наук им. К. И. Сатпаева, комната 334. Тел.: 291-59-38.

Адрес типографии: «NurNaz GRACE», г. Алматы, ул. Рыскулова, 103.

E d i t o r i n c h i e f

doctor of Economics, professor, academician of NAS RK

I. K. Beisembetov

Deputy editor in chief

Zholtayev G.Zh. prof., dr. geol-min. sc.

E d i t o r i a l b o a r d:

Abakanov T.D. prof. (Kazakhstan)
Abisheva Z.S. prof., academician (Kazakhstan)
Agabekov V.Ye. academician (Belarus)
Aliyev T. prof., academician (Azerbaijan)
Bakirov A.B. prof., (Kyrgyzstan)
Bespayev Kh.A. prof. (Kazakhstan)
Bishimbayev V.K. prof., academician (Kazakhstan)
Buktukov N.S. prof., academician (Kazakhstan)
Bulat A.F. prof., academician (Ukraine)
Ganiyev I.N. prof., academician (Tadjikistan)
Gravis R.M. prof. (USA)
Yergaliev G.K. prof., academician (Kazakhstan)
Zhukov N.M. prof. (Kazakhstan)
Kozhakhmetov S.M. prof., academician (Kazakhstan)
Kontorovich A.Ye. prof., academician (Russia)
Kurskeyev A.K. prof., academician (Kazakhstan)
Kurchavov A.M. prof., (Russia)
Medeu A.R. prof., academician (Kazakhstan)
Muhamedzhanov M.A. prof., corr. member. (Kazakhstan)
Nigmatova S.A. prof. (Kazakhstan)
Ozdoyev S.M. prof., academician (Kazakhstan)
Postolatii V. prof., academician (Moldova)
Rakishev B.R. prof., academician (Kazakhstan)
Seitov N.S. prof., corr. member. (Kazakhstan)
Seitmuratova Ye.U. prof., corr. member. (Kazakhstan)
Stepanets V.G. prof., (Germany)
Humphery G.D. prof. (USA)
Steiner M. prof. (Germany)

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.

ISSN 2518-170X (Online),

ISSN 2224-5278 (Print)

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

The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 10892-Ж, issued 30.04.2010.

Periodicity: 6 times a year.

Circulation: 300 copies.

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,

<http://www.geolog-technical.kz/index.php/en/>

© National Academy of Sciences of the Republic of Kazakhstan, 2020

Editorial address: Institute of Geological Sciences named after K.I. Satpayev
69a, Kabanbai batyr str., of. 334, Almaty, 050010, Kazakhstan, tel.: 291-59-38.

Address of printing house: «NurNaz GRACE», 103, Ryskulov str, Almaty.

NEWS

OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN

SERIES OF GEOLOGY AND TECHNICAL SCIENCES

ISSN 2224-5278

Volume 3, Number 441 (2020), 196 – 199

<https://doi.org/10.32014/2020.2518-170X.73>

UDC 10167, 61.31.59

T. E. Gaipov, A. Bayeshov, B. E. Myrzabekov, E. K. Abdulina

JCS D.V. Sokolsky Institute of Fuel Catalysis and Electrochemistry, Almaty, Kazakhstan.

E-mail: tolya77784@mail.ru, bayeshov@mail.ru, myrzabekbegzat@mail.ru, elnura.abdulina@mail.ru

**FORMATION OF SELENIUM POWDERS
IN CATHODE REDUCTION OF SELENITE IONS
IN COPPER (II) HYDROCHLORIC ACID SOLUTION**

Abstract. The work presents the results of the study of cathode reduction of selenium (IV) ions in hydrochloric acid medium in the presence of Cu (II) ions. The following electrolysis parameters were studied: concentrations of hydrochloric acid and copper (II) ions. In the course of the studies, it has been found that an increase in cathode current density and hydrochloric acid concentration leads to a decrease in the current yield of selenium powder. This exposure to hydrochloric acid is due to the fact that the formed copper monovalent ions are complexed with chlorine ions of type CuCl_n^{n-} , where the number "n" increases with an increase in the concentration of hydrochloric acid and, accordingly, this leads to a decrease in the reducing capacity of cuproions. The effect of copper (II) ion concentration has a positive effect on the current output of the powder formation of the investigated element. This is due to the increase in the concentration of intermediate products - monovalent copper ions.

It should be noted that under all optimal electrolysis conditions, little colloidal selenium powder is observed in the near-cathode space, due to the monovalent ions involved in the reaction. At high cathode current densities, partial formation of copper selenide is also observed. This is because freshly formed selenium and copper powder interact with each other to form metal selenide. Thus, the cathodic reduction of tetravalent selenium in hydrochloric acid solutions in the presence of divalent copper ions to form selenium powders was first investigated. It has been shown that an increase in copper (II) ion concentrations leads to an increase in the current yield of selenium powder and an increase in hydrochloric acid concentration leads to a decrease. The proposed "red-ox" Cu (II) - Cu (I) system allows electrocatalytic reduction of selenite ion to form ultradisperse selenium powders.

Key words: selenium, powder, recovery, selenite ion, copper (II).

Introduction. Selenium is a constant companion of many sulfide ores and concentrates of heavy and non-ferrous metals, isomorphic replacing sulfur, due to its high chemical activity, is present in raw materials, usually as selenides and in some cases as elemental [1]. The main industrial significance are sulfide deposits. The selenium content in sulfides ranges from 7 to 110 g / t. Global selenium reserves are estimated at ~90 thousand tons for copper deposits. Selenium is also found, for example, in coal and crude oil (from 0.5 to 12 ppm), as well as in seawater (4 ppm), which increases its global reserves by 80-90 times, but these resources are not currently involved in industrial turnover. It seems that in order to implement this technology, there must be a significant increase in selenium prices. The main industrial sources of selenium are slurries formed during electrolytic treatment of copper anodes. Copper slurries contain 5-25 % selenium in the form of compounds with noble metals. The main producers of selenium are countries such as Japan, Canada, Europe, the United States, China, Mexico and Russia [2].

The presence of a wide range of related metals and chemical elements in selenium-containing industrial products implies a variety of processing methods.

To date, the main amount of selenium (up to 90 %) is extracted from the electrolyte slurries of copper and Nickel production, which has led to the emergence of a large number of technological studies in this direction.

Under the guidance of Professor A. Bayeshov, numerous works were carried out and the electrochemical properties of selenium were studied in more detail [3-4]. It is shown that it is possible to

obtain selenium powder from tetravalent selenium ions when polarized by a cathode pulse current, and that it is possible to restore selenium (VI) anions in the presence of "red-ox" systems Ti (III)-Ti (IV), Cr (II)-Cr (III) and Fe (II)-Fe (III).

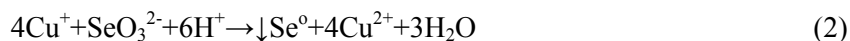
The standard potential (E^0) of the Cu (I) - Cu (II) system in hydrochloric acid solution is -0.54 V, and the potential of the Se-Se (IV) system is 0.77 V. This indicates that monovalent copper ions chemically reduce tetravalent selenium ions to an elementary state, while copper (I) ions are oxidized to a divalent state.

The divalent copper ions present in the solution at low cathode current densities are also reduced stepwise and mainly to the monovalent state by reaction:



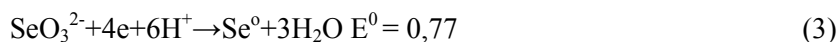
which can participate in the reaction of reducing selenite ions to elemental powdered selenium by reaction (2).

The monovalent copper ions formed by the reaction (1) according to the potentials of the above-mentioned redox systems Cu (I) - Cu (II) and Se-Se (IV), in the cathode space as well as in the volume of the solution, will enter into the chemical reaction of reducing selenium ions (IV):



at the same time, dispersed selenium powders of red-brown color are formed.

There is also a direct cathode reduction of Selenite ions at the cathode:



Experimental part. In this paper, the experiments were performed in an electrolyzer with a volume of 50 ml, the electrode spaces are not separated. A titanium plate was used as the cathode. The current yield of selenium powder was calculated by the weight of the resulting powder.

As can be seen from figure 1, increasing the concentration of hydrochloric acid leads to a decrease in the current output of the formation of selenium powder. This effect of hydrochloric acid is due to the fact that the formed ions of monovalent copper bind in a complex with chlorine ions of the CuCl_n^{n-} -type, where the number "n" increases with increasing concentration of hydrochloric acid and, accordingly, this leads to a decrease in the reducing ability of cuproions by reaction (2). All this in total leads to a decrease in the current output of the formation of selenium powder.

As can be seen from figure 2, with an increase in the concentration of divalent copper ions in the solution, the cathode yield of the selenium powder formation current increases. This is due to an increase in the concentration of intermediate products - monovalent copper ions.

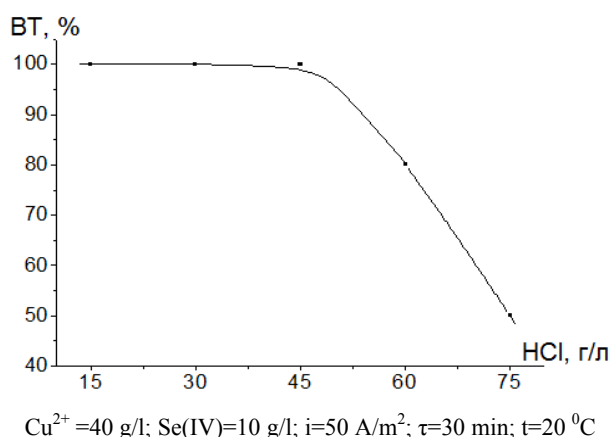


Figure 1 – Effect of hydrochloric acid concentration on the current output of selenium powders formation

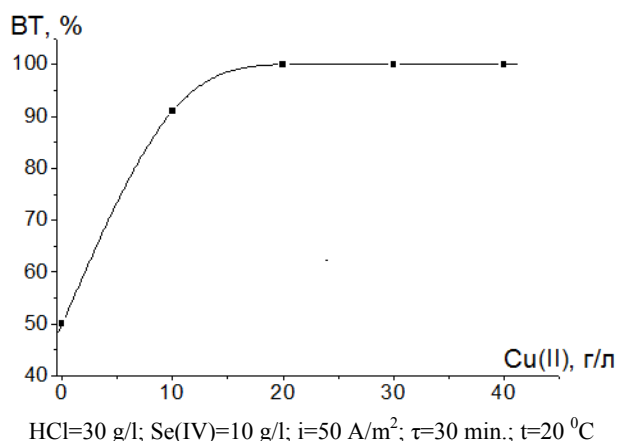


Figure 2 – Dependence of the current output of selenium powders formation on the concentration of copper (II) chloride

Results and discussion. When the solution temperature increases from 20 to 60 $^\circ\text{C}$, the current output of selenium powder formation has a maximum current output of 100 %.

It should be noted that in all optimal conditions of electrolysis in the cathode space, a small amount of colloidal selenium powder is observed, this is due to the participation in the reaction of monovalent ions formed by the chemical reaction (1) and (2). At high cathode current densities, partial formation of copper selenide is also observed.

This is due to the fact that freshly formed selenium and copper powders interact with each other to form metal selenide:



Thus, for the first time, the cathode reduction of tetravalent selenium in hydrochloric acid solutions in the presence of divalent copper ions with the formation of selenium powders was studied. It is shown that an increase in the concentration of copper (II) ions leads to an increase in the current yield of selenium powder formation, and an increase in the concentration of hydrochloric acid leads to a decrease. The proposed "red-ox" Cu (II) - Cu (I) system allows electrocatalytically restoring selenite ions to form ultrafine selenium powders.

Acknowledgments. The work was supported by the Ministry of Education and Science of the Republic of Kazakhstan (AP05131096).

Т. Э. Гаипов, А. Башов, Б. Э. Мырзабеков, Е. Қ. Абдулина

«Д. В. Сокольский атындағы жанармай, катализ және электрохимия институты» АҚ, Алматы, Қазақстан

МЫСТЫҢ (II) ТҰЗ ҚЫШҚЫЛДЫ ЕРІТІНДІСІНДЕ СЕЛЕНИТ-ИОНДАРДЫ КАТОДТЫ ҚАЛПЫНА КЕЛТІРУДЕ СЕЛЕН ҰНТАҚТАРЫН ҚАЛЫПТАСТЫРУ

Аннотация. Жұмыста Cu (II) иондарының қатысуы негізінде тұзды қышқылды ортада селен иондарын катодтық қалпына келтіруді зерттеу нәтижелері ұсынылған. Электролиздің мынадай параметрлері зерттелді: ерітіндінің температурасы, тұз қышқылы мен мыс (II) иондарының концентрациясы. Зерттеу барысында тұз қышқылының концентрациясы артатындықтан, селен ұнтағының пайда болу тогының шығымы төмендейтіні айқындалды. Тұз қышқылының мұндай әсері бірвалентті мыстың түзілетін иондары CuCl_n^{n-} типті хлор-иондармен кешенге байланыстырылуына қатысты, мұнда «n» саны тұз қышқылының концентрациясының ұлғаюы негізінде өседі және тиісінше, бұл купроиондардың қалпына келтіру қабілетінің төмендеуіне әкеледі. Мыс (II) иондары концентрациясының әсері зерттелетін элемент ұнтағының пайда болу тогына оң әсер етеді. Бұл аралық өнімдер, яғни, мыстың бір валентті иондарының концентрациясының ұлғаюына байланысты.

Айта кететін болсақ, электролиздің барлық оңтайлы жағдайларында катодтық кеңістікте селен коллоидты ұнтағының шамалы мөлшері байқалады, бұл бір валентті иондар реакциясына қатысуға байланысты. Токтың жоғары катодты тығыздығы кезінде мыс селенидінің жартылай түзілуі байқалады. Бұл жағдай селен мен мыс ұнтағы бір-бірімен өзара әрекеттесіп, металл селенидінің пайда болуына әкеледі.

Түйін сөздер: селен, ұнтақ, қалпына келтіру, селенит-ион, мыс (II).

Т. Э. Гаипов, А. Башов, Б. Э. Мырзабеков, Е. Қ. Абдулина

Институт топлива, катализа и электрохимии им. Д.В. Сокольского, Алматы, Казахстан

ФОРМИРОВАНИЕ ПОРОШКОВ СЕЛЕНА ПРИ КАТОДНОМ ВОССТАНОВЛЕНИИ СЕЛЕНИТ-ИОНОВ В СОЛЯНОКИСЛОМ РАСТВОРЕ МЕДИ (II)

Аннотация. В работе представлены результаты исследования катодного восстановления ионов селена (IV) в солянокислой среде в присутствии ионов Cu (II). Изучены следующие параметры электролиза: температура раствора, концентрации соляной кислоты и ионов меди (II). В процессе проведения исследований установлено, что увеличение концентрации соляной кислоты приводит к снижению выхода по току образования порошка селена. Такое воздействие соляной кислоты обусловлено тем, что образующиеся ионы одновалентной меди связываются в комплекс с хлор-ионами типа CuCl_n^{n-} , где число «n» возрастает с

увеличением концентрации соляной кислоты и, соответственно, это приводит к снижению восстановительной способности купроионов. Влияние же концентрации ионов меди (II) положительно сказывается на выходе по току формирования порошка исследуемого элемента. Это связано с увеличением концентрации промежуточных продуктов – одновалентных ионов меди.

Следует отметить, что во всех оптимальных условиях электролиза в прикатодном пространстве наблюдается незначительное количество коллоидного порошка селена, это связано с участием в реакции одновалентных ионов. При высоких катодных плотностях тока также наблюдается частичное образование селенида меди. Это связано с тем, что свежобразованный порошок селена и меди взаимодействуют друг с другом с образованием селенида металла.

Ключевые слова: селен, порошок, восстановление, селенит-ион, медь (II).

Information about authors:

Tulkinzhon Gaipov, Candidate of Chemical Sciences, the Senior Researcher of laboratory of electrochemical technologies of JCS “D.V. Sokolsky Institute of fuel, catalysis and electrochemistry”, Almaty, Kazakhstan; tolya77784@mail.ru; <https://orcid.org/0000-0002-3702-1716>

Abduali Bayeshov, Doctor of Chemical Sciences, Professor, Academician of The National Academy of Sciences of The Republic of Kazakhstan. Head of the laboratory of electrochemical technologies of JCS “D.V. Sokolsky Institute of fuel, catalysis and electrochemistry”, Almaty, Kazakhstan; bayeshov@mail.ru; <https://orcid.org/0000-0003-0745-039X>

Myrzabekov Begzat, PhD, Senior Researcher of laboratory of electrochemical technologies of JCS “D.V. Sokolsky Institute of fuel, catalysis and electrochemistry”, Almaty, Kazakhstan; myrzabekbegzat@mail.ru; <https://orcid.org/0000-0001-7321-2782>

Abdulina Elnur, doctoral candidate, engineer of electrochemical technologies of JCS “D.V. Sokolsky Institute of fuel, catalysis and electrochemistry”, Almaty, Kazakhstan; elnura.abdulina@mail.ru; <https://orcid.org/0000-0001-7700-3304>

REFERENCES

[1] Zhong L., Cao Y., Li W., Xie K., Pan W.P. Selenium speciation in flue desulfurization residues // *Journal of Environmental Sciences*. 2011. Vol. 23. 1. P. 171-176. DOI: 10.1016/S1001-0742(10)60390-7.

[2] Naumov A.V. A survey of the world market for selenium and tellurium (the economic of selenium and tellurium) // *Russ. J. Non-Ferr. Metals*. 2006. Vol. 47, N 4. P. 18-26.

[3] Bayeshov A., Ivanov N., Myrzabekov B. Electrochemical behavior of Selenium as part of Composite Electrode in Sulfuric Acid Medium // *Journal of Advances in Chemistry*. 2014. Vol. 7. N 3. P. 1378-1385. DOI: <https://doi.org/10.24297/jac.v7i3.2373>

[4] Bayeshov A., Kadirbayeva A.S., Bayeshova A.K., Zaykov Y.P. *Formation of copper powders by anode and cathode half-periods of industrial alternating current* // *NAS RK's news. Geology and Technical Science Series*. 2018 N 6. P. 73-79. DOI: 10.32014/2019.2518-170X.70

**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 copyright-holder. 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://www.nauka-nanrk.kz)

ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

<http://www.geolog-technical.kz/index.php/en/>

Редакторы *Д. С. Аленов, М. С. Ахметова, Т. А. Апендиев*
Верстка *Д. А. Абдрахимовой*

Подписано в печать 12.06.2020.
Формат 70x881/8. Бумага офсетная. Печать – ризограф.
13,6 п.л. Тираж 300. Заказ 3.