

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»

NEWS

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN

JSC «D.V. SOKOLSKY INSTITUTE OF FUEL,
CATALYSIS AND ELECTROCHEMISTRY»

ХИМИЯ ЖӘНЕ ТЕХНОЛОГИЯ СЕРИЯСЫ



СЕРИЯ ХИМИИ И ТЕХНОЛОГИИ



SERIES CHEMISTRY AND TECHNOLOGY

6 (432)

**ҚАРАША – ЖЕЛТОҚСАН 2018 ж.
НОЯБРЬ – ДЕКАБРЬ 2018 г.
NOVEMBER – DECEMBER 2018**

1947 ЖЫЛДЫҢ ҚАҢТАР АЙЫНАН ШЫҒА БАСТАҒАН
ИЗДАЕТСЯ С ЯНВАРЯ 1947 ГОДА
PUBLISHED SINCE JANUARY 1947

ЖЫЛЫНА 6 РЕТ ШЫҒАДЫ
ВЫХОДИТ 6 РАЗ В ГОД
PUBLISHED 6 TIMES A YEAR

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. Web of 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 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 в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по химическим наукам для нашего сообщества.

Б а с р е д а к т о р ы
х.ғ.д., проф., ҚР ҰҒА академигі **М.Ж. Жұрынов**

Р е д а к ц и я а л қ а с ы:

Ағабеков В.Е. проф., академик (Белорус)
Волков С.В. проф., академик (Украина)
Воротынцев М.А. проф., академик (Ресей)
Газалиев А.М. проф., академик (Қазақстан)
Ергожин Е.Е. проф., академик (Қазақстан)
Жармағамбетова А.К. проф. (Қазақстан), бас ред. орынбасары
Жоробекова Ш.Ж. проф., академик (Қырғыстан)
Иткулова Ш.С. проф. (Қазақстан)
Манташян А.А. проф., академик (Армения)
Пралиев К.Д. проф., академик (Қазақстан)
Баешов А.Б. проф., академик (Қазақстан)
Бүркітбаев М.М. проф., академик (Қазақстан)
Джусипбеков У.Ж. проф. корр.-мүшесі (Қазақстан)
Молдахметов М.З. проф., академик (Қазақстан)
Мансуров З.А. проф. (Қазақстан)
Наурызбаев М.К. проф. (Қазақстан)
Рудик В. проф., академик (Молдова)
Рахимов К.Д. проф. академик (Қазақстан)
Стрельцов Е. проф. (Белорус)
Тәшімов Л.Т. проф., академик (Қазақстан)
Тодераш И. проф., академик (Молдова)
Халиков Д.Х. проф., академик (Тәжікстан)
Фарзалиев В. проф., академик (Әзірбайжан)

«ҚР ҰҒА Хабарлары. Химия және технология сериясы».

ISSN 2518-1491 (Online),

ISSN 2224-5286 (Print)

Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» Республикалық қоғамдық бірлестігі (Алматы қ.)

Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 30.04.2010 ж. берілген №1089-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,
www.nauka-nanrk.kz / chemistry-technology.kz

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2018

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

Главный редактор
д.х.н., проф., академик НАН РК **М. Ж. Журинов**

Редакционная коллегия:

Агабеков В.Е. проф., академик (Беларусь)
Волков С.В. проф., академик (Украина)
Воротынцев М.А. проф., академик (Россия)
Газалиев А.М. проф., академик (Казахстан)
Ергожин Е.Е. проф., академик (Казахстан)
Жармагамбетова А.К. проф. (Казахстан), зам. гл. ред.
Жоробекова Ш.Ж. проф., академик (Кыргызстан)
Иткулова Ш.С. проф. (Казахстан)
Манташян А.А. проф., академик (Армения)
Пралиев К.Д. проф., академик (Казахстан)
Баешов А.Б. проф., академик (Казахстан)
Буркитбаев М.М. проф., академик (Казахстан)
Джусипбеков У.Ж. проф. чл.-корр. (Казахстан)
Мулдахметов М.З. проф., академик (Казахстан)
Мансуров З.А. проф. (Казахстан)
Наурызбаев М.К. проф. (Казахстан)
Рудик В. проф., академик (Молдова)
Рахимов К.Д. проф. академик (Казахстан)
Стрельцов Е. проф. (Беларусь)
Ташимов Л.Т. проф., академик (Казахстан)
Тодераш И. проф., академик (Молдова)
Халиков Д.Х. проф., академик (Гаджикистан)
Фарзалиев В. проф., академик (Азербайджан)

«Известия НАН РК. Серия химии и технологии».

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 и архивов Министерства культуры и информации Республики Казахстан №10893-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://nauka-nanrk.kz / chemistry-technology.kz>

© Национальная академия наук Республики Казахстан, 2018

Адрес редакции: 050100, г. Алматы, ул. Кунаева, 142,
Институт органического 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

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

doctor of chemistry, professor, academician of NAS RK **M.Zh. Zhurinov**

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

Agabekov V.Ye. prof., academician (Belarus)
Volkov S.V. prof., academician (Ukraine)
Vorotyntsev M.A. prof., academician (Russia)
Gazaliyev A.M. prof., academician (Kazakhstan)
Yergozhin Ye.Ye. prof., academician (Kazakhstan)
Zharmagambetova A.K. prof. (Kazakhstan), deputy editor in chief
Zhorobekova Sh.Zh. prof., academician (Kyrgyzstan)
Itkulova Sh.S. prof. (Kazakhstan)
Mantashyan A.A. prof., academician (Armenia)
Praliyev K.D. prof., academician (Kazakhstan)
Bayeshov A.B. prof., academician (Kazakhstan)
Burkitbayev M.M. prof., academician (Kazakhstan)
Dzhusipbekov U.Zh. prof., corr. member (Kazakhstan)
Muldakhmetov M.Z. prof., academician (Kazakhstan)
Mansurov Z.A. prof. (Kazakhstan)
Nauryzbayev M.K. prof. (Kazakhstan)
Rudik V. prof., academician (Moldova)
Rakhimov K.D. prof., academician (Kazakhstan)
Streltsov Ye. prof. (Belarus)
Tashimov L.T. prof., academician (Kazakhstan)
Toderash I. prof., academician (Moldova)
Khalikov D.Kh. prof., academician (Tadjikistan)
Farzaliyev V. prof., academician (Azerbaijan)

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 periodic printed publication in the Committee of Information and Archives of the Ministry of Culture and Information of the Republic of Kazakhstan N 10893-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://nauka-nanrk.kz/chemistry-technology.kz>

© National Academy of Sciences of the Republic of Kazakhstan, 2018

Editorial address: Institute of Organic Catalysis and Electrochemistry named after D. V. Sokolsky
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 THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN

SERIES CHEMISTRY AND TECHNOLOGY

ISSN 2224-5286

<https://doi.org/10.32014/2018.2518-1491.27>

Volume 6, Number 432 (2018), 57 – 66

UDC 547.94 +547.458.68+543.429.2

O.A. Nurkenov¹, S.D.Fazylov¹, A.Zh.Issayeva¹,
T.M. Seilkhanov², T.S. Zhivotova¹, Z.T. Shulgau³, Zh.M. Kozhina⁴

¹ Institute of Organic Synthesis and Coal Chemistry the Republic of Kazakhstan, Karaganda, Kazakhstan,² Sh. Ualikhanov Kokshetau state university, Kazakhstan,³ RSE on the REM "National Center for Biotechnology" CS of the MES of the RK, Astana, Kazakhstan,⁴ L.N. Gumilyov Eurasian national university, Kazakhstan.e-mail: nurkenov_oral@mail.ru, iosu8990@mail.ru, ayauly_jan@mail.ru, tseilkhanov@mail.ru,
kozhina.janagul@yandex.ru

COMPLEXES OF INCLUSION OF FUNCTIONALLY-SUBSTITUTED HYDRASONS OF ISONICOTHIC ACID WITH CYCLODEXTRINES AND THEIR ANTIRADICAL ACTIVITY

Abstract. In the present work, supramolecular complexes based on N- (diethylamino) benzylidenisonicotinohydrazide and N- (2-bromo-3-phenyl) allylidenisonicotinohydrazide and cyclodextrins (β -CD, 2-GP- β -CD) were first obtained and studied. Comparison of the integral intensities of the ¹H NMR signals of substrate (hydrazone) and β - and 2-GP- β -CD- β receptors in supramolecular complexes showed that in all cases complexes of 1 guest molecule composition are formed for 2 host molecules. It was found that during the interaction they form an inclusion complex with the entry of the substrate molecule into the inner cavity of the receptor by the methylamine end. The resulting products form a mixture capable of dissolving in water or forming stable aqueous dispersions. The antiradical effect of synthesized supramolecular complexes on the DPPH radical was estimated. A concentration capable of 50% lowering the optical density of a 100 μ M solution of DPPH radical was determined. For a supramolecular complex based on N-(diethylamino)-benzylidenisonocinate-hydrazide and 2-GP- β -cyclodextrin, IC₅₀ (DPPH) was found to be 46.4 μ M.

Key words: β -cyclodextrin, 2-hydroxypropyl-cyclodextrin, supramolecular inclusion complexes, antiradical activity.

Hydrazones obtained on the basis of known isonicotinic acid hydrazide are used as antibacterial and antitubercular drugs, analytical reagents and dyes [1]. However, some of them have low solubility in water. At present, various ways of increasing the solubility of medicinal substances in water are developed and used: the use of special auxiliaries, including the inclusion of drugs in the complex of cyclodextrin [2].

Cyclodextrins (CD) are cyclic oligosaccharides that have a hydrophobic internal cavity and a hydrophilic outer shell [3]. Cyclodextrins (CD) are cyclic oligosaccharides that have a hydrophobic internal cavity and a hydrophilic outer shell [4]. By forming the inclusion complex, it is possible to increase the stability of low molecular substances sensitive to the action of light and air oxygen, increase their solubility in water, bioavailability, and reduce toxicity. Due to this, CSDs are widely used in the food, cosmetic, pharmaceutical industry, in the production of dyes, in analytical chemistry, in the elimination of environmental pollution by ecotoxicants, etc. [5-7].

The stability of the complexes is caused by the formation of a variety of non-covalent forces of interaction between the molecules of cyclodextrin and the "guest": Van der Waals, hydrophobic and etc. Cyclodextrin in the complex protects the guest molecule from damage by various reactive molecules and thereby reduces the rate of oxidation, steric rearrangement, hydrolysis, racemization and enzymatic degradation [8, 9].

It is promising to use the obtained hydrazones as a constituent supramolecular system (substrate) with a cyclic oligosaccharide - β -cyclodextrin (receptor) having a truncated cone molecule with internal protons H_3 and H_5 and external H_2 and H_4 protons (Fig. 1). The possibility of including the active substance in the capsule of β -cyclodextrin is due to hydrophobic interactions between the BAS and the complexing agent.

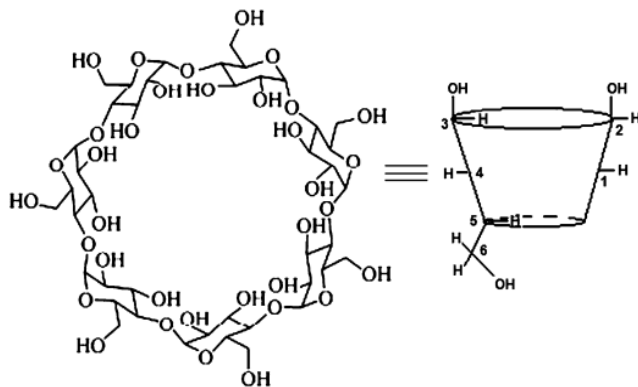
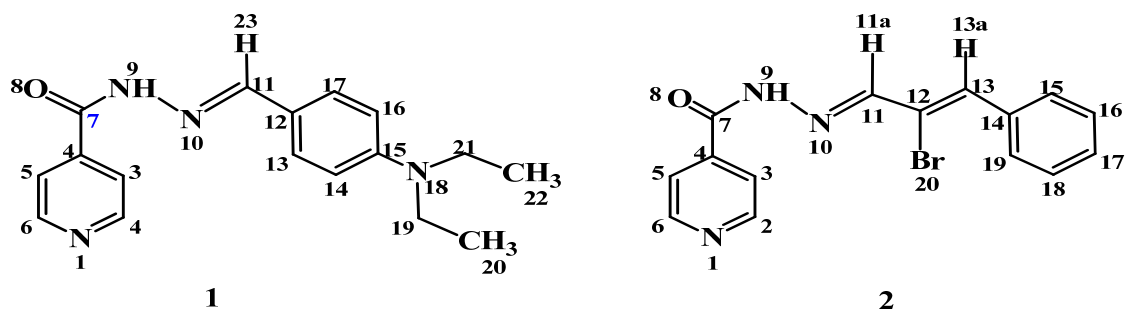


Figure 1 - Schematic representation of the structure of β -cyclodextrin molecules

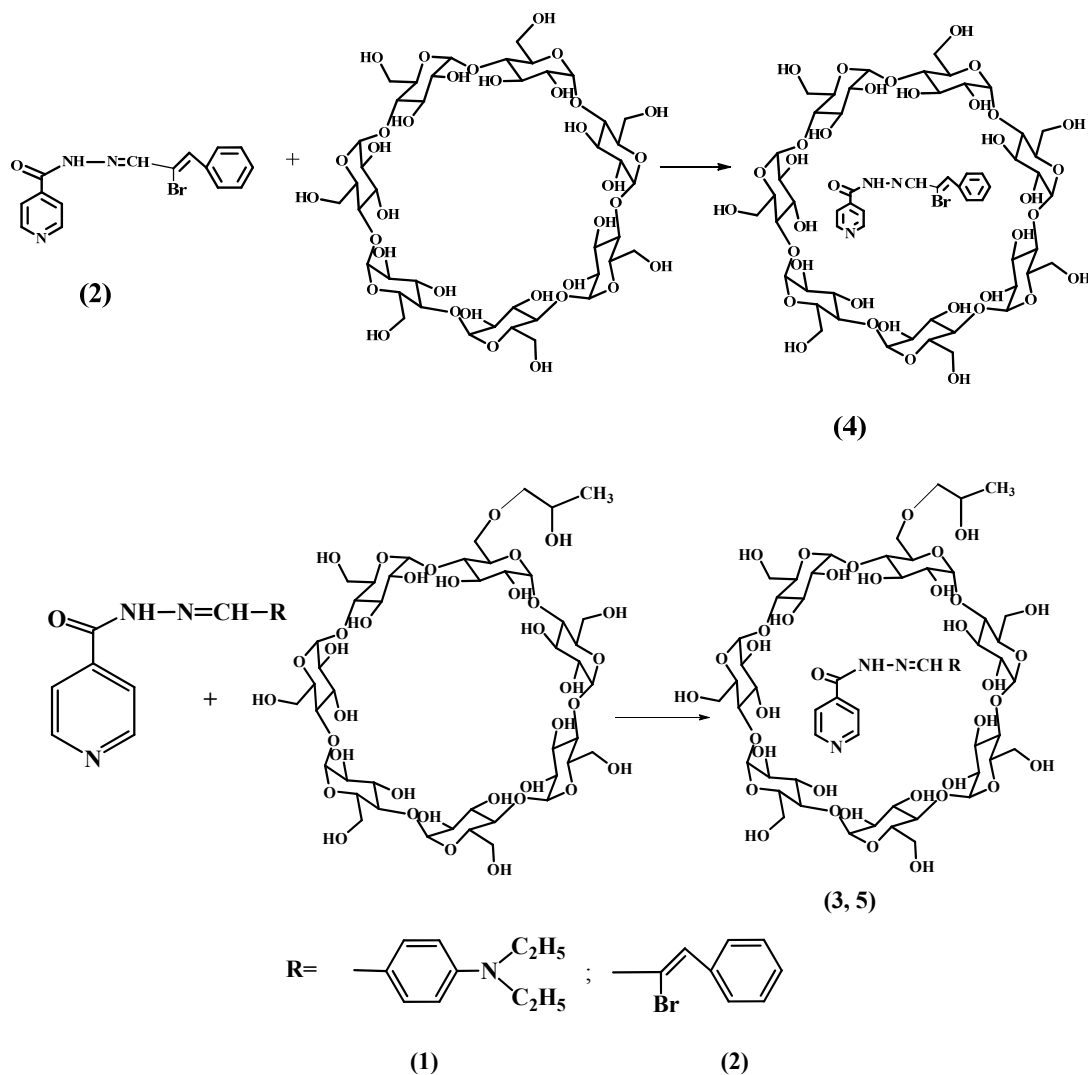
As hydrazones, N-(diethylamino)benzylidenisonicotinohydrazide (**1**) and N-(2-bromo-3-phenyl)allylideneisonicotinohydrazide (**7**) were selected as substrata for supramolecular self-assembly, which, according to the bioprospecting data, have high antituberculous, antimycobacterial activity and inhibitors of glutamine-phenylurea transaminase and threonine aldolase (see below), as well as poor solubility of the latter in water.



Supramolecular chemistry is dominated by the size and shape or geometric complementarity of the interacting components, therefore β -CD and its 2-hydroxy derivative-2-GP- β -CD were used to obtain inclusion complexes with substrates **1** and **2**.

Investigation by NMR spectroscopy of supramolecular complexes is based on the determination of the difference in the values of chemical shifts of ^1H and ^{13}C substrates (**1**, **2**) and receptors (β -CD, 2-GP- β -CD) in the free state and in the complexes as a result of intermolecular interaction. By the magnitude of chemical shifts of internal or external proton protons, it is possible to detect the formation of internal (inclusion) or external (without inclusion) complexes, respectively. The change in chemical shifts of ^1H and ^{13}C in the spectra of substrates makes it possible to determine the direction of occurrence of the latter in the CD cavity [10, 11].

The structure of substrates of supramolecular self-assembly **1** and **2** was established based on the results of ^1H and ^{13}C NMR spectroscopy obtained in DMSO-d_6 (Tables 1, 2 (**1**) and 1, 3, 4 (**2**)). The correctness of assigning one-dimensional NMR spectra of ^1H and ^{13}C **1** and **2** was confirmed by two-dimensional correlations of the NMR spectra of ^1H - ^1H COSY, ^1H - ^{13}C HMQC (Table 1).

Table 1 -NMR data of ^1H , ^{13}C , ^1H - ^1H COSY, ^1H - ^{13}C HMQC substrates 1 and 2

Substrate	δ , ppm, J, Hz			
	^1H	^{13}C	^1H - ^1H COSY	^1H - ^{13}C HMQC
1	1.06 t (6H, H-20,22, ^3J 6.9), 3.31-3.35 m (4H, H-19,21), 6.66 d (2H, H-14,16, ^3J 8.7), 7.48 d (2H, H-13,17, ^3J 8.7), 7.77 d (2H, H-3,5, ^3J 4.6), 8.25 s (1H, H-23), 8.72 d (2H, H-2,6, ^3J 4.6), 11.72 s (1H, H-9).	12.96 (C-20,23), 44.26 (C-19,21), 111.56 (C-14,16), 120.76 (C-12), 122.00 (C-3,5), 129.56 (C-13,17), 141.37 (C-4,11), 149.57 (C-2,6), 150.41 (C-15), 161.48 (C-7).	$\text{H}^{19,21}\text{-H}^{20,22}$ (1.03, 3.33; 3.32, 1.05); $\text{H}^{13,17}\text{-H}^{14,16}$ (6.65, 7.48; 7.48, 6.66); $\text{H}^{3,5}\text{-H}^{2,6}$ (7.76, 8.72; 8.71, 7.77).	$\text{H}^{20,22}\text{-C}^{20,22}$ (1.03, 12.93); $\text{H}^{14,16}\text{-C}^{14,16}$ (6.63, 111.53); $\text{H}^{13,17}\text{-C}^{13,17}$ (7.45, 129.54); $\text{H}^{3,5}\text{-C}^{3,5}$ (7.76, 121.92); $\text{H}^{2,6}\text{-C}^{2,6}$ (8.70, 150.73).
2	7.38-7.43 m (3H, H-15,19,17), 7.67 s (1H, H-13), 7.77 d (2H, H-3,5, ^3J 1.8), 7.84 d (2H, H-16,18, ^3J 6.4), 8.34 s (1H, H-11), 8.75 d (2H, H-2,6), 12.19 s (1H, H-9).	119.50 (C-12), 122.07 (C-3,5), 128.99 (C-15,19), 130.01 (C-17), 130.34 (C-16,18), 135.04 (C-14), 139.37 (C-13), 140.85 (C-4), 149.53 (C-11), 150.90 (C-2,6), 162.27 (C-7).	$\text{H}^{16,18}\text{-H}^{15,17,19}$ (7.40, 7.84; 7.83, 7.43); $\text{H}^{2,6}\text{-H}^{3,5}$ (7.76, 8.75; 8.74, 7.77).	$\text{H}^{15,19}\text{-C}^{15,19}$ (7.40, 129.31); $\text{H}^{13}\text{-C}^{13}$ (7.67, 139.39); $\text{H}^{3,5}\text{-C}^{3,5}$ (7.76, 122.07); $\text{H}^{16,18}\text{-C}^{16,18}$ (7.85, 130.14); $\text{H}^{11}\text{-C}^{11}$ (8.32, 119.49); $\text{H}^{2,6}\text{-C}^{2,6}$ (8.74, 150.97).

The ratio of the integrated intensities of the protons in the compounds in question corresponded to the structures 1 and 2 presented. NMR spectra of ^1H and ^{13}C β - and 2-GP- β -CD-nanov in the free state and supramolecular complexes 3-5 on their basis with substrates 1 and 2 are presented in Tables 2-4.

Table 2 – Chemical shifts of the ^1H and ^{13}C nuclei of substrate **1** and 2-GP- β -cyclodextrin in the free state (δ_0) and in the complex **3** (δ)

Atom number	Group	δ_0 , ppm.		δ , ppm.		$\Delta\delta = \delta - \delta_0$	
		^1H	^{13}C	^1H	^{13}C	^1H	^{13}C
Substrate 1							
2	CH	8.72	149.57	8.71	150.75	-0.01	1.18
3	CH	7.77	122.00	7.76	121.99	-0.01	-0.01
4	C		141.37		141.69		0.32
5	CH	7.77	122.00	7.76	121.99	-0.01	-0.01
6	CH	8.72	149.57	8.71	150.75	-0.01	1.18
7	C		161.48		163.82		2.34
9	NH	11.72		11.63		-0.11	
11	CH		141.37		141.69		0.32
12	C		120.76		120.94		0.18
13	CH	7.48	129.56	7.48	129.55	0	-0.01
14	CH	6.66	111.56	6.68	111.60	0.02	0.04
15	C		150.41		151.53		1.12
16	CH	6.66	111.56	6.68	111.60	0.02	0.04
17	CH	7.48	129.56	7.48	129.55	0	-0.01
19	CH ₂	3.35	44.26	3.36	44.27	0.01	0.01
20	CH ₃	1.06	12.96	1.00	12.84	-0.06	-0.12
21	CH ₂	3.35	44.26	3.36	44.27	0.01	0.01
22	CH ₃	1.06	12.96	1.00	12.84	-0.06	-0.12
23	CH	8.25		8.26		0.01	
2-HP-β-CD							
1	CH	4.79	102.33	4.80	102.29	0.01	-0.04
2	CH	3.26	72.56	3.28	72.94	0.02	0.38
3	CH	3.70	73.56	3.73	73.55	0.03	-0.01
4	CH	3.18	82.11	3.21	82.20	0.03	0.09
5	CH	3.56	72.56	3.60	72.30	0.04	-0.26
6	CH ₂	3.56	60.40	3.60	60.43	0.04	0.03

Table 3 – Chemical shifts of the ^1H and ^{13}C nuclei of substrate **2** and β -cyclodextrin in the free state (δ_0) and in the complex **4** (δ)

Atom number	Group	δ_0 , ppm.		δ , ppm.		$\Delta\delta = \delta - \delta_0$	
		^1H	^{13}C	^1H	^{13}C	^1H	^{13}C
Substrate 2							
2	CH	8.75	150.90	8.38	150.98	-0.37	0.08
3	CH	7.77	122.07	7.95	124.49	0.18	2.42
4	C		140.85				
5	CH	7.77	122.07	7.95	124.49	0.18	2.42
6	CH	8.75	150.98	8.38	150.98	-0.37	0.08
7	C		162.27				
9	NH	12.19		12.19		0	
11	CH _a	8.34	149.53	8.38		0.04	
12	C		119.50				
13	CH _a	7.67	139.37	7.95		0.28	
14	C		135.04		133.50		-1.54
15	CH	7.43	128.99	7.53	129.42	0.10	0.43
16	CH	7.84	130.34	7.95	131.17	0.11	0.83
17	CH	7.43	130.01	7.53	132.11	0.10	2.10
18	CH	7.84	130.34	7.95	131.17	0.11	0.83
19	CH	7.43	128.99	7.53	129.42	0.10	0.43
β-CD							
1	CH	4.77	102.40	4.79	102.46	0.02	0.06
2	CH	3.26	72.83	3.27	72.93	0.01	0.10
3	CH	3.58	73.54	3.60	73.57	0.02	0.03
4	CH	3.28	81.98	3.31	82.07	0.03	0.09
5	CH	3.50	72.50	3.51	72.56	0.01	0.06
6	CH ₂	3.58	60.42	3.60	60.45	0.02	0.03

Table 4 – Chemical shifts of the ^1H and ^{13}C nuclei of substrate **2** and 2-GP- β -cyclodextrin in the free state (δ_0) and in the complex of **5** (δ)

Atom number	Group	δ_0 , ppm.		δ , ppm.		$\Delta\delta = \delta - \delta_0$	
		^1H	^{13}C	^1H	^{13}C	^1H	^{13}C
Substrate 2							
2	CH	8.75	150.90	8.78	149.72	0.03	-1.82
3	CH	7.77	122.07	7.87	124.04	0.10	1.97
4	C		140.85		140.25		-0.60
5	CH	7.77	122.07	7.87	124.04	0.10	1.97
6	CH	8.75	150.98	8.78	149.72	0.03	-1.82
7	C		162.27		163.61		1.34
9	NH	12.19		12.19		0	
11	CH_a	8.34	149.53	8.38	149.72	0.04	0.19
12	C		119.50				
13	CH_a	7.67	139.37	7.87	139.64	0.20	0.27
14	C		135.04		131.18		-3.86
15	CH	7.43	128.99	7.52	129.00	0.09	0.01
16	CH	7.84	130.34	7.87	129.42	0.03	-0.62
17	CH	7.43	130.01	7.52	129.42	0.09	-0.59
18	CH	7.84	130.34	7.87	129.42	0.03	-0.62
19	CH	7.43	128.99	7.52	129.00	0.09	0.01
2-HP-β-CD							
1	CH	4.79	102.33	4.80	102.36	0.01	0.03
2	CH	3.26	72.56	3.28	72.91	0.02	0.35
3	CH	3.70	73.56	3.73	73.53	0.03	-0.03
4	CH	3.18	82.11	3.21	82.01	0.03	-0.10
5	CH	3.56	72.56	3.60	72.91	0.04	0.35
6	CH_2	3.56	60.40	3.60	60.66	0.04	0.20

Comparison of the integrated intensities of the signals of ^1H NMR of the molecules of substrates **1** and **2** and the receptors of β - and 2-GP- β -CD in supramolecular complexes **3-5** showed that in all cases complexes of the composition of the guest molecule are formed for **2** host molecules.

In the formation of the supramolecular complex **3**, as a result of the supramolecular self-assembly **1** with 2-GP- β -CD, changes in the proton chemical shifts in the cyclodextrin $\Delta\delta$ molecule occurred to a greater extent in the internal hydrophobic protons H-3, H-5, H-6 than in the external hydrophilic surface of protons H-1, H-2 and H-4. In molecule **1**, the largest changes in proton spectra are observed in diethylamine protons H-20, H-22, H-19, H-21 and located closer to the above protons in the phenylidene protons H-14 and H-16. The proton also undergoes screening in the process of complexation, the aromatic pyridine hydrophobic protons H-2,6 and H-3,5. It can be assumed that the greatest supramolecular interaction of host and host molecules is realized by means of the above protons during the formation of complex **3** (Fig. 2).

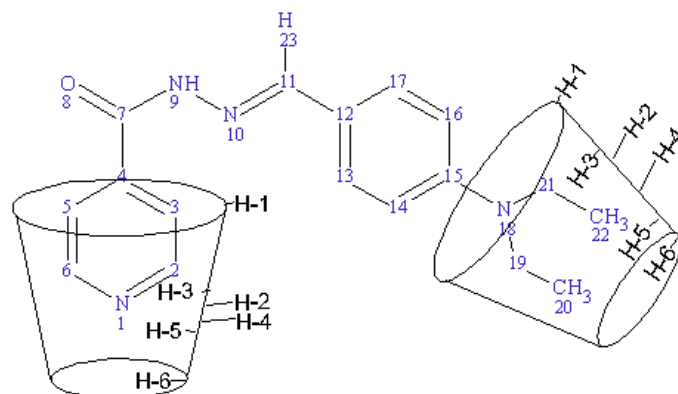


Figure 2 - Supposed supramolecular inclusion complexes **3**

Screening of external cyclodextrin protons is probably due to the intermolecular interaction of hydrophilic protons with external hydroxyl groups of 2-GP- β -CD-N, as well as the possible slight formation of external complexes [12-15]. The water-soluble aggregates formed in this way are capable of solubilizing the molecules of substrates through non-inclusive complexation [16-18]. A significant change in the chemical shifts of the imine proton H-9 is probably due to the hydrophilic interaction of its hydroxy-group receptor.

Supramolecular self-assembly of substrate **2** with β - and 2-GP- β -CDs with the formation of supracomplexes **4** and **5** was also accompanied by a change in internal hydrophobic protons of CD and insignificant screening of external proton receptors. In molecule **1**, the largest changes in proton chemical shifts occurred in the phenyl and pyridine fragments. When β -CD- β was used as the receptor, the greatest changes in proton chemical shifts were observed in the protons of the pyridine fragment of complex **4**, whereas the use of 2-GP- β -CD in supramolecular self-assembly with substrate **2** leads to the greatest change in the chemical shifts of the protons of the phenyl radical in the supracomplex **5**.

The proposed models of supracomplexes **4** and **5** are similar in structure and are shown in Figure 3. In order to study the biological activity of the obtained supramolecular inclusion complexes 3-5, their antiradical effect on the DPPH radical was evaluated. The antiradical action of the presented samples was investigated with respect to the radical 2,2-diphenyl-1-picryl hydrazyl (DPPH •) [19].

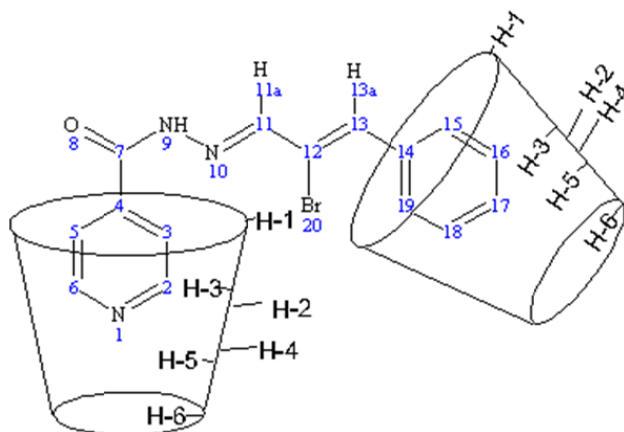


Figure 3 - Supposed supramolecular inclusion complexes **4** and **5**

A methanol solution of DPPH (100 μ M) was used for the initial evaluation of the antiradical activity of the samples under study in the DPPH-radical test. For the selection of substances with a pronounced antiradical activity, 2 ml of a 100 μ M methanolic solution of DPPH was mixed with 20 μ l of the test object dissolved in DMSO at a concentration of 5 mM. Thus, the final concentration of the test substance in the reaction mixture was 50 μ M. 10 minutes after the solution of the test compound was added to the DPPH radical solution, the optical density reduction at 515 nm was measured. For substances capable of reducing the optical density by more than 30%, an interaction test with DPPH radical was carried out at the final concentrations of the test substances 100, 75, 50, 25, 20, 10 and 5 μ M. Then, the concentration of the test substance was determined, which was able to reduce the optical density by 50% - IC_{50} (DPPH) (Table 5). In control, a 100 μ M solution of DPPH was added with 20 μ l of a solvent - DMSO.

Table 5 - Optical density of the solution of a 100 μ M DPPH radical after a 10-minute incubation with the test substance at a final concentration of 50 μ M

№	Connection cipher	Optical density	The decrease in the optical density of the initial solution of DPPH-radical, in% of the control
1.	(3)	0,535	52,3
2.	(4)	1,094	2,5
3.	(5)	1,058	5,7
4.	Control (DPPH solution without test sample)	1,122	-

From Table 5 we see that Compound **3** in the final concentration of 50 μM reduces the optical density of the initial solution of DPPH radical by 52.3%, which means it is promising for further studies. The remaining compounds showed no pronounced antiradical activity under the conditions of this test system.

In the second series of experiments, we studied the ability of compound **3** at various concentrations (from 5.0 to 100 μM) to interact with the DPPH radical (Table 6).

Table 6 - Optical density of the solution of a 100 μM DPPG radical after a 10-minute incubation with **3** at the final concentrations in the reaction mixture of 100, 75, 50, 25, 20, 10 and 5 μM

№	The final concentration of 3 in the reaction mixture, μM	Optical density
1.	100	0,079
2.	75	0,275
3.	50	0,491
4.	25	0,723
5.	20	0,798
6.	10	0,907
7.	5	0,963
	Control (DPPH solution without test sample)	1,042

Using the constructed calibration curve (Fig. 4), the concentration of Compound **3** was determined, capable of 50% decrease in the optical density of a 100 μM solution of DPPH radical. For compound **3**, IC_{50} (DPPH) was found to be 46.4 μM .

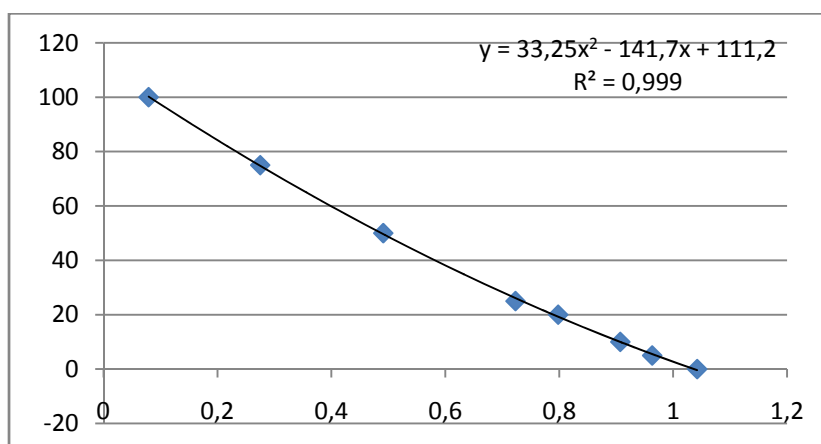


Figure 4 - Dependence of the optical density of the DPPH radical solution on the concentration of **3**

Using the constructed calibration curve (Table 7, Fig. 5), the concentration of ascorbic acid, capable of 50% lowering the optical density of 100 μM DPPH radical solution, was determined. For ascorbic acid, IC_{50} (DPPH) was found to be 21.14 μM .

Thus, supramolecular complexes based on the functionally substituted N-benzylidene- and allylidene-isonicotinohydrate with cyclodextrins ($\beta\text{-CD}$, hydroxypropyl- $\beta\text{-CD}$) were obtained and their structures studied by NMR spectroscopy. It is shown that the products obtained from a mixture that is capable of dissolving in water or forming stable aqueous dispersions.

Table 7 - Optical density of the solution of a 100 μM DPPG radical after a 10-minute incubation with ascorbic acid at the final concentrations in the reaction mixture of 25, 20, 10 and 5 μM

№	The final concentration of ascorbic acid in the reaction mixture, μM	Optical density
1.	25	0,429
2.	20	0,545
3.	10	0,792
4.	5	0,914
	Control (DPPH solution without test sample)	1,042

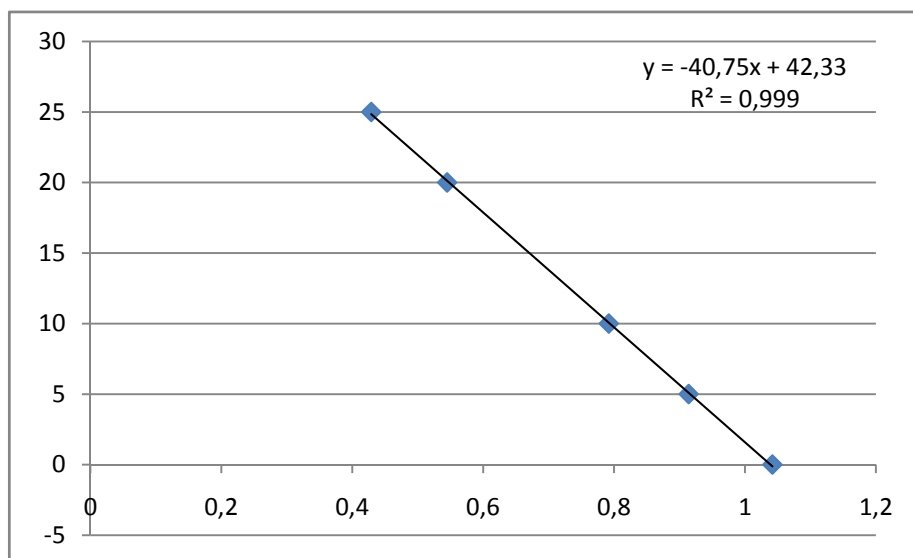


Figure 5 - Dependence of the optical density of the DPPH radical solution on the concentration of ascorbic acid

The antiradical effect of synthesized supramolecular inclusion complexes against DPPH radical was estimated. Antiradical activity under the conditions of this test system was shown in Sample 3, for which a concentration was determined capable of 50% decrease in the optical density of a 100 μM solution of DPPH radical. For compound 3, IC₅₀ (DPPH) was found to be 46.4 μM .

According to our data, the IC₅₀ (DPPH) (μM) for the reference sample, in this case for ascorbic acid, was 21.1 μM . The activity of the sample of Compound 3, for which IC₅₀ (DPPH) was 46.4 μM is inferior to the reference sample of ascorbic acid.

According to the literature data [20] IC₅₀ (DPPH) (μM) for ascorbic acid is 27, for glutathione - 49, for hydroquinone - 27, for trolox - 28, for α -tocopherol - 28. Thus, the activity of compound 3 is comparable with activity known antioxidant - glutathione.

Experimental part

β - and 2-GP- β -CDDs were used by Fluka companies with a purity of 99%. The ^1H and ^{13}C NMR spectra were recorded on a Jeol JNM-ECA 400 spectrometer (399.78 and 100.53 MHz on ^1H and ^{13}C nuclei, respectively) in a DMSO- d_6 solution at room temperature. Chemical shifts are measured relative to the residual signals of protons or carbon atoms DMSO- d_6 .

Preparation of inclusion complexes (3-5) of functionally substituted N-benzylidene- and allylideneisonicotinhydrazide (1, 2) with β - and hydroxypropyl- β -cyclodextrin. We chose the method of coprecipitation, since this method makes it possible to obtain a very pure preparation of the inclusion complex in a crystalline form. In a 1: 1 ratio, a saturated solution of cyclodextrin in water was added dropwise to a concentrated solution of the functionally substituted N-benzylidene- and allylideneisonicotinhydrazide in an organic solvent (ethanol, dioxane, DMF, etc.). After that, they interfered with a magnetic stirrer at a temperature of 85-90°C. The individuality of the proposed complexes was checked by thin-layer chromatography on Silufol UV-254 plates in isopropyl alcohol-25% ammonia-water 7:2:1 solution. The final product was dried at a temperature of 600°C in vacuum drying at atmospheric pressure of 0.4 kgf/cm². The inclusion complexes of hydrazones with cyclodextrins were obtained in the form of a powder.

The work was carried out with the financial support of the Committee of Science and the Ministry of Education of the Republic of Kazakhstan on "Grant Financing", No. Registration 0115PK01782, AP05131054 "Development of scientific bases and effective methods of creation of new polyfunctional pyridine compounds with the purpose of search on their basis of potential biological active substances for medicine".

REFERENCES

- [1] [Wiseman B](#), [Carpene X](#), [Feliz M](#), [Donald LJ](#), [Pons M](#), [Fita I](#), [Loewen PC](#). Isonicotinic acid hydrazide conversion to Isonicotinyl-NAD by catalase-peroxidases // [J Biol Chem](#), 2010, 285(34):26662-26673. DOI: 10.1074/jbc.M110.139428. (In Eng).
- [2] [Judge V](#), [Narasimhan B](#), [Ahuja M](#), [Balzarini J](#) and etc. Isonicotinic acid hydrazide derivatives: Synthesis, antimicrobial activity, and QSAR studies // *Med Chem Res*, 2012, 21:1451–1470. DOI 10.1007/s00044-011-9662-9. (In Eng).
- [3] [Okumura H](#), [Kawaguchi Y](#), and [Harada A](#). Preparation and Characterization of Inclusion Complexes of Poly(dimethylsiloxane)s with Cyclodextrins // *Macromolecules*, 2001, 34 (18), pp 6338–6343. DOI: 10.1021/ma010516i. (In Eng)
- [4] [Wenz G](#), [Han B](#), and [Muller A](#). Cyclodextrin Rotaxanes and Polyrotaxanes // *Chem. Rev.*, 2006, 106 (3), pp 782–817. DOI: 10.1021/cr970027+. (In Eng).
- [5] [Liguori A](#), [D'auria M](#), [Emanuele L](#), [Scrano L](#), [Lelario F](#), [Bufo S](#). Reactivity of rimsulfuron in newly formed inclusion combinations by using cyclodextrin and zeolite // *Int. Journ. Of Environmental Analit. Chem.* 2007. V.87. P.1043-1052. DOI: [10.1080/03067310701440874](#). (In Eng).
- [6] [Zimmer S](#), [Grebe A](#), [Bakke S](#), [Bode N](#) and etc. Cyclodextrin promotes atherosclerosis regression via macrophage reprogramming // *Science Translational Medicine*, 2016, V. 8, Issue 333, pp. 333ra50. DOI: 10.1126/scitranslmed.aad6100. (In Eng).
- [7] [Loftsson T](#), [Brewster M.E](#). Pharmaceutical applications of cyclodextrins: basic science and product development // *Journal of Pharmacy and Pharmacology*. 2010. V. 62. P. 1607-1621. DOI: 10.1111/j.2042-7158.2010.01030.x. (In Eng).
- [8] [Kurkov S.V](#), [Loftsson T](#). Cyclodextrins // *International Journal of Pharmaceutics*. – 2013, V. 453, pp 167-180. DOI:10.1016/j.ijpharm.2012.06.055. (In Eng).
- [9] [Nowakowski M](#), [Ejchart A](#). Complex formation of fenchone with α -cyclodextrin: NMR titrations // *J. Incl. Phenom. Macrocycl. Chem.* 2014, V. 79. P. 337-342. DOI: 10.1007/s10847-013-0356-4. (In Eng).
- [10] [Maheshwari A](#), [Sharma M](#), [Sharma D](#). Complexation of sodium picosulphate with beta cyclodextrin: NMR spectroscopic study in solution // *J. Incl. Phenom. Macrocycl. Chem.*, 2013, V. 77, pp 337-342. DOI: 10.1007/s10847-012-0251-4. (In Eng).
- [11] [Huang Y.D](#). Comments on "Novel molecularly imprinted polymer based on β -cyclodextrin@graphene oxide: Synthesis and application for selective diphenylamine determination" // [J Colloid Interface Sci](#). 2018., P. 31042-31047. doi: 10.1016/j.jcis. 2018.09.001. (In Eng).
- [12] [Maheshwari A.](#), [Sharma M.](#), [Sharma D](#). Complexation of sodium picosulphate with beta cyclodextrin: NMR spectroscopic study in solution // *J. Incl. Phenom. Macrocycl. Chem.*, 2013. V. 77, pp 337-342. DOI: 10.1007/s10847-012-0251-4. (In Eng).
- [13] [Demarco P.V](#), [Thakkar A.I](#). Cyclohepta-amilose Inclusion Complexes. A Proton Magnetic Resonance Study // *J. Chem. Soc., Chem. Commun*, 1970. P.2-4. DOI: [10.1039/c29700000002](#). (In Eng).
- [14] [Hazra S](#), [Hossain M](#), [Kumar G.S](#). Studies on α -, β -, and γ -cyclodextrin inclusion complexes of isoquinoline alkaloids berberine, palmatine and coralyne // *J. Incl. Phenom. Macrocycl. Chem.*, 2014, V. 78, pp 311-323. DOI: 10.1007/s10847-013-0301-6. (In Eng)
- [15] [Loftsson T](#), [Masson M](#), [Brewster M.E](#). Self-association of cyclodextrins and cyclodextrin complexes // *J. Pharm. Sci.* 2004. V. 93. P. 1091-1099. DOI: [10.1002/jps.20047](#). (In Eng).
- [16] [Zhao D.G.](#), [Liao K.I.](#), [Ma X.Y.](#), [Yan X.H](#). Study of the supramolecular inclusion of β -cyclodextrin with andrographolide // *J. Inclusion Phenom. Macrocycl. Chem.* 2002. V. 43. № 3-4, pp 259-264. DOI: 10.1023/A:1021223407297. (In Eng).
- [17] [Nacsá Á](#), [Ambrus R](#), [Berkési O.J.](#), [Szabó-Révész P](#), [Aigner Z](#). Water-soluble loratadine inclusion complex: analytical control of the preparation by microwave irradiation // *Pharm. Biomed. Anal.* 2008. V. 48. № 3. P. 1020-1023. DOI: 10.1016/j.jpba.2008.07.001. (In Eng).
- [18] [Cirri M](#), [Maestrelli F](#), [Mennini N](#), [Mura P](#). Physicalchemical characterization of binary and ternary systems of ketoprofen with cyclodextrins and phospholipids // *J. Pharm. Biomed. Anal.*, 2009, V. 50, pp 683-689. DOI: [10.1016/j.jpba.2008.11.003](#). (In Eng).
- [19] [Brand-Williams W.](#), [Cuvelier M.E.](#), [Berset C](#). Use of a free radical method to evaluate antioxidant activity // *Lebensm Wiss Technol*, 1995. V. 28. P. 25–30. DOI: [10.1016/S0023-6438\(95\)80008-5](#). (In Eng).
- [20] [Plattner S](#). et al. Studying the reducing potencies of antioxidants with the electrochemistry inherently present in electrospray ionization-mass spectrometry // *Anal Bioanal Chem.*, 2014, pp 213–224. DOI: 10.1007/s00216-013-7445-5. (In Eng).

О.А. Нуркенов¹, С.Д. Фазылов¹, А.Ж. Исаева¹,
Т.М. Сейлханов², Т.С. Животова¹, З.Т. Шұлғау³, Ж.М. Қожина⁴

¹ҚР Органикалық синтез және көмір химиясы институты, Қарағанды қ., Қазақстан Республикасы;

²Ш. Уәлиханов атындағы Көкшетау мемлекеттік университеті, Қазақстан Республикасы;

³ҚР БҒМ ҒК «Ұлттық биотехнология орталығы» ШЖҚ-дағы РМК, Астана қ., Қазақстан Республикасы;

⁴Л.Н.Гумилев атындағы Еуразия ұлттық университеті, Астана қ., Қазақстан Республикасы,

ФУНКЦИОНАЛДЫҚ-ОРЫНБАСЫЛҒАН ИЗОНИКОТИН ҚЫШҚЫЛЫНЫҢ ГИДРАЗОНДАРЫ МЕН ЦИКЛОДЕКСТРИНДЕРДІҢ КОМПЛЕКСТІК КЕШЕНДЕРІ ЖӘНЕ ОЛАРДЫҢ АНТИРАДИКАЛДЫҚ БЕЛСЕНДІЛІКТЕРІ

Аннотация. Берілген жұмыста алғаш рет циклодекстриндердегі (β -ЦД, 2-ГП- β -ЦД) N-(диэтиламино) бензилиденизоникотиногидразид және N-(2-бromo-3-фенил)аллилиденизоникотиногидразидінің негізіндегі супрамолекулярлық кешендердің реакциялары қарастырылып, зерттелді. β - және 2-ГП- β -ЦД рецепторлары мен субстраттар (гидразондар) молекулаларының ¹H ЯМР интегралдық қарқындылық дабылдарын сәйкестендіру кезінде барлық жағдайда 1 қонақ молекуласының 2 рецептордың молекуласы құрамында болатын кешендер түзілетіні байқалды. Олардың субстрат молекуласының метиламиндік тобы жағынан рецептордың ішкі жағына кіруі арқылы қосылу кешені түзілетіні анықталды. Алынған өнімдер суда ери алатын қоспа түзеді немесе суда тұрақты дисперсиялар түзеді. Сонымен қатар, ДФПГ-радикалы қатысында циклодекстриндердегі гидразондардың супрамолекулярлық кешенінің антирадикалдық әсері бағаланды. ДФПГ-радикалының ерітіндісінің 100 μ M оптикалық тығыздықты 50%-ға дейін төмендете алатын концентрациясы анықталды. N-(диэтиламино)-бензилиденизоникотиногидразиді мен 2-ГП- β -циклодекстриннің супрамолекулярлық кешені үшін IC₅₀(DPPH) 46,4 μ M тең.

Түйін сөз: β -циклодекстрин, 2-гидроксипропил- β -циклодекстрин, супрамолекулярлық қосылу кешендері, антирадикалдық белсенділік.

О.А. Нуркенов¹, С.Д. Фазылов¹, А.Ж. Исаева¹,
Т.М. Сейлханов², Т.С. Животова¹, З.Т. Шұлғау, ³ Ж.М. Қожина⁴

¹Институт органического синтеза и углекислотной химии РК, г. Караганда, Республика Казахстан;

²Кокшетауский государственный университет им. Ш. Уалиханова, Республика Казахстан;

³РГП на ПХВ «Национальный центр биотехнологии» КН МОН РК, г. Астана, Республика Казахстан;

⁴Евразийский национальный университет им. Л.Н. Гумилева, г. Астана, Республика Казахстан,

КОМПЛЕКСЫ ВКЛЮЧЕНИЯ ФУНКЦИОНАЛЬНО-ЗАМЕЩЕННЫХ ГИДРАЗОНОВ ИЗОНИКОТИНОВОЙ КИСЛОТЫ С ЦИКЛОДЕКСТРИНАМИ И ИХ АНТИРАДИКАЛЬНАЯ АКТИВНОСТЬ

Аннотация. В настоящей работе впервые были получены и изучены супрамолекулярные комплексы на основе N-(диэтиламино)бензилиденизони-котиногидразида и N-(2-бromo-3-фенил)аллилиденизоникотиногидразида и циклодекстринами (β -ЦД, 2-ГП- β -ЦД). Сопоставление интегральных интенсивностей сигналов ¹H ЯМР молекул субстратов (гидразонов) и рецепторов β - и 2-ГП- β -ЦД-на в супрамолекулярных комплексах показало, что во всех случаях образуются комплексы состава 1 молекула гостя на 2 молекулы хозяина. Установлено, что при взаимодействии они образуют комплекс включения с вхождением молекулы субстрата во внутреннюю полость рецептора метиламинным концом. Полученные продукты образуют смесь, способную растворяться в воде или образовывать устойчивые водные дисперсии. Оценено антирадикальное действие синтезированных супрамолекулярных комплексов в отношении ДФПГ-радикала. Определена концентрация, способная на 50% снизить оптическую плотность 100 μ M раствора ДФПГ-радикала. Для супрамолекулярного комплекса на основе N-(диэтиламино)-бензилиденизоникотиногидразида и 2-ГП- β -циклодекстрина, IC₅₀(DPPH) оказалась равной 46,4 μ M.

Ключевые слова: β -циклодекстрин, 2-гидроксипропил- β -циклодекстрин, супрамолекулярные комплексы включения, антирадикальная активность.

МАЗМҰНЫ

<i>Тунгатарова С.А., Ксандопуло Г., Кауменова Г.Н., Жумабек М., Байжуманова Т.С., Григорьева В.П., Комашко Л.В., Бегимова Г.У.</i> Метанды синтез газға каталитикалық риформингілеуде жану әдісімен композитті материалдарды жасау...6	
<i>Johann Dieck, Tатаева Р., Байманова А., Бакешова Ж., Капсалямов Б.</i> Ақаба суларды биологиялық өңдеу: теориялық негіздері және эксперименттік зерттеулер.....	16
<i>Орымбетова Г.Э., Conficoni D., Касымова М.К., Кобжасарова З.И., Орымбетов Э.М., Шамбулова Г.Д.</i> Сүт және сүт өнімдерінде қорғасын тәуекелін бағалау.....	23
<i>Талғатов Э.Т., Әуезханова А.С., Тумабаев Н.Ж., Ахметова С.Н., Сейтқалиева Қ.С., Бегмат Е.Ә., Жармагамбетова Ә.Қ.</i> Фенилацетиленді гидрлеуге арналған магнитті тасымалдағышқа отырғызылған полимер-палладий катализаторлары	29
<i>Ермагамбет Б.Т., Ремнев Г.Е., Мартемьянов С.М., Бухаркин А.А., Касенова Ж.М., Нурғалиев Н.У.</i> Майқұбы және Экібастұз көмір бассейндерінің диэлектрикалық қасиеттері.....	38
<i>Бейсенбаев А.Р., Жабаева А.Н., Сунцова Л.П., Душкин А.В., Адекенов С.М.</i> Оксима пиностробинның супрамолекулярлық кешенін синтездеу мен зерттеу.....	46
<i>Jadhav A. S., Mohanraj G. T., Mayadevi S., Gokarn A. N.</i> Йодты адсорбцияның саны бойынша катеху атты жаңғақтың қабығынан алынатын нано-беттік белсендірілген көмірдің көлемін анықтаудың жылдам әдісі.....	53
<i>Нүркенов О.А., Фазылов С.Д., Исаева А.Ж., Сейлханов Т.М., Животова Т.С., Шұлғау З.Т., Қожина Ж.М.</i> Функционалдық-орынбасылған изоникотин қышқылының гидразондары мен циклодекстриндердің комплекстік кешендері жән.....	57
<i>Ермагамбет Б.Т., Нурғалиев Н.У., Абылгазина Л.Д., Маслов Н.А., Касенова Ж.М., Касенов Б.К.</i> Көмір шлак қалдықтарының өнімдерінен бағалы компоненттер алудың әдістері.....	67
<i>Шоманова Ж.К., Сафаров Р.З., Жумаканова А.С., Носенко Ю.Г., Жанибекова А.Т., Шапекова Н.Л., Лорант Д.</i> Феррокорытпаны өңдеу қалдықтары негізінде алынған катализаторлар бетін электрондық микроскопия әдісімен зерттеу.....	79
<i>Баешов А., Гаишов Т.Э., Баешова А.К., Колесников А.В.</i> Мыс (II) иондарын үш валентті титан иондарымен цементациялау арқылы нано – және ультрадисперсті мыс ұнтақтарын алу.....	87
<i>Баешов А.Б., Мырзабеков Б.Э., Колесников А.В.</i> Құрамында титан (IV) иондары бар күкірт қышқылы ерітіндісінде мыс анодын қолдану кезінде электролит көлемінде дисперсті мыс ұнтақтарының түзілу заңдылықтары.....	96
<i>Чиркун Д. И., Левданский А.Э., Голубев В.Г., Сарсенбекулы Д., Қумисбеков С.А.</i> Өнеркәсіптік барабанды диірмендер жұмысын сарапталау және оларды жетілдіру жолдары.....	102
<i>Бродский А.Р., Григорьева В.П., Комашко Л.В., Нурмаканов Е.Е., Чанышева И.С., Шаповалов А.А., Шлыгина И.А., Яскевич В.И.</i> Молекула зонды бар Fe/γ-Al ₂ O ₃ катализдік жүйенің өзара әрекеттестігі I. γ-Al ₂ O ₃ және Fe/γ-Al ₂ O ₃ бастапқы жүйенің зерттелуі.....	109
<i>Бродский А.Р., Григорьева В.П., Комашко Л.В., Нурмаканов Е.Е., Чанышева И.С., Шаповалов А.А., Шлыгина И.А., Яскевич В.И.</i> Взаимодействие каталитической системы Fe/γ-Al ₂ O ₃ с молекулами-зондами II. Исследование носителя γ-Al ₂ O ₃ и системы Fe/γ-Al ₂ O ₃ после взаимодействия с водородом и аммиаком.....	120
<i>Доспаев М. М., Баешов А., Жумаканова А.С., Доспаев Д.М., Сыздықова Б.Б., Какенов К.С., Есенбаева Г.А.</i> Калий метасиликаты ертіндісінде мыс анодын поляризациялау кезіндегі нанодисперсті мыс силикаты ұнтағының түзілу механизм.....	130
<i>Надиоров К.С., Черкаев Г.В., Чихонадских Е.А., Маккаевева Н.А., Садырбаева А.С., Орымбетова Г.Э.</i> Екі отынды ііж кемелердің пайдаланылған газдарымен зиянды заттардың шығарылуының қоршаған ортаға және тұрғындар денсаулығына әсерін талдау	138
<i>Хусаин Б.Х., Винникова К.К., Сасс А.С., Рахметова К.С., Кензин Н.Р.</i> Бейтараптандыру процестегі пайдаланылған газдар шығудың аэродинамикалық модельдеу.....	150
<i>Утегенова Л.А., Нурлыбекова А.К., Хажиақбер Аиса, Жеңіс Ж.</i> Ақшыл сепкіл гүлөсімдігінің майда еритін құрамын зерттеу.....	156

СОДЕРЖАНИЕ

Тунгатарова С.А., Ксандопуло Г., Кауменова Г.Н., Жумабек М., Байжуманова Т.С., Григорьева В.П., Комашко Л.В., Бегимова Г.У. Разработка композитных материалов методом горения для каталитического риформинга метана в синтез-газ.....	6
Johann Duesck, Tатаева Р., Байманова А., Бакешова Ж., Капсалямов Б. Биологическая обработка сточных вод: теоретическая основа и экспериментальные исследования.....	16
Орымбетова Г.Э., Conficoni D., Касымова М.К., Кобжасарова З.И., Орымбетов Э.М., Шамбулова Г.Д. Оценка риска свинца в молоке и молочной продукции	23
Талгатов Э.Т., Ауезханова А.С., Тумабаев Н.Ж., Ахметова С.Н., Сейткалиева К.С., Бегмат Е.А., Жармагамбетова А.К. Полимер-палладиевые катализаторы на магнитном носителе для гидрирования фенилацетилена.....	29
Ермагамбет Б.Т., Ремнев Г.Е., Мартемьянов С.М., Бухаркин А.А., Касенова Ж.М., Нурғалиев Н.У. Диэлектрические свойства углей Майкубенского и Экибастузского бассейнов.....	38
Бейсенбаев А.Р., Жабаяева А.Н., Сунцова Л.П., Душкин А.В., Адекенов С.М. Синтез и изучение супрамолекулярного комплекса оксима пиностробина.....	46
Jadhav A. S., Mohanraj G. T., Mayadevi S., Gokarn A. N. Быстрый метод определения площади нано-поверхности активированного угля полученного из оболочки ореха катеху по числу адсорбции йода.....	53
Нуркенов О.А., Фазылов С.Д., Исаева А.Ж., Сейтханов Т.М., Животова Т.С., Шульгау З.Т., Кожина Ж.М. Комплексы включения функционально-замещенных гидразонов изоникотиновой кислоты с циклодекстринами и их антирадикальная активность.....	57
Ермагамбет Б.Т., Нурғалиев Н.У., Абылгазина Л.Д., Маслов Н.А., Касенова Ж.М., Касенов Б.К. Методы извлечения ценных компонентов из золошлаковых отходов углей.....	67
Шоманова Ж.К., Сафаров Р.З., Жумаканова А.С., Носенко Ю.Г., Жанибекова А.Т., Шапекова Н.Л., Лорант Д. Исследование методом электронной микроскопии поверхности катализаторов, полученных на основе отходов ферросплавного производства.....	79
Баешов А., Гаитов Т.Э., Баешова А.К., Колесников А.В. Получение нано- и ультрадисперсных порошков меди цементацией ионов меди (II) ионами трехвалентного титана	87
Баешов А.Б., Мырзабеков Б.Е., Колесников А.В. Закономерности образования дисперсных медных порошков в объеме электролита при использовании медного анода в растворе серной кислоты, содержащей ионы титана (IV)	96
Чиркун Д. И., Левданский А. Э., Голубев В.Г., Сарсенбекулы Д., Кумисбеков С.А. Анализ работы барабанных промышленных мельниц и пути их усовершенствования	102
Бродский А.Р., Григорьева В.П., Комашко Л.В., Нурмаканов Е.Е., Чанышева И.С., Шаповалов А.А., Шлыгина И.А., Яскевич В.И. Взаимодействие каталитической системы Fe/ γ -Al ₂ O ₃ с молекулами-зондами I. Исследование γ -Al ₂ O ₃ и исходной системы Fe/ γ -Al ₂ O ₃	109
Бродский А.Р., Григорьева В.П., Комашко Л.В., Нурмаканов Е.Е., Чанышева И.С., Шаповалов А.А., Шлыгина И.А., Яскевич В.И. Взаимодействие каталитической системы Fe/ γ -Al ₂ O ₃ с молекулами-зондами II. Исследование носителя γ -Al ₂ O ₃ и системы Fe/ γ -Al ₂ O ₃ после взаимодействия с водородом и аммиаком	120
Доспаев М. М., Баешов А., Жумаканова А.С., Доспаев Д.М., Сыздыкова Б.Б., Какенов К.С., Есенбаева Г.А. Механизм образования нанодисперсного порошка силиката меди в растворе метасиликата калия	130
Надилов К.С., Черкаев Г.В., Чихонадских Е.А., Маккаевеева Н.А., Садырбаева А.С., Орымбетова Г.Э. Анализ влияния выбросов вредных веществ с отработавшими газами судовых двухтопливных двс на окружающую среду и здоровье населения.....	138
Хусаин Б.Х., Винникова К.К., Сасс А.С., Рахметова К.С., Кензин Н.Р. Аэродинамическое моделирование прохождения выбросов в процессе нейтрализации.....	150
Утегенова Л.А., Нурлыбекова А.К., Хажиакбер Ауса, Жеңіс Ж. Исследование жирорастворимого состава рябчика Бледноцветного.....	156

CONTENTS

<i>Tungatarova S.A., Xanthopoulou G., Kaumenova G.N., Zhumabek M., Baizhumanova T.S., Grigorieva V.P., Komashko L.V., Begimova G.U.</i> Development of composite materials by combustion synthesis method for catalytic reforming of methane to synthesis gas.....	6
<i>Dueck Johann, Tatayeva R., Baymanova A., Bakeshova Zh., Kapsalyamov B.</i> Biological treatment of waste water: theoretical background and experimental research.....	16
<i>Orymbetova G.E., Conficoni D., Kassymova M.K., Kobzhasarova Z.I., Orymbetov E.M., Shambulova G.D.</i> Risk assessment of lead in milk and dairy products	23
<i>Talgatov. E.T., Auyezkhanova A.S., Tumabayev N.Z., Akhmetova S.N., Seitkaliyeva K.S., Begmat Y.A., Zharmagambetova A.K.</i> Polymer-palladium catalysts on magnetic support for hydrogenation of phenylacetylene.....	29
<i>Ermagambet B.T., Remnev G.E., Martemyanov S.M., Bukharkin A.A., Kasenova Zh.M., Nurgaliyev N.U.</i> Dielectric properties of the coals of Maykuben and Ekibastuz basins.....	38
<i>Beisenbayev A.R., Zhabayeva A.N., Suntsova L.P., Dushkin A.V., Adekenov S.M.</i> Synthesis and study of pinostrobin oxime supramolecular complexes.....	46
<i>Jadhav A. S., Mohanraj G. T., Mayadevi S., Gokarn A. N.</i> Rapid method for determination of nano surface area of arecanut shell derived activated carbon by iodine adsorption number.....	53
<i>Nurkenov O.A., Fazylov S.D., Issayeva A.Zh., Seilkhanov T.M., Zhivotova T.S., Shulgau Z.T., Kozhina Zh.M.</i> Complexes of inclusion of functionally-substituted hydrasons of isonicotic acid with cyclodextrines and their antiradical activity.....	57
<i>Yermagambet B.T., Nurgaliyev N.U., Abylgazina L.D., Maslov N.A., Kasenova Zh.M., Kasenov B.K.</i> Methods for extraction of valuable components from ash-and-slag coal wastes.....	67
<i>Shomanova Zh.K., Safarov R.Z., Zhumakanova A.S., Nosenko Yu.G., Zhanibekova A.T., Shapekova N.L., Lorant D.</i> Electron microscopy surface study of catalysts based on ferroalloy production waste.....	79
<i>Bayeshov A., Gaipov T.E., Bayeshova A.K., Kolesnikov A.V.</i> Synthesis of nano- and ultradisperse copper powders by cementation of copper (II) ions by three-valent titanium ions.....	87
<i>Bayeshov A.B., Myrzabekov B.E., Kolesnikov A.V.</i> Patterns of formation of dispersed copper powders in the body of electrolyte during the use of copper anode in sulfuric acid solution along with titanium (IV) ions.....	96
<i>Chyrkun D.I., Leudanski A.E., Golubev V.G., Sarsenbekuly D., Kumisbekov S.A.</i> Analysis of industrial drum mills' operation and ways of their improvement.....	102
<i>Brodskiy A.R., Grigor'eva V.P., Komashko L.V., Nurmakanov Y.Y., Chanysheva I.S., Shapovalov A.A., Shlygina I.A., Yaskevich V.I.</i> Interaction of the Fe/ γ -Al ₂ O ₃ catalytic system with probe molecules I. Research of the γ -Al ₂ O ₃ and the Fe/ γ -Al ₂ O ₃ initial system	109
<i>Brodskiy A.R., Grigor'eva V.P., Komashko L.V., Nurmakanov Y.Y., Chanysheva I.S., Shapovalov A.A., Shlygina I.A., Yaskevich V.I.</i> Interaction of the catalytic Fe/ γ -Al ₂ O ₃ system with probe molecules II. Study OF γ -Al ₂ O ₃ support and Fe/ γ -Al ₂ O ₃ system after interaction with hydrogen and ammonia.....	120
<i>Dospaev M.M., Bayeshov A., Zhumakanova A.S., Dospaev D.M., Syzdykova B.B., Kakenov K.S., Esenbaeva G.A.</i> Mechanism of forming nanodisperse copper silicate powder during anodic polzrization of copper electrode in potassium silicate solution.	130
<i>Nadirov K.S., Cherkaev G.V., Chikhonadskikh E.A., Makkaveeva N.A., Sadyrbaeva A.S., Orymbetova G.E.</i> Analysis of influence of emissions of harmful substances with exhaust gases of marine dual fuel internal combustion engine on the environment and human health.....	138
<i>Khusain B.Kh., Vinnikova K.K., Sass A.S., Rakhmetova K.S., Kenzin N.R.</i> Aerodynamic modeling of emissions passage in the neutralization process.....	150
<i>Utegenova L.A., Nurlybekova A.K., Hajiakber Aisa, Jenis J.</i> Liposoluble constituents of <i>Fritillaria pallidiflora</i>	156

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.chemistry-technology.kz/index.php/ru/>

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

Редакторы: *М. С. Ахметова, Т. А. Апендиев, Аленов Д.С.*
Верстка на компьютере *А.М. Кульгинбаевой*

Подписано в печать 05.12.2018.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
9,8 п.л. Тираж 300. Заказ 6.