

CHEMISTRY
and PHYSICS
of MODERN
MATERIALS

Processing, Production
and Applications

Editors

Jimsher N. Aneli, DSc

Alfonso Jiménez, PhD

Stefan Kubica, PhD



Apple Academic Press



CRC Press

Taylor & Francis Group

CHEMISTRY AND PHYSICS OF MODERN MATERIALS

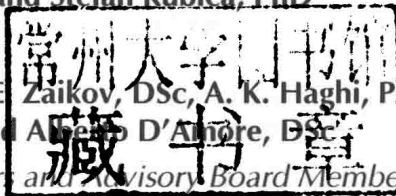
Processing, Production and Applications

Edited by

**Jimsher N. Aneli, DSc, Alfonso Jiménez, PhD,
and Stefan Kubica, PhD**

**Gennady E. Zaikov, DSc, A. K. Haghi, PhD,
and Alberto D'Amore, DSc**

Reviewers and Advisory Board Members



Apple Academic Press

TORONTO NEW JERSEY

Apple Academic Press Inc. | Apple Academic Press Inc.
3333 Mistwell Crescent | 9 Spinnaker Way
Oakville, ON L6L 0A2 | Waretown, NJ 08758
Canada | USA

©2014 by Apple Academic Press, Inc.
Exclusive worldwide distribution by CRC Press, a member of Taylor & Francis Group

No claim to original U.S. Government works
Printed in the United States of America on acid-free paper

International Standard Book Number-13: 978-1-926895-45-1 (Hardcover)

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission and sources are indicated. Copyright for individual articles remains with the authors as indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the authors, editors, and the publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The authors, editors, and the publisher have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged, please write and let us know so we may rectify in any future reprint.

Trademark Notice: Registered trademark of products or corporate names are used only for explanation and identification without intent to infringe.

Library of Congress Control Number: 2013942333

Library and Archives Canada Cataloguing in Publication

Chemistry and physics of modern materials : processing, production and applications/edited by Jimsher N. Aneli, DSc, Alfonso Jiménez, PhD, and Stefan Kubica, PhD.

Includes bibliographical references and index.

ISBN 978-1-926895-45-1

I. Nanotechnology. 2. Nanostructured materials. I. Aneli, J. N., editor of compilation II. Jiménez, Alfonso, 1965- editor of compilation III. Kubica, Stefan Jakub, editor of compilation

T174.7.C44 2013

620'.5

C2013-903906-6

Apple Academic Press also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic format. For information about Apple Academic Press products, visit our website at www.appleacademicpress.com and the CRC Press website at www.crcpress.com

CHEMISTRY AND PHYSICS OF MODERN MATERIALS

Processing, Production and Applications

ABOUT THE EDITORS

Jimsher N. Aneli, DSc

Jimsher N. Aneli, DSc, is a professor at the Institute of Machine Mechanics at Georgian Technical University of Tbilisi State University in Tbilisi, Georgia. He is a scientist in the field of chemistry and the physics of oligomers, polymers, composites, and nanocomposites. He is the author of over 250 scientific articles and inventions. His research interests include the technology of polymer composites with special designations, such as composites with electrical conducting and high mechanical properties; the creation of polymer chemically stable sensors with high sensitivity to mechanical deformations, temperature, electric, and magnetic fields; and hydrogen electric.

Alfonso Jiménez, PhD

Alfonso Jiménez, PhD, is currently a professor of analytical chemistry and food science and technology at the University of Alicante, in Spain since 2001. He is the Head of the Polymer and Nanomaterials Analysis Group. He has edited 13 books on polymer degradation, stabilization biodegradable, and sustainable composites and has written 67 research papers published in journals in the area of analytical chemistry and polymer science. He has chaired organizing committees for several international conferences on biopolymers and polymer chemistry, in particular BIOPOL-2007 and BIOPOL-2009 held in Alicante, Spain. His main research areas include chemical characterization of polymers and biopolymers, environmentally friendly additives in polymers, characterization of biodegradable polymers and sustainable composites, modification of PLA for flexible films manufacturing, natural antioxidants for active packaging, and TPUs obtained from vegetable oils.

Stefan Kubica, PhD

Stefan Kubica, PhD, is head of the research center at the Institute for Engineering of Polymer Materials & Dyes, which is a research institute with its headquarters in Torun, Poland. It has divisions at Gliwice, Piastow (formerly Rubber Research Institute "STOMIL") and Zgierz, Poland. Professor Stefan Kubica is world well-known specialist in the field of polymer investigation of properties and applications of low-molecular compounds, oligomers, composites and nanocomposites. Professor Kubica is a contributor and co-contributor in several monograph and has written about 150 original papers.

REVIEWERS AND ADVISORY BOARD MEMBERS

Gennady E. Zaikov, DSc

Gennady E. Zaikov, DSc, is Head of the Polymer Division at the N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Moscow, Russia, and professor at Moscow State Academy of Fine Chemical Technology, Russia, as well as professor at Kazan National Research Technological University, Kazan, Russia. He is also a prolific author, researcher, and lecturer. He has received several awards for his work, including the the Russian Federation Scholarship for Outstanding Scientists. He has been a member of many professional organizations and on the editorial boards of many international science journals.

A. K. Haghi, PhD

A. K. Haghi, PhD, holds a BSc in urban and environmental engineering from University of North Carolina (USA); a MSc in mechanical engineering from North Carolina A&T State University (USA); a DEA in applied mechanics, acoustics and materials from Université de Technologie de Compiègne (France); and a PhD in engineering sciences from Université de Franche-Comté (France). He is the author and editor of 65 books as well as 1000 published papers in various journals and conference proceedings. Dr. Haghi has received several grants, consulted for a number of major corporations, and is a frequent speaker to national and international audiences. Since 1983, he served as a professor at several universities. He is currently Editor-in-Chief of the International Journal of Chemoinformatics and Chemical Engineering and Polymers Research Journal and on the editorial boards of many international journals. He is also a faculty member of University of Guilan (Iran) and a member of the Canadian Research and Development Center of Sciences and Cultures (CRDCSC), Montreal, Quebec, Canada.

Alberto D'Amore, DSc

Alberto D'Amore, DSc, is currently Associate Professor of Materials Science and Technology at Second University of Naples-SUN in Rome, Italy. He has authored more than one hundred scientific papers published in international journals and books. He is a member of the scientific committees of many international conferences and is on the editorial boards of several international journals. Currently he is the Chairman of the International-Times of Polymers (TOP) and Composites conferences.

LIST OF CONTRIBUTORS

Alekseeva, O. M.

Institute of Biochemical Physics N. M. Emanuel Academy of Sciences, Russia, 119334, Moscow, st. Kosygin d.4. (495) 939-74-09, Email: olgavek@yandex.ru

Alinkina, E. S.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Moscow, 119334 Russia

Aloev, V. Z.

Kabardino-Balkarian State Agricultural Academy, Nal'chik – 360030, Tarchokov st., 1 a, Russian Federation

Altshuler, M. L.

FGBU I. Mechnikov Research Institute for Vaccines and Sera of RAMS. Moscow. 105064 Maliy Kazyonniy side. Fax: 8 (495) 916-11-52. e-mail: labpitsred@yandex.ru

Antonov, Y. A.

N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygin Str. 4. 119334 Moscow, Russia, Tel. +7(495)939-74-02; Fax:+7(495)137-41-01. e-mail: chehonter@yandex.ru

Aphashagova, Z. Kh.

Kabardino-Balkarian State University, Chernyshevskii st., 173, Nal'chik 360004, Russian Federation

Babkin, V. A.

403343 SF VolgSABU, c. Mikhailovka, region Volgograd, S.Michurina 21. E-mail:sfi@reg.avtlg.ru

Bazylyak, L. I.

Chemistry of Oxidizing Processes Division; Physical Chemistry of Combustible Minerals Department; Institute of Physical–Organic Chemistry & Coal Chemistry named after L. M. Lytvynenko; National Academy of Science of Ukraine, 3rd Naukova Str, Lviv–53, 79053, UKRAINE; e-mail: hop_vfh@ukr.net; bazylyak.L.I@nas.gov.ua

Bekusarova, S. A.

Gorsky State Agrarian University, Kirov str., 37, Vladikavkaz, Republic of North Ossetia Alania, Russia, ggau@globalalania.ru;

Belostotskaja, I. S.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Blinkova, L. P.

FGBU I. Mechnikov Research Institute for Vaccines and Sera of RAMS. Moscow. 105064 Maliy Kazyonniy side. Fax: 8 (495) 916-11-52. e-mail: labpitsred@yandex.ru

Bome, N. A.

Tyumen State University, Semakova str., 1, 625003, Tyumen, Russia, +7(3452) 46-40-61, 46-81-69. president@utmn.r

Burlakova, E. B.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Bychkova, A. V.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina str., 4, Moscow, 119334, Russia, E-mail: annb0005@yandex.ru

Chalykh, A. E.

Institute of physical chemistry and electrochemistry named by Frumkin, Leninsky prospect, 31, GSP-I, Moscow, 119991

Deberdeev, R. Ya.

Kazan State Technological University, ul. Karla Marksa 68, Kazan, Republic of Tatarstan, 420015 Russia

Derkach, S. A.

Mechnicov Institute of Microbiology and Immunology of Academy of Medical Sciences of Ukraine

Durlakova, T. B.

Emanuel Institute of Biochemical Physics of the Russian Academy of Science

Evlashkina, V. F.

FGBU I. Mechnikov Research Institute for Vaccines and Sera of RAMS. Moscow. 105064 Maliy Kazyonniy side. Fax: 8 (495) 916-11-52. e-mail: labpitsred@yandex.ru

Evteeva, N. M.

Institute of biochemical physics of N. M.Emanuelja of the Russian academy, Sciences, the Russian Federation, 119991 Moscow, Kosygina str. 4, Fax: 095 1374101.

Fatianova, E. A.

Katarína Valachová, Mária Baňasová, Ľubica Machová, Ivo Juránek, Štefan Bezek, Ladislav Šoltés Department "General and Inorganic chemistry", South-West State University, Kursk, Russia

Fatkullina, L. D.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina 4, Moscow, 119334 Russia

Fattakhov, S. G.

Arbuzov Institute of Organic and Physical Chemistry of the Russian Academy of Science

Generozova, I. P.

Timiryazev Institute of Plant Physiology of the Russian Academy of Science

Gerasimov, V. K.

Institute of physical chemistry and electrochemistry named by Frumkin, Leninsky prospect, 31, GSP-I, Moscow, 119991

Gumargalieva, K. Z.

N. N. Semenov Institute of Chemical Physics, RAS, Moscow

Gurchenkova, Y. A.

Sochi Institute of Russian people's friendship university, Kuibyshev str. 32, E-mail: sfrudn@rambler.ru, Fax +7 (8622) 411043.

Hadavi Moghadam, B.

Department of Textile Engineering, University of Guilan, Rasht, Iran

Haghi, A. K.

University of Guilan, Rasht, Iran, E-mail: Haghi@Guilan.ac.ir

Hasanzadeh, M.

Department of Textile Engineering, University of Guilan, Rasht, Iran, Tel.: +98-21-33516875; fax: +98-182-3228375, Email: m_hasanzadeh@aut.ac.ir

Jordanskii, A. L.

N. N. Semenov Institute of Chemical Physics, RAS, 4 street Kosygina, 4119991, Moscow

Ivanova, N. N.

Institute of Dermatology and Venerology of Academy of Medical Sciences of Ukrainestr. Chernishevskaya 7/9, 61057 Kharkov, Ukraine, e-mail: jet-74@mail.ru, fax +38-057- 706-32-03

Ivo Juránek

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia

Katarína Valachová

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia, Tel.: +421902303680. E-mail address: katarina.valachova@savba.sk

Kazakova, L. I.

Institute of Theoretical and Experimental Biophysics Russian Academy of Science, 142290 Pushchino, Moscow region 142290, Russia

Kharuta, L. G.

Sochi Institute of Russian people's friendship university, Kuibyshev str. 32, E-mail: sfrudn@rambler.ru, Fax +7 (8622) 411043.

Khokhriakov, N. V.

Izhevsk State Agricultural Academy, Basic Research and Educational Center of Chemical Physics and Mesoscopy, Udmurt Scientific Center, Ural Division, Russian Academy of Science, Russia, Izhevsk, 426000, e-mail: korablev@udm.net.

Khrapova, N. G.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Khrustova, N. V.

N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, 4 Kosygin Street, 119334 Moscow, Russia

Khuzakhanov, R. M.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Kirsh, I. A.

Moscow State University of Food Production, 33 Talalihin st. Moscow Russia 109316, kaf.vms@rambler.ru

Klodzinska, E.

Institute for Engineering of Polymer Materials and Dyes, 55 M. Sklodowskiej-Curie str., 87-100 Torun, Poland, E-mail: Ewa.Klodzinska@impib.pl

Kokov, L. S.

Sklifosovsky Research Institute for Emergency Medicine, Moscow

Korablev, G. A.

Izhevsk State Agricultural Academy, Basic Research and Educational Center of Chemical Physics and Mesoscopy, Udmurt Scientific Center, Ural Division, Russian Academy of Science, Russia, Izhevsk, 426000, E-mail: korablevga@mail.ru, biakaa@mail.ru

Kosenko, R. Yu.

N. N. Semenov Institute of Chemical Physics, RAS, 4 street Kosygina, 4119991, Moscow

Kotsar, E. V.

Institute of Dermatology and Venerology of Academy of Medical Sciences of Ukraine str. Chernishevskaya 7/9, 61057 Kharkov, Ukraine, e-mail: jet-74@mail.ru, fax +38-057- 706-32-03

Kovarski, A. L.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina str., 4, Moscow, 119334, Russia

Koverzanova, E. V.

N.N. Semenov Institute of Chemical Physics, RAS, Moscow

Kozlov, G. V.

Kabardino-Balkarian State Agricultural Academy, Nal'chik – 360030, Tarchokov st., 1 a, Russian Federation

Kozlova, Z. G.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 119334, Moscow, 4 Kosygin St. E-mail: yevgeniya-s@inbox.ru, fax: (495) 137-41-01

Kozlova, N. I.

Sochi Institute of Russian people's friendship university, Kuibyshev str. 32, E-mail: sfrudn@rambler.ru, Fax +7 (8622) 411043.

Krikunova, N. I.

Emanuel Institute of Biochemical Physics of the Russian Academy of Science

Kubica, S.

Institute for Engineering of Polymer Materials and Dyes, 55 M. Sklodowskiej-Curie str., 87-100 Torun, Poland, Email: S.Kubica@impib.pl

Kushnireva, Ye. V.

N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, 4 Kosygin Street, 119334 Moscow, Russia

Kuvardin, N. V.

Department "General and Inorganic chemistry", South-West State University, Kursk, Russia

Kytsya, A.R.

Chemistry of Oxidizing Processes Division; Physical Chemistry of Combustible Minerals Department; Institute of Physical–Organic Chemistry & Coal Chemistry named after L. M. Lytvynenko; National Academy of Science of Ukraine, 3rd Naukova Str., Lviv–53, 79053, UKRAINE; e-mail: hop_vfh@ukr.net; bazyljak.L.I@nas.gov.ua

Ladislav Šoltés

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia

Leonova, V. B.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina str., 4, Moscow, 119334, Russia

Lomakin, S. M.

Establishment of the Russian Academy of Sciences Institute of biochemical physics of N.M.Emanuelja, 119991 Moscow, Kosygina str. 4, Fax: (095 1374101

Lubica Machová

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia

Luschenko, G. V.

North Caucasus Research Institute of mountain and foothill agriculture, Williams's str, 1, 391502, Mikhailovskoye, Republic of North Ossetia Alania, Russia, t/f +7(8672) 73-03-40

Maedeh Sajedi

Textile Engineering department, Faculty of Engineering, University of Guilan, Rasht P.O.BOX 3756, Guilan, Iran

Magomedov, G. M.

Dagestan State Pedagogical University, Yaragskii st., 57, Makhachkala 367003, Russian Federation

Mahmood Saberi Motlagh

Textile Engineering department, Faculty of Engineering, University of Guilan, Rasht P.O.BOX 3756, Guilan, Iran

Makhrova, N. V.

Kazan State Technological University, ul. Karla Marksa 68, Kazan, Republic of Tatarstan, 420015 Russia

Malamatov, A. Kh.

Kabardino-Balkarian State University, Chernyshevskii st., 173, Nal'chik 360004, Russian Federation

Mária Baňasová

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia

Mavrov, G. I.

Institute of Dermatology and Venerology of Academy of Medical Sciences of Ukraine str. Chernishevskaya 7/9, 61057 Kharkov, Ukraine, e-mail: jet-74@mail.ru, fax +38-057- 706-32-03

Medvedeva, I. B.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, ul. Kosygina 4, Moscow, 119334 Russia

Misharina, T. A.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, ul. Kosygina 4, Moscow, 119334 Russia, Email: e-mail: tmish@rambler.ru

Misin, V. M.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Nikiforov, G. A.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Nikiforova, O. V.

FGBU I. Mechnikov Research Institute for Vaccines and Sera of RAMS. Moscow. 105064 Maliy Kazyonniy side. Fax: 8 (495) 916-11-52. e-mail: labpitsred@yandex.ru

Niyazy, F. F.

Department "General and Inorganic chemistry", South-West State University, Kursk, Russia, Email: FarukhNiyazi@yandex.ru

Olkhov, A. A.

Moscow State Academy of Chemical Technology of M.V. Lomonosov, 119571 Moscow, prosp. Vernadskogo, 86, Email: aolkhov72@yandex.ru

Pakhomov, Y. D.

FGBU I. Mechnikov Research Institute for Vaccines and Sera of RAMS. Moscow. 105064 Maliy Kazyonniy side. Fax: 8 (495) 916-11-52. e-mail: labpitsred@yandex.ru

Pomogova, D. A.

Moscow State University of Food Production, 33 Talalihin st. Moscow Russia 109316

Remizov, A. B.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Rosenfeld, M. A.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina str., 4, Moscow, 119334, Russia

Rusanova, S. N.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Rybalko, A. E.

Sochi Institute of Russian people's friendship university, Kuibyshev str. 32, E-mail: sfrudn@rambler.ru, Fax +7 (8622) 411043.

Sechko, E. V.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Shabarchina, L. I.

Institute of Theoretical and Experimental Biophysics Russian Academy of Science, 142290 Pushchino, Moscow region 142290, Russia, E-mail: shabarchina@rambler.ru

Shishkina, L. N.

N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, 4 Kosygin Street, 119334 Moscow, Russia. E-mail: shishkina@sky.chph.ras.ru

Shtol'ko, V. N.

Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, 4 Kosygin Street. 119334 Moscow, Russia

Shugaev, A. P.

Timiryazev Institute of Plant Physiology of the Russian Academy of Science

Simonova, Yu. S.

Moscow State Academy of Chemical Technology of M.V. Lomonosov, 119571 Moscow, prosp. Vernadskogo, 86, Email: aolkhov72@yandex.ru

Skipina, K. P.

Sochi Institute of Russian people's friendship university, Kuibyshev str. 32, E-mail: sfrudn@rambler.ru, Fax +7 (8622) 411043.

Sofina, S. Ju.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Sogrina, D. A.

Moscow State University of Food Production, 33 Talalihin st. Moscow Russia 109316

Sorokina, O. N.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygina str., 4, Moscow, 119334, Russia

Starostina, I. A.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015

Štefan Bezek

Institute of Experimental Pharmacology and Toxicology, Slovak Academy of Sciences, Bratislava 84104, Slovakia

Stoyanov, O. V.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015, Email: ov_stoyanov@mail.ru

Stoyanova, L. F.

Kazan State Technological University, K.Marx, 68, Kazan, Tatarstan, Russia, 420015, Email: ov_stoyanova@mail.ru

Sukhorukov, G. B.

School of Engineering & Materials Science, Queen Mary University of London, London, UK.

Terenina, M. B.

Emanuel Institute of Biochemical Physics of the Russian Academy of Science

Titova, M. I.

A. V. Vishnevsky Institute of Surgery, Moscow

Turovsky, A. A.

Chemistry & Biotechnology of Combustible Minerals Division; Physical Chemistry of Combustible Minerals Department; Institute of Physical–Organic Chemistry & Coal Chemistry named after L. M. Lytvynenko; National Academy of Science of Ukraine, 3rd Naukova Str., Lviv–53, 79053, UKRAINE
e-mail: hop_vfh@ukr.net

Tzomatova, F. T.

North Caucasus Research Institute of mountain and foothill agriculture, Williams's str, 1, 391502, Mikhailovskoye, Republic of North Ossetia Alania, Russia, t/f +7(8672) 73-03-40

Usachev, S. V.

N. N. Semenov Institute of Chemical Physics, RAS, Moscow

Usmanova, R. R.

Ufa State technical university of aviation; 12 Karl Marks str., Ufa 450000, Bashkortostan, Russia, E-mail: Usmanovarr@mail.ru

Vahid Mottaghtalab

Textile Engineering department, Faculty of Engineering, University of Guilan, Rasht P.O.BOX 3756, Guilan, Iran

Vasiliev, Yu. G.

Izhevsk State Agricultural Academy, Basic Research and Educational Center of Chemical Physics and Mesoscopy, Udmurt Scientific Center, Ural Division, Russian Academy of Science, Russia, Izhevsk, 426000, E-mail: korablev@udm.net.

Volodkin, A. A.

Establishment of the Russian Academy of Sciences Institute of biochemical physics of N.M.Emanuelja, 119991 Moscow, Kosygina str. 4, Fax: (095 1374101

Vorobyeva, A. K.

Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, ul. Kosygina 4, Moscow, 119334 Russia

Weisfeld, L. I.

N.M. Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, Kosygina str., 4, 119334, Moscow, Russia, chembio@sky.chph.ras.ru;

Yakh'yaeva, Kh. Sh.

Dagestan State Pedagogical University, Yaragskii st., 57, Makhachkala 367003, Russian Federation

Yanovsky, Yu. G.

Institute of Applied Mechanics of Russian Academy of Sciences, Leninskii pr., 32 A, Moscow-119991, Russian Federation

Zaikov, G. E.

Kinetics of Chemical & Biological Processes Division; Institute of Biochemical Physics named after N. N. Emanuel; Russian Academy of Sciences, 4 Kosygin Str., Moscow, 119991, Russia; e-mail: chembio@sky.chph.ras.ru

Zakharov, D. S.

403343 SF VolgSABU, c. Mikhailovka, region Volgograd, S.Michurina 21. E-mail:sfi@reg.avtlg.ru

Zhigacheva, I. V.

Emanuel Institute of Biochemical Physics of the Russian Academy of Science, Email: zhigacheva@mail.ru

Zhirikova, Z. M.

Kabardino-Balkarian State Agricultural Academy, Nal'chik – 360030, Tarchokov st., 1 a, Russian Federation

Zhuravleva, I. L.

N. M. Emanuel Institute of Biochemical Physics, Russian Academy of Sciences, Kosygin Str. 4, 119334 Moscow, Russia