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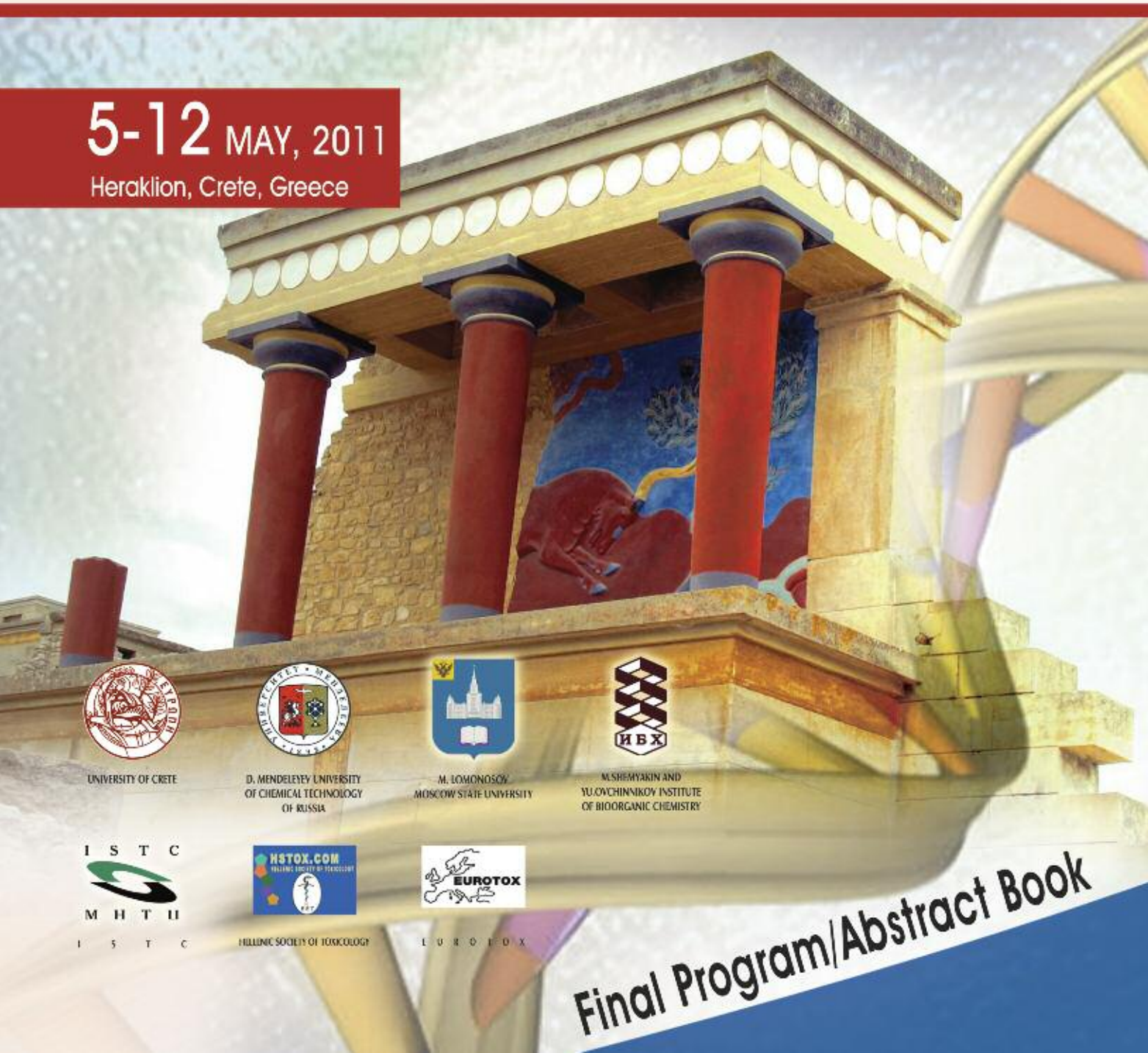
"BIOMATERIALS AND BIONANOMATERIALS:
RECENT ADNANCES AND SAFETY - TOXICOLOGY ISSUES"

2nd Russian - Hellenic Symposium with International Participation and Young Scientist's School

5-12 MAY, 2011

Heraklion, Crete, Greece



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Final Program/Abstract Book

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UNIVERSITY OF CRETE

D. MENDELEYEV UNIVERSITY OF CHEMICAL TECHNOLOGY OF RUSSIA

HELLENIC SOCIETY OF TOXICOLOGY

Welcome Letter

On behalf of the organizing committee of the 2nd Russian – Hellenic Symposium on Polymeric Biomaterials and Bionanomaterials: Recent Advances Safety and Toxicology Issues, we are privileged to invite you to grace with your presence and participation the works of the Symposium, which is to be held in Heraklion, in the beautiful island of Crete, in May 2011.

The theme of the Symposium concerns one of the most progressing directions of science and technology. BioNanoToxicology Issues lie at the interface of many disciplines, ranging from biology to chemistry, toxicology, computational science chemistry, nanotechnology and biotechnology. The Symposium is a continuation of a long term co-operation between Russian and Hellenic scientists in this field that has been ongoing for the last 20 years, in the frame of the bilateral scientific state programs.

The International Advisory Board of the Symposium is chaired by the president of the D. Mendeleyev University of Chemical Technology of Russia, Academician of the Russian Academy of Sciences, P. D. Sarkisov, and the Rector of the University of Crete, world-wide known Professor of Ophthalmology Ioannis Palikaris and the Vice Rector of M. Lomonosov Moscow State University, Academician of the Russian Academy of Sciences, A.R. Khokhlov.

It is anticipated that scientists from the Russian Academy of Science, the most prominent Universities as well as Technological Institutes and Companies and distinguished field specialists coming form many countries will attend the symposium. Reduced registration rates were provided, in order to enable more young scientists to attend the Symposium.

At this symposium the attendee will have the chance to meet important representatives of research in the field, discuss with them and exchange ideas. This will accomplish the aim of the symposium, which is the generation of new and vigorous interactions between the different aforementioned disciplines, which will have enormous positive effects in our societies.

We welcome you in Crete and we wish you a pleasant stay enjoying the smiling Cretan sun, the sounds of the Cretan lyre, the scents of orange blossom and jasmine, a slice of cool red watermelon and a glass of iced raki.

Co-Chairmen of the Organizing Committee

Aristidis Tsatsakis, PhD, DSc, ERT

Mikhail Shtilman, PhD, DSc

Committees

Co-President	Co-President	Co-President
Palikaris Ioannis	**Sarkisov Pavel**	**Khokhlov Alexey**

International Advisory Board

Co-President	Palikaris Ioannis	Professor, Rector of the University of Crete, Iraklion, Greece
Co-President	Sarkisov Pavel	Academician of RAS, President of D. Mendeleyev University of Russia, Moscow, Russia
Co-President	Khokhlov Alexey	Academician of RAS, Vice-Rector of M. Lomonosov Moscow State University, Moscow, Russia
	Berlin Alexander	Academician of RAS, Director of N. Semenov Institute of Chemical Physics of RAS, Moscow, Russia
	Kabanov Alexander	Professor, Director of Center for Drug Delivery and Nanomedicine, University of Nebraska, Omaha, USA
	Lappas Alexander	Principal Researcher, Foundation for Research and Technology, Crete
	Neufeld Ron	Professor, Queen's University, Kingston, Ontario, Canada
	Ozerin Alexander	Corresponding member of RAS, Director of N. Enikolopov Institute of Synthetic Polymeric Materials of RAS, Moscow, Russia
	Panarin Eugenii	Corresponding member of RAS, Director of Institute of Macromolecular Compounds of RAS, St. Petersburg, Russia
	Rizos Apostolos	Professor, Department of Chemistry, University of Crete, Iraklion, Greece
	Tkachuk Vsevolod	Academician of RAS and RAMS, Dean of Faculty of Fundamental Medicine, M. Lomonosov Moscow State University, Moscow, Russia
	Torchilin Vladimir	Professor, Director of Center of Pharm. Biotech & Nanomedicine, Northeastern University, Boston, USA
	Tsakalof Andreas	Professor, Medical Chem. Dep., University of Thessaly, Larissa, Greece
	Varfolomeev Sergey	Corresponding member of RAS, Director of N. Emanuel Institute of Biochemical Physics of RAS, Moscow, Russia
	Ulbrich Karel	Professor, Head of Dept. of Biomedicinal Polymers, Institute of Macromolecular Chemistry, Prague, Czech Republic
	Zezin Alexander	Corresponding member of RAS, Head of Chair, M. Lomonosov Moscow State University, Moscow, Russia

Organizing Committee

Co-Chairman of Symposium Tsatsakis Aristidis	Professor, Director of Forensic Sciences & Toxicology Dep., University of Crete, Iraklion, Greece
Co-Chairman of Symposium Shtilman Mikhail	Professor, Head of Center “Biomaterials”, D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia
Eremin Sergey	Professor, M.Lomonosov Moscow State University, Moscow, Russia
Klyachko Natalia	Professor, M.Lomonosov Moscow State University, Moscow, Russia
Markvicheva Elena	Professor, M.Shemyakin-Yu.Ovchinikov Institute of Bioorganic Chemistry, Moscow, Russia
Shashkova Irina	PhD, Senior scientific worker, D.Mendeleyev University of Chemical Technology of Russia, Moscow, Russia
Shishatskaya Ekaterina	Professor, Head of Chair Medical Biology, Siberian Federal University, Krasnoyarsk, Russia
Tsatzarakis Manolis	PhD, Senior scientific worker, University of Crete, Iraklion, Greece

Scientific program

Thursday, May 5, 2011

Arrival – Registration	
20.00	Welcome Cocktail

Friday, May 6, 2011

08.00-09.00	Breakfast
10.00	**OPENING CEREMONY**
10.00-10.10	**WELCOME ADDRESS** **A. M. Tsatsakis, Co-chairman of the Organizing Committee** *University of Crete, Heraklion, Crete, Greece*
10.10-10.20	**WELCOME ADDRESS** **I. Palikaris, Co-President of the Symposium** *University of Crete, Heraklion, Crete, Greece*
10.20-10.30	**WELCOME ADDRESS** **P. Sarkisov, Co-President of the Symposium** *D.Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
10.30-10.40	**PRESENTATION OF THE SYMPOSIUM PROGRAM** **M. I. Shtilman, Co-chairman of the Organizing Committee** *D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
10.40-11.10	**OPENING LECTURE** **POLYMER MICELLES FOR DRUG DELIVERY FROM BENCH TO BESIDE** **A. V. Kabanov** *University of Nebraska, Omaha, USA*
11.10-11.30	Coffee break, Poster session
11.30-13.00	***MORNING SESSION***
	Chairmen: Prof. A. Kabanov, Prof. P. Sarkisov
11.30-12.00	**DEVELOPMENT OF HIERARHICALLY STRUCTURED SMART SURFACES** **S. H. Anastasiadis** *Institute of Electronic Structure and Laser University of Crete, Heraklion, Greece*

12.00-12.30 **BIONANOMATERIALS FOR GENE AND CELL THERAPY OF ISCHEMIC DESEASE**
V. A. Tkachuk
Lomonosov Moscow State University, Moscow, Russia

12.30-13.00 **NATURAL AND ARTIFICAL CONSTRUCTIONAL MATERIALS**
A. Al. Berlin
N. Semenov Institute of Chemical Physics, RAS, Moscow, Russia

13.00-14.00 Lunch

14.00-16.00 Break

16.00-17.50 ***EVENING SESSION - Young Scientists Session. 1.***

Chairmen: Prof. S. Eremin, Prof. E. Markvicheva

16.00-16.10 **IDENTIFICATION OF FUNCTIONAL DETERMINANTS ENCODED IN THE SURFACE OF NATURAL PEPTIDE TOXINS**
A.A. Polyansky[1,2], A.O. Chugunov[1], B. Zagrovic[2], R.G. Efremov[1]
[1]M.M. Shemyakin and Yu.A. Ovchinnikov Institute of Bioorganic Chemistry, RAS, Moscow, Russia
[2]Laboratory of Computational Biophysics Department of Structural and Computational Biology Max F. Perutz Laboratories, Vienna, Austria

16.10-16.20 **DEVELOPMENT OF SCREENING METHOD FOR THE DETERMINATION OF FLUOROQUINOLONES IN ANIMAL PRODUCT**
I.S. Nesterenko[1,2], A.V. Zhukov[1], E.S. Vylegzhanina[1], A.A. Komarov[1], A.N. Panin
[1]The All-Russian State Center for Quality and Standardization of Veterinary Drugs and Feeds, Moscow, Russia
[2] Department of Chemical Enzymology, Faculty of Chemistry, M. Lomonosov Moscow State University, Moscow, Russia

16.20-16.40 **ANALYTICAL APPLICATIONS OF SELF-ASSEMBLING PEROXIDASE-CHITOSAN AND PEROXIDASE-GELATIN FILMS AS THE BASIS FOR OPTICAL BIOSENSORS**
I.A. Veselova, L.V. Malinina, P.V. Rodionov, T.N. Shekhovtsova
Analytical Chemistry Division Chemistry Department of Lomonosov Moscow State University, Moscow, Russia

16.40-16.50 **MICROENCAPSULATED TUMOR SPHEROIDS AS AN IN VITRO CELL BASED ASSAY FOR ANTICANCER DRUG SCREENING**
D. Zaytseva-Zotova[1], M. Drozdova[1], T. Yuablokova[2], I. Chevalot[3], A. Marc[3], S. Burov[2], E. Markvicheva[1]
[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, Moscow, Russia
[2]Institute of Macromolecular Compounds, St-Petersburg, Russia
[3]ENSAIA-INPL, Nancy Universite, Vandoeuvre-lès-Nancy, France

16.50-17.00 **MACROPOROUS SCAFFOLDS BASED ON MODIFIED POLY(VINYLALCOHOL) FOR TISSUE ENGINEERING: CYTOTOXICITY STUDY**
M. Drozdova[1], D. Zaytseva-Zotova[1], R. Akasov[1], A. Golunova[2], M. Semenikhina[2], A. Artyukhov[2], E. Andreeva[3], M. Shtilman[2], E. Markvicheva[1]
[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, Moscow, Russia
[2]D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia
[3]Institute of Bio-Medical Problems RAS, Moscow, Russia

17.00-17.10 **POLYELECTROLYTE NANOCAPSULES DOPED WITH HIGHLY LUMINESCENT EUROPIUM(III) COMPLEXES**
R. Zairov[1], M. Gruner[2], D. Tatarinov[1], A. Ibragimova[1], I. R. Nizameev[1], A. Mustafina[1], A. Konovalov[1]
[1]A.E.Arbuzov Institute of Organic and Physic Chemistry, Kazan, Russia
[2]Dresden Technological University, Dresden, 01062, Germany

17.10-17.20 **IMMUNOCHROMATOGRAPHIC TESTS FOR THE DETECTION OF SEVEN GROUPS OF DRUGS OF ABUSE IN ORAL FLUID**
S.V. Morozov, V. Morozova, R. Kiseleva, V. Pushkina S. Petrochenko, M. Myagkova
Moscow Research and Practical Center for Narcology of Moscow Health Department, Moscow, Russia

17.20-17.30 **MEMBRANE CHROMATOGRAPHY VS COLUMN CHROMATOGRAPHY: THE POTENTIAL USE FOR THE PROTEIN AND POLYPEPTIDE PURIFICATION**
N. Brykova[1], D. A. Gusarov[2], D. I. Bairamashvili[2]
[1]M. V. Lomonosov Moscow State Academy of Fine Chemical Technology, Moscow, Russia
[2]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry, Moscow, Russia

17.30-17.40 **FLUORESCENCE POLARIZATION IMMUNOASSAY FOR THE EXPRESS DETECTION OF BISPHENOL A**
K.A. Maksimova[1], S.A. Eremin[1], R. Abuknesha[2]
[1]Department of Chemical Enzymology, Faculty of Chemistry, M. V. Lomonosov Moscow State University, Moscow, Russia
[2]Division of Life Sciences, King's College University of London, London, UK

17.40-17.50 **EXPRESS DETECTION OF MYCOPHENOLIC ACID IN SERUM USING METHOD OF FLUORESCENCE POLARIZATION IMMUNOASSAY**
A.P. Bondarenko, S.A. Eremin
Department of Chemical Enzymology, Faculty of Chemistry M. V. Lomonosov Moscow State University, Moscow, Russia

18.00-19.00 Break

19.00-20.00 Dinner

Saturday, May 7, 2011

08.00-09.00 Breakfast

09.45-13.30 ***MORNING SESSION***

Chairmen: Prof. P. Kopechkova, Prof. V. Tkachuk

09.45-10.15 **FIBERS AND NANOCOMPOSITES BASED ON BIODEGRADABLE BACTERIAL POLYESTERS**
E.M. Antipov[1], A.V. Rebrov[2], V.A. Gerasin[2]
[1]Mendeleev University of Chemical Technology, Moscow, Russia
[2]Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, Moscow, Russia

10.15-10.45 **SMART BIOMATERIALS AND DRUG DELIVERY SYSTEMS**
J. Kopecek & P. Kopeckova
University of Utah, Salt Lake City, USA

10.45-11.15 **POTENTIAL OF SYNTHETIC POLYMERS IN TARGETED DRUG AND GENE DELIVERY**
K. Ulbrich[1], T. Etrych[1], P. Chytil[1], M. Pechar[1], L. Kostka[1], V. Šubr, B. Říhová[2]
[1]Institute of Macromolecular Chemistry v.v.i., Academy of Sciences of the Czech Republic, 162 06 Prague 6, Czech Republic. E-mail:ulbrich@imc.cas.cz
[2]Institute of Microbiology v.v.i., Academy of Sciences of the Czech Republic, Videnska 1083, 142 20 Prague 4, Czech Republic

11.15–11.30	Coffee break, Poster session
	Chairmen: Prof. J. Kopechek, Prof. K.Ulbrich,
11.30-12.00	**ENCAPSULATION USING ALGINATE: DIFFERENT APPROACHES** **D. Poncelet** *ONIRIS, UMR CNRS GEPEA 6144, Nantes, France*
12.00-12.30	**DESIGN OF SOFT NANOMATERIALS FOR DRUG DELIVERY: OPPORTUNITIES AND CHALLENGES** **T. Bronich** *University of Nebraska, Omaha, USA*
12.30-13.00	**TRANSPORT IN BIODEGRADABLE COMPOSITES BASED ON POLYHYDROXYALKANOATES: FROM BARRIER MATERIALS TO MICROPARTICLES FOR DRUG DELIVERY** **A. L. Iordanskii[1], A.P. Bonartsev[2], S.Z. Rogovina[1], S.G. Karpova[1], M.I. Shtilman[3], E.A. Zhukova[3],** *[1]N. Semenov Institute of Chemical Physics, RAS, Moscow, Russia,* *[2]M. Lomonosov Moscow State University, Biological Department, Moscow, Russia,* *[3]D. Mendeleyev University of Chemical Technology of Russia, Moscow)*
13.00-13.30	**COMPUTER SIMULATIONS OF TRANSMEMBRANE HELICAL DIMERS: FROM STRUCTURE TO FUNCTIONING** **P.E. Volynsky, G.N. Fakhrutdinova, A.A Polyansky, R.G. Efremov** *Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry RAS, Moscow, Russia*
13.30-14.30	Lunch
14.30-16.00	Break
16.00-17.40	***EVENING SESSION – Young Scientists Session. 2.***
	Chairmen: Prof. N. Klyachko, Prof. Yu. Golovin
16.00-16.10	**CRYSTALLIZATION AND PORE STRUCTURE FORMING OF CALCIUM-PHOSPHATE GLASS-CERAMIC BIOMATERIALS** **N.V. Buchilin, E.E. Stroganova, N.Yu. Mikhailenko** *D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
16.10-16.20	**WATER SOLUBLE POLYMERIC PLANT GROWTH REGULATORS AS CONTROLLED RELEASE SYSTEMS** **A.A. Dobrynin, D.S. Komissarov, I.M. Shashkova, M.I. Shtilman** *D. I. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
16.20-16.30	**POLYANILINE AND POLYPYRROLE COMPLEXES - THE NEW WATER SOLUBLE MATERIALS FOR MEDICO-BIOLOGICAL USE** **Y.O. Mezhuev, Yu.V. Korshak, M.I. Shtilman, A.I. Piskareva** *D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
16.30-16.40	**NOVEL AMPHIPHILIC POLYMERS FOR MEDICINE AND BIOTECHNOLOGY** **A.V. Goryachaya, A.N. Kuskov, S.O. Lukin, P.P. Kulikov, M.I. Shtilman** *D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia*
16.40-16.50	**CROSSLINKED MACROPOROUS HYDROGEL OF POLYVINYL ALCOHOL FOR MEDICINE AND BIOTECHNOLOGY** **A.A. Artyukhov[1], D.E. Lesovoy[2], A.S. Golunova[1], A.P. Fomina[1], M. I. Shtilman[1]** *[1]D.Mendeleyev University of Chemical Technology of Russia, Moscow, Russia* *[2]Faculty of Fundamental Medicine, Lomonosov Moscow State University, Moscow, Russia*

16.50-17.00 **MACROPOROUS POLYMER HYDROGEL MATRICES TAILORED FOR CELL GROWTH PROMOTION**
A.S. Golunova[1], D.S. Zaytseva-Zotova[2], M.A. Semenikhina[1], M.G. Drozdova[2], R.A. Akasov[1,2], A.A. Artyukhov[1], E.A. Markvicheva[2], M.I. Shtilman[1]
[1]Mendeleyev University of Chemical Technology of Russia, Moscow, Russia
[2]Shemyakin and Ovchinnikov Institute of Bioorganic Chemistry, RAS

17.00-17.10 **MACROPOROUS HYDROGELS BASED ON STARCH DERIVATIVES**
A.P. Fomina[1], A.A. Artyukhov[1], D.E. Lisovyy[2], M.I. Shtilman[1]
[1]D. I. Mendeleyev University of Chemical Technology of Russia, Research and teaching center "Biomaterials" 125047, Moscow, Miusskaya Square, 9
[2]M. V. Lomonosov Moscow State University, Faculty of fundamental medicine, 117192 Moscow, Lomonosov Prospect ,House 31, Building 5

17.10-17.20 **CHITOSAN/POLYESTER COPOLYMERS PREPARED BY SOLID-STATE SYNTHESIS AS PROMISING BIOMATERIALS**
T. Demina[1], T. Akopova[1], A. Tsoy[3], C. Grandfils[2], E. Markvicheva[3], A. Zelenetskii[1]
[1]Enikolopov Institute of Synthetic Polymer Materials, RAS, Moscow, Russia
[2]Centre Interfacultaire des Biomaderiaux University of Liège, Chemistry Institute Liege (Sart-Tilman), Belgium
[3]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry, RAS, Moscow, Russia

17.20-17.30 **EXAMPLES OF LIPOPLEX MORPHOLOGY INFLUENCE ON TRANSFECTION EFFICIENCY**
A. S. Alekseeva[1], M. A. Maslov[2], I. A. Boldyrev[1]
[1]Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry, RAS, Moscow, Russia
[2]Lomonosov State Academy of Fine Chemical Technology, Moscow, Russia

17.30-17.40 **SHORT-CHAIN POLYMERIZABLE LIPID AS A BUILDING BLOCK FOR POTENTIAL DRUG CARRIERS**
I.A. Boldyrev
Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry RAS, Moscow, Russia

17.40-19.00 Break

19.00-20.00 Dinner

Sunday, May 8, 2011

08.00-09.00 Breakfast

09.45-13.30 ***MORNING SESSION***

Chairmen: Prof. A. Berlin, Prof. D. Poncelet

09.45-10.15 **SMART POLYMERS**
A. R. Khokhlov, Co-President of the Symposium
Lomonosov Moscow State University, Moscow, Russia

10.15-10.45 **LASER-ABLATIVE SYNTHESIS OF ULTRA-CLEAN COLLOIDAL NANOMATERIALS FOR BIOLOGICAL APPLICATIONS**
A. V. Kabashin
Laboratoire LP3 Faculté des Sueuces de Luminy,Mediterranean University, Marseille, France

10.45-11.15	**FATE AND TOXICITY ASSESSMENT OF NANOPARTICULATE DRUG CARRIER COMPLEX DELIVERING ORAL INSULIN** **R.J. Neufeld[1], C. Pinto Reis[1,2], C. Woitiski[1,2], B. Sarmento[3], and F. Veiga[2]** *[1]Queen's University, Kingston, Ontario, Canada, [2]University of Coimbra, Portugal* *[3]University of Porto, Portugal*
11.15-11.30	Coffee break, Poster session
	Chairmen: Prof. R. Neufeld, Prof. A. Tsatsakis
11.30-12.00	**BIONANOMATERIALS – TOXICOLOGICAL ISSUE – PATHOLOGY** **St. E. Theocharis** *University of Athens, Athens, Greece*
12.00-12.30	**MOLECULARLY IMPRINTED POLYMERS AND THEIR APPLICATIONS IN DRUG DISCOVERY** **A. K. Tsakalof** *University of Thessaly, Larissa, Greece*
12.30-13.00	**NANOMATERIALS ON THE MARKET** **Ch. Tsitsimpikou** *MSc, PhD, General Chemical State Laboratory, Division of Environment, Section of Dangerous Compounds, Compositions and Articles, Athens, Greece*
13.00-13.30	**ASSESSMENT OF EXPOSURE AND RISKS FROM BIONANOMATERIALS** **J. Liesivuori, past-President EUROTOX** *Finnish Institute of Occupational Health, Turku, Finland*
13.30-14.30	Lunch
14.30-16.00	Break
16.00-18.00	***EVENING SESSION***
	Chairmen: Prof. S. Burov, Prof. E. Shishatskaya
16.00-16.30	**SELF-ASSEMMBLING ANTIVIRALS AGAINST INFLUENZA** **A. A. Chinarev[1], A.B. Tuzikov[1], A.S. Gambaryan[2], N.V. Bovin[1]** *[1]Shemyakin & Ovchinikov Institute of Bioorganic Chemistry, Moscow, Russia* *[2]Chumakov Institute of Polyomyelitis and Viral Encephalitis, Moscow, Russia*
16.30-17.00	**IMMOBILIZED ENZYMATIC REAGENT FOR BIOLUMINESCENT ECOLOGICAL MONITORING** **E. Esimbekova[1,2], V. Kratasyuk[2]** *[1]Institute of Biophysics, Krasnoyarsk, Russia,* *[2]Siberian Federal University, Krasnoyarsk, Russia*
17.00-17.30	**MODELS OF ENZYMES' FUNCTIONING INSIDE THE LUMINOUS BACTERIA USING BIO-MATERIALS: NEW APPROACH FOR APPLICATION IN BIOENGINEERING** **V. Kratasyuk[1,2] , E. Esimbekova[2,1], E. Nemtseva[1,2], I. Sukovataya[1]** *[1]Siberian Federal University, Krasnoyarsk, Russia* *[2]Institute of Biophysics, Siberian Branch of Russian Academy of Sciences, Krasnoyarsk, Russia*
17.30-18.00	**STIMULI RESPONSIVE LANTHANIDE DOPED NANOPARTICLES** **A.R. Mustafina** *A.E. Arbuzov Institute of Organic and Physical Chemistry, Kazan Scientific Center Russian Academy of Sciences, Kazan Russia*
18.00-19.00	Break
19.00-20.00	Dinner

Monday, May 9, 2011

08.00-09.00 Breakfast

10.00-14.00 ***MORNING SESSION***

Chairmen: Prof. T. Bronich, Prof. M. Shtilman

09.45-10.15 **BIOMATERIALES IN BIOANALYSIS METHODS**
S. A. Eremin
Department of Chemical Enzymology Faculty of Chemistry, M.V. Lomonosov Moscow State University, Moscow, Russia

10.15-10.45 **DEVELOPMENT OF MAGNETITE COLLOIDAL NANOCLUSTERS AS MRI CONTRAST AGENTS**
A. Kostopoulou[1,2], K.P.V. Sabareesh[3,4], T. Kalaivari[3,5], A. Lascialfari[3,4,5], A. Douvalis[6], L. Manna[7], A. Lappas[1]
[1]Institute of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Heraklion, Greece
[2]University of Crete, Heraklion, Greece
[3]Universita' degli Studi di Milano, and INSTM, Milano, Italy
[4]Universita' degli Studi di Pavia, Pavia, Italy
[5]CNR-Istituto di Nanoscienze, Modena, Italy
[6]University of Ioannina, Ioannina, Greece
[7]Instituto Italiano di Tecnologia, Genova, Italy

10.45-11.15 **DESIGN OF DRUG DELIVERY SYSTEMS USING HYDRAZONE CHEMICAL LIGATION**
S. V. Burov[1], P.S. Chelushkin[1], M.V. Leko[1], T.V. Yablokova[1], M.Yu. Dorosh[1], S.V. Orlov[2], S.N. Morozkina[2], A.G. Shavva[2]
[1]Institute of Macromolecular Compounds, St-Petersburg, Russia
[2]St-Petersburg State University, St-Petersburg, Russia

11.15-11.30 Coffee break, Poster session

Chairmen: Prof. E. Antipov, Prof. S. Rogovina

11.30-12.00 **BIODEGRADABLE MICROCARRIERS WITH ENTRAPPED PEPTIDES FOR TISSUE ENGINEERING**
E. Markvicheva[1], A. Tsoy[1], I. Prudchenko[1], C. Grandfils[2]
[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chem., Stn RAS, Moscow, Russia
[2]Interfacultary Research Centre on Biomaterials, University of Liège, Chemistry Institute CEIB Liège (Sart-Tilman), Belgium

12.00-12.30 **EVALUATION OF BIOCOMPATIBILITY OF NATURAL POLYMERS**
E. I. Shishatskaya
Siberian Federal University Krasnoyarsk, Russia

12.30-13.00 **POLYUNSATURATED FATTY ACIDS IN DIFFERENT FISH PRODUCTS AND BENEFIT-RISK RATIO OF FISH INTAKE IN HUMAN NUTRITION**
V. Morgun
Krasnoyarsk Centre for Metrology and Standardization, Krasnoyarsk, Russia

13.00-13.30 **EXPERIENCE OF SIBERIAB FEDERAL UNIVERSITY IN THE BIOLOGY TEACHING TRAINING OF SPECIALISTS IN BIOMATERIALS SCIENCE**
V. A. Sapojnikov
Siberian Federal University, Institute of Fundamental Biology and Biotechnology, Krasnoyarsk, Russia

13.30-14.00 **DEGRADATION OF POLYHYDROXYALKANOATES IN A FRESHWATER RESERVOIR**
M.I. Gladyshev[1,2], T.G. Volova[1,2], M.Y. Trusova[2], N.O. Zhila[2]
[1]Siberian Federal University, Svobodny av. 79, Krasnoyarsk 660041, Russia
[2]Institute of Biophysics of Siberian Branch of Russian Academy of Sciences, Akademgorodok, Krasnoyarsk 660036, Russia

14.00-15.00 Lunch

15.00-15.30 Break

15.30-19.00 ***EVENING SESSION***

Chairmen: Prof. V. Morgun, Prof. V. Sapojnikov

15.30-16.00 **APPLICATION OF HYDROPHILIC IONIC LIQUIDS FOR THE REACTIONS CATALYZED BY PLANT PEROXIDASES, NATIVE AND ENCAPSULATED IN A CELLULOSE MATRIX**
S.V. Muginova, A.E. Poliakov, D.A. Myasnikova and T. Shekhovtsova
M.V. Lomonosov Moscow State University, Chemical Department, Moscow, Russia

16.00-16.30 **PREPARATION AND CHARACTERIZATION OF ACYL-β-CYCLODEXTRIN NANOCAPSULES LOADING 4 – THIOUREIDOIMINOMETHYLPYRIDINIUM PERCHLORATE**
D.V. Popov[1], L.D. Radnaeva[1, 2], V.N. Elokhina[3], S.V. Amosova[3], B.A. Trofimov[3]
[1]Baikal Institute of Nature Management SB RAS, Ulan-Ude, Russia
[2]Buryat State University, Ulan-Ude, Russia
[3]A.E. Favorsky Irkutsk Institute of Chemistry SB RAS, Irkutsk, Russia

16.30-17.00 **BIENZYME NANOSCALE COMPLEXES FOR MEDICAL APPLICATIONS**
S.V. Uglanova[1,2], E.A. Zaitseva[1], A.V. Lopukhov[1], A.V. Kabanov[1,3], N.L. Klyachko[1]
[1]M.V. Lomonosov Moscow State University, Faculty of Chemistry, Department of Enzymology, Lenin's Hills, 119991, Moscow, Russia
[2]IBCP RAS, Kosygina str., 4, 119334, Moscow, Russia
[3]University of Nebraska Medical Center, Nebraska, Omaha, USA

17.00-17.30 **A METHOD TO PRODUCE BIOLOGIGALLY ACTIVE NANOCOMPLEXES BY NON-COVALENT CONJUGATION OF PROTEINS WITH VIRAL PARTICLES**
T.N. Erokhina[1], A.A. Yaroslavov[2], I.B. Kaplan[2], S.Yu. Morozov[2], A.G. Solovyev[2], A.A. Rokhnyanskaya[2], A.S. Malinin[2], A.G. Atabekov[2]
[1]Shemyakin & Ovchinikov Institute of Bioorganic Chemistry, RAS, Moscow, Russia
[2]Lomonosov Moscow State University, Moscow, Russia

17.30-18.00 **STUDY OF NANOSIZED FERRIOXIDE SYSTEMS IN THE REACTION OF THE METHYLBUTENE DEHYDROGENATION**
M.A. Bochkov, O.I. Akhmerov, G.I. Fedorov, Kh.E. Kharlampidi
Kazan State Technological University, Kazan, Russian Federation

18.00-19.00 **Workshop of ISTC: ISTC PROJECTS IN AREA OF BIOMATERIALS AND BIONANOMATERIALS: SUCCESSES AND PERSPECTIVES**

18.00-19.00 Break

19.00-20.00 Dinner

Tuesday, May 10, 2011

08.00-09.00	Breakfast
10.00-10.50	***MORNING SESSION – Young Scientists Session. 3.***
	Chairmen: Prof. A. Iordanskii, Prof. A. Tsakalov
10.00-10.10	**PROPERTIES OF LUMINESCENT TB-DOPED SILICA NANOPARTICLES WITH ADSORBED SURFACTANTS ON THEIR SURFACE** **O.D. Bochkova, A.R. Mustafina, V.V. Skripacheva, Yu.G. Elistratova, A.R. Muhametshina, S.E. Solovieva, A.I. Konovalov** *A.E. Arbuzov Institute of Organic and Physical Chemistry of Kazan Scientific Center of RAS, Kazan, Russia*
10.10-10.20	**HYDROPHOBIC ANISOTROPY OF SCORPION α-TOXINS SURFACE IS INTERRELATED WITH SPECIES SELECTIVITY AND TOXICITY** **A.O. Chugunov[1], A.D. Koromyslova[2], A.A. Vassilevski[1], A.A. Polyansky[1], R.G. Efremov[1]** *[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry, RAS, Moscow, Russia* *[2]Lomonosov Moscow State University, Moscow, Russia*
10.20-10.30	**LIPID-PROTEIN NANODISCS – PROMISING MEDIUM FOR STABILIZATION IN SOLUTION AND STRUCTURE-FUNCTIONAL STUDIES OF MEMBRANE BIOMOLECULES** **Z.O. Shenkarev, E.N. Lyukmanova, A.S. Paramonov, A.S. Arseniev** *Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry, Moscow, Russia*
10.30-10.40	**LARGE-SCALE CELL-FREE PRODUCTION OF MEMBRANE PROTEINS** **E.N. Lyukmanova, N.F. Khabibullina, L.N. Shingarova, L.E. Petrovskaya, Z.O. Shenkarev, A.S. Arseniev, D.A. Dolgikh, M.P. Kirpichnikov** *Shemyakin & Ovchinnikov Institute of Bioorganic Chemistry, Moscow, Russia*
10.40-10.50	**THE NOVEL DIAGNOSTIC METHOD FOR THE EARLY DRUG ADDICTION REVEAL** **V.S. Morozova, S.N. Petrochenko, V.V. Shipitsyn, R.Yu. Kiseleva, M.A. Myagkova, E.A. Bryun** *Moscow Research and Practical Center for Narcology of Moscow Health Department, Moscow, Russia*
10.50-11.30	Coffee break, Poster session
	CLOSING CEREMONY
11.30-13.00	**Farewell Address – Closing Remarks**
13.00-14.00	Lunch
19.00-22.00	Farewell Dinner

Wednesday, May 11, 2011

Wednesday, May 11, 2011

08.00-09.00	Breakfast
10.00-13.00	Excursion Festos Palace
13.00-14.00	Lunch
19.00-22.00	Dinner

Thursday, May 12, 2010

Thursday, May 12, 2011

08.00-09.00	Breakfast
	Departure of Participants

List of Posters

P01. BIOCIDES FOR PRESERVATION OF THE HISTORICAL MONUMENTS
E.N. Pokrovskaja[1], J.L.Kovalchuk[2]
Moscow State Building University[1], Institute of problems of ecology and evolution RAS[2]

P02. POLYMERIC MICRO SPHERES AS ANTISTATIC COMPONENTS OF PROTECTION LAYER FOR LIGHT - SENSITIVE MATERIALS
I.A. Gritskova[1], M.A. Sakvarelidze[2], S.M. Levachev[3], A.S. Mikhailov[2], A.E. Kharlov[2], P.N. Chadaev[1]
[1]Moscow State Academy of Fine Chemical Technology n.a. M.V. Lomonosov, Moscow, Russia
[2]Moscow Cinema Video Institute, Moscow, Russia
[3]Moscow State University n.a M.V. Lomonosov, Moscow, Russia

P03. THE INVESTIGATION OF PHOTOCATALYTIC PROPERTIES AND STRUCTURE OF PORPHYRIN-CONTAINING SYSTEMS ON THE BASE OF BIODEGRADABLE POLYMERS FOR USE IN PHOTODYNAMIC THERAPY
S.Z. Rogovina, N.A. Aksenova, V.A. Timofeeva, A.B. Soloveva N.
Semenov Institute of Chemical Physics, Russian Academy of Sciences, Moscow, Russia

P04. BENZODIHYDROTHIO(SELENO)CHROMILIUM SALTS AS NOVEL SYSTEMS FOR ANTIMICROBIAL DRUG DESIGN
O.V. Fedotova, O.A. Mazhukina, Ya.B. Drevko
Chernyshevski Saratov State University, Saratov, Russia

P05. DESIGNING OF THE PROLONGED FORM OF THE CYTOSTATIC DRUG ENCAPSULATED IN RESORBABLE POLYMERIC MATRIX
A.M. Kuzmina[1], A.V. Goreva[2], E.I. Shishatskaya[2]
[1]Siberian Federal National University, Krasnoyarsk, Russia
[2]Institute of Biophysics SB RAS, Krasnoyarsk, Russia

P06. STABILIZATION OF LYSK, THE ENZYME FOR STAPHYLOCOCCAI INFECTIONS TREATMENT
L.Yu. Filatova[1], D.M. Donovan[2], C.C. Becker[2], A.K. Gladilin[1], N.L. Klyachko[1]
[1]M.V. Lomonosov Moscow State University, Moscow, Russia
[2]Animal and Natural Resources Institute, ARS - USDA Beltsville Agricultural Research Center, USA

P07. SYNTHESIS AND PROPERTIES OF STATIONARY PHASES BASED ON SILICA AND GOLD NANOPARTICLES STABILIZED BY DIFFERENT ORGANIC LIGANDS FOR HPLC
P.G. Rudakovskaya, A.A. Kuznecov, E.K. Beloglazkina, A.G. Majouga, I.A.Ananieva, N.V. Zyk
Lomonosov Moscow State University, Department of chemistry, laboratory of biological active organic compounds, Moscow, Russian Federation

P08. THE DEVELOPMENT OF HILIC METHOD OF PROTEIN AND POLYPEPTIDE AGGREGATION ANALYTICAL CONTROL AND QUANTITATION
V.D. Gusarova[1], D.A. Gusarov[1], T.V. Vorobjeva[1], D.I. Bairamashvili[1]
[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry, Moscow, Russian Federation

P09. NANOTECHNOLOGY OF DESIGN OF PHARMACEUTICAL BIOTRANSPLANTANTS FOR SOLVING PROBLEMS OF REGENERATIVE MEDICINE
A.B. Shipovskaya, I.V. Zudina, N.V. Ostrovsky, E.V. Kozyreva, Yu.E. Salkovsky, D.A. Buzinova
Saratov State University named after N. Chernyshevsky, Saratov, Russia

P10. SOME ASPECTS OF APPLICATION OF POLYANILINE IN MEDICAL AND BIOLOGICAL AREAS
Yu.V. Zhavoronkov, T.I. Zhavoronkova, Ya.O. Mezhuev, Yu.V.Korshak
D.Mendeleyev University of Chemical Technology of Russia, Moscow, Russia

P11. POLYANILINE AS A MATERIAL THAT MAY BE USED IN BIOSENSORS AND GENE ENGINEERING

M.A. Salop, Yu.V Korshak, A.I. Piskareva, K.D. Sanchenkova, Ya.O. Mezhuev
D. Mendeleyev University of Chemical Technology of Russia, Moscow, Russia

P12. EXPERIMENTAL EVIDENCE OF SOME UNUSAL FEATURES IN PREPARATION AND BIOPROPERIES OF POLYANILINE AND POLYPYRROLE

Yu.V. Korshak, Ya.O. Mezhuev, A.A. Koledenkov, M.I. Shtilman
D.I. Mendeleev University of Chemical Technology of Russia, Moscow, Russia

P13. NANO SIZED OPEN POROSITY IN ULTRA HIGH MOLECULAR WEIGHT IMPLANTS PRODUCED BY COMPACTION TECHNIQUE

F. Shutov
F&D Innovative Composites, Inc., Cookeville, TN, USA

P14. A TISSUE-ENGINEERED ARTIFICIAL SKIN GROWN TO RESEMBLE THE NATIVE SKIN.

D.E. Lesovoy[1], A.A. Artyukhov[2], S.M. Chudnykh[3], P.S. Krizyna[4], M. I. Shtilman[2]
[1]Faculty of Fundamental Medicine, Lomonosov Moscow State University, Moscow, Russian Federation
[2]Mendeleyev University of chemical Technology of Russia, Moscow, Russian Federation
[3]Moscow State University of General Medicine and Dentistry, Moscow, Russian Federation
[4]National Medical Academy of Post-Graduate Education, Kyiv, Ukraine

P15. CYTOTOXICITY STUDY OF LIPOSOMAL FORMULATION OF METHOTREXATE DERIVATIVE USING MICROENCAPSULATED MULTICELLULAR TUMOR SPHEROIDS AS 3D *IN VITRO* MODEL

A. Tsoy[1], N. Kuznetsova[1], E. Vodovozova[1], E. Markvicheva[1]
[1]Shemyakin-Ovchinnikov Institute of Bioorganic Chemistry, Russiam Academy of Sciences, Moscow, Russia

P16. LANTHANIDE DOPED NANOPARTICLES AS A BASIS TO SENSE BIORELEVANT ANIONS

V.V. Skripacheva, N.A. Davydov, S.V. Fedorenko, A.R. Mustafina, A.I. Konovalov
A. Arbuzov Institute of Organic and Physical Chemistry, Kazan Scientific Center of the Russian Academy of Sciences, Kazan, Russia

P17. USING ANTIOXIDANT ENZYMES FOR DIAGNOSTIC BIOMATERIALS INCLUDING BIODEGRADABLE POLYMERS AND NANOMATERIALS

E. Smirnova[1], A. O. Shevtsova[2]
[1]Siberian Federal University, Krasnoyarsk, Russia
[2]Hematologic center, Krasnoyarsk, Russia

P18. INTEGRATED MANAGEMENT OF INDUSTRIAL SECURITY INCLUDING BIOMEDICAL PRODUCTION

L.V. Polyakova, G.I. Kandelaki,
Mendeleev University for Chemical Technology of Russia, Moscow, Russia

P19. CALCIUM-PHOSPHATE CERAMIC, GLASSCERAMIC AND COMPOSITE MATERIALS IN *IN VIVO* EXPERIMENT

P.D. Sarkisov[1], N.V. Buchilin[1], N.Yu. Mikhailenko[1], E.E. Stroganova[1], E.S. Lukin[1], S.M. Barinov[2], V.V. Smirnov[2], A.S. Zelyanin[3], V.V. Filippov[3]
[1]D. Mendeleyev University of Chemical Technology of Russia
[2]A. Baikov Institute of Metallurgy and material science RAS
[3]B. Petrovskii scientific center of surgery of Russia RAMS

P20. DETERMINATION OF THE METAL NANOPARTICLE SIZE IN THEIR COMPLEXES WITH SELF-ASSEMBLED STRUCTURES
G.Yu. Ostaeva, E.D. Selischeva, and I.M. Papisov
Moscow Automobile and Road State Technical University (MADI), Moscow, Russian Federation

P21. THE INFLUENCE OF SURFACTANT TYPE ON MIDDLE PARTICLES SIZE OF PLGA MICROSPHERES AND ENCAPSULATION EFFICIENCY OF MODEL DRUG
S.A. Kedik[1], E.V. Blinskaya[2], A.V. Panov[1], N.V. Tichonova[2], E.A. Petrova[1], M.D. Sapelnicov[1]
[1]Lomonosov Moscow State Academy of Fine Chemical Technology (Moscow)
[2]Zakusov institute of pharmacology, RAMS, Moscow, Russia

P22. NEW DELIVERY SYSTEMS FOR HYDROPHOBIC DRUGS BASED ON MODIFIED AMYLOSE
D.V. Yeremin[1], A.V. Panov[1], S.A. Kedik[1].
[1]Institute of Pharmaceutical Technology, Moscow, Russia

P23. DETERMINATION OF MONOMERIC COMPOSITION OF THE SOVIDON BY NMR 13C SPECTROSCOPY METHOD
M. Zaitsev, A.Panov, S.Kedik, J.Cherta, I.Sakaeva
Moscow State Academy of Fine Chemical Technology, Moscow, Russia

P24. SYNTHESIZE AND MOLECULAR WEIGHT CHARACTERISTICS OF POLYHEXAMETHYLENE GUANIDINE HYDROCHLORIDE
I. Sedishev, A.Panov, S. Kedik, Kha Kam An, E. Zhavoronok
Lomonosov Moscow State Academy of Fine Chemical Technology, Moscow, Russia

P25. POLYPYRROLE – MATERIAL FOR MEDICINE AND BIOLOGY
K.D. Sanchenkova, M.A. Salop, Ya.O.Mezhuev, Yu.V.Korshak
D.Mendeleyev University of Chemical Technology of Russia, Moscow, Russia

P26. STRUCTURAL AND FUNCTIONAL RELATIONSHIPS OF NEW TYPES OF SILKS, PROSPECTIVE FOR BIOMEDICAL APPLICATIONS
O.Sokolova, M. Mardashova, N. Neretin, E. Krasnova, T. Neretina
Moscow State University, Dept. of Biology Moscow, Russia

P27. RECOMBINANT SPIDER SILK PROTEINS FORM NANOFIBERS AND SURFACE-INDUCED CRYSTALLINE LAMELLAE
D.V.Bagrov[1], O.S.Sokolova[1], V.G.Bogush[2], V.V.Prokhorov[3]
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P28. VARIOS METHODS OF DEFINITION OF DEGREE OF TOXITY
N.A. Koltovoy
Sklifosovsky Institute, Moscow, Russia

P29. POLYMER MORPHOLOGY IN CONFINEMENT AND CLOSE TO SURFACES
K. Chrissopoulou[1], K. Andrikopoulos[2], S. Bollas[1], S. Fotiadou[1,3], G. Voyiatzis[4], S.H. Anastasiadis[1,5]
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P30. DEVELOPMENT OF BIODEGRADABLE POLYMER SCAFFOLDS WITH TWO CONTROLLED PORE SIZE DISTRIBUTIONS

M. Paraskevopoulos, S. Kivotidi, C. Tsioptsias, C. Panayiotou
Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki, 54124, Greece

P31. SYNTHESIS AND CHARACTERIZATION OF HYDROXYAPATITE BIOMORPHIC BIOCERAMICS FROM NATIVE WOOD

G. Gaitanopoulos, C. Tsioptsias, C. Panayiotou
Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki 54124, Greece

P32. IN VIVO EVALUATION OF GENOTOXICITY OF IMIDACLOPRID

P.D. Stivaktakis, M. Kavvalakis, G. Maravgakis, A.M. Tsatsakis
Laboratory of Toxicology, University of Crete, Heraklion, Greece, 71003

P33. CRYSTALLIZATION KINETICS IN POLYMER / LAYERED SILICATE NANOCOMPOSITES

H. Papananou[1], E. Pavlopoulou[1], K. Chrissopoulou[1], G. Portale[2], W. Bras[2] , S. H. Anastasiadis[1,3]
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Acknowledgements

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E U R O T O X

General Information

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Abstract Book

DEVELOPMENT OF HIERARCHICALLY STRUCTURED SMART SURFACES*

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Controlling the surface morphology of solids and manufacturing of functional surfaces with special responsive properties has been the subject of intense research. We report a methodology for creating functionally responsive surfaces by irradiating silicon wafers with femtosecond laser pulses and subsequently coating them with different types of functional conformal coatings. Such surfaces exhibit controlled hierarchical roughness at the micro- and the nano-scale, which mimics the surface texture of water repellent natural surfaces. When a simple alkylsilane coating is utilized, highly water repellent surfaces are produced that quantitatively compare to those of the Lotus leaf. When a polymer brush is "grafted from" these surfaces based on a pH-sensitive polymer, the surfaces can alter their behavior from super-hydrophilic (after immersion in a low pH buffer) to super-hydrophobic and water-repellent (following immersion to a high pH buffer). We quantify the water repellency of such responsive systems by drop elasticity measurements whereas we demonstrate that the water repellent state of such surfaces requires appropriate hydrophobicity of the functionalizing polymer. When a photo-responsive spiropynan-based coating is applied, a dynamic optical control of the wetting properties is obtained and the surface can be switched from super-hydrophilic (following UV irradiation) to hydrophobic (following green irradiation). In all the above cases we show that the principal effect of roughness is to cause amplification of the response to the different external stimuli.

* Sponsored by NATO's Scientific Affairs Division, the Greek GSRT and the E.U.

In collaboration with E. Stratakis, M. Barberoglou, V. Zorba, A. Mateescu, D. S. Achilleos, M. Vamvakaki, C. Fotakis

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NATURAL AND ARTIFICIAL CONSTRUCTIONAL MATERIALS

Al.Al. Berlin
Semenov Institute of Chemical Physics of RAS

Materials used by man in his activities have always been playing an important and even decisive role in the development of the civilization. It is not accidental that they gave names to the whole historical epochs: Stone, Bronze, Iron Age… Modern epoch can be called the Polymer Age.

In the report attempt to show that the man has taken from the nature and that he contrived himself; where he has overtaken it and began to make better and where still there are resources for search, and also that the nature for the present makes better the man.

The man is ahead of the nature in many fields relating to creation of new materials. He creates number metals and alloys resistant to various loads. We use oil as a raw material and synthesize a great number of organic polymers and high-strength fibers.

Processings of various materials, especially polymeric, developed by the man have huge advantages than natural one.

We created composites with record strength and heat-resistance.

At the same time, there is a considerable lag in the development of gradient structures.

Plastic ceramics is still a dream of the mankind. Inorganic polymers, inorganic-organic composite materials (widespread in the nature) seem to be our future. They shall be easy to process, shall have thermal, chemical and water resistance.

Finally, we need a material, which could be used instead of oil and gas for synthesis of organic polymers and composites - it could be natural polysaccharides, cellulose, chitin, and proteins. It is necessary to develop new polymer processing methods that have less environmental impact.

One more important problem (especially from ecological point of view) is reprocessing of constructional materials and subsequent use of such products.

IDENTIFICATION OF FUNCTIONAL DETERMINANTS ENCODED IN THE SURFACE OF NATURAL PEPTIDE TOXINS

A.A. Polyansky[1,2], A.O. Chugunov[1], B. Zagrovic[2], R.G. Efremov[1]
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Poisoned animals produce a bunch of biologically active compounds – components of their venoms, which have a number of specific targets in the host cell. Usually, such toxins from different source can have the same molecular target. Different sodium-channel peptide toxins represent an intriguing example in this context – these molecules by-and-large possess different folds, but modulate the gating mechanism of the channels in a similar manner and bind to common parts of the target. Hence, these molecules represent a suitable model to investigate similarity of proteins with important biological function encoded in structure and dynamics of their surfaces independent of the similarity in their primary, secondary or tertiary structure. Here we present a novel approach destined to analysis of molecular surfaces and included quantitative assessment of their hydrophobicity, charge distribution, and geometry.
It is important to note that the analysis of geometrical and physico-chemical surface features performed exclusively on static conformations would be biased. To avoid this, we employ also long time-scale molecular dynamics simulations of protein molecules in realistic environments. Probing of elaborated approach along the family of sodium-channel toxins allowed identifications of particular surface patches common for molecules from different groups. Delineated "surface fingerprints" in most cases are formed by aromatic residues, which are either conservative along certain toxin group, or for some molecules were proved in experiments to be important for biological activity. This information will be subsequently used to reconstruct and validate 3D models for sodium channels *in silico,* and to design novel toxins with predefined activities. Moreover, proposed approach represent a powerful tool in investigation of the similarity between surface properties for various structurally different proteins possessing similar biological activity.

DEVELOPMENT OF SCREENING METHOD FOR THE DETERMINATION OF FLUOROQUINOLONES IN ANIMAL PRODUCT

I.S. Nesterenko[1,2], A.V. Zhukov[1], E.S. Vylegzhanina[1], A.A. Komarov[1] and A.N. Panin
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Fluoroquinolones (FQs), such as enrofloxacin and ciprofloxacin, are among the most commonly used antibiotics for the treatment of bacterial infection. They are widely used both for animals and for humans. The potential contamination of animal origin foodstuffs with FQs made it necessary for monitoring the quality of these materials and to develop a method to screen for the possible presence of the drug residues. The maximum residue levels (MRLs) established by European Union for various FQs in beef, pork, poultry, eggs, fish and milk range from 10-1900 μg/kg [1].Now in the world, the common way to determine FQs residues is chromatography, such as high-pressure liquid chromatography (HPLC) [2]. But it is both labor-intensive and expensive, and therefore is not suitable for the routine screening of large numbers of samples. To avoid using labor-intensive instrumental methods to detect residues of FQs in food, a simple and convenient indirect enzyme-linked immunosorbent assay (ELISA) method for FQs was developed using polyclonal antibody prepared in this study.
Materials and Methods. To get antigens there have been synthesized conjugates of enrofloxacin (ENR), ciprofloxacin (CIP) with bovine serum albumin (BSA), ovalbumin (OVA) and soybean trypsin inhibitor (STI) by modified carbodiimide method [3]. Obtained conjugates FQs-protein were investigated by UV spectrometry. Polyclonal rabbit sera have been received by immunization of rabbits.
Results and Discussion. All antibody raised in rabbits and synthesized antigen were screened and characterized using homologous and heterologous competitive ELISA (cELISA) formats to select the best combinations. The highest sensitive variant for the ENR and CIP was the homologous combination: ENR-BSA and anti-ENR-BSA. The limit of detection for ENR and CIP were 0,1 μg l^{-1} and 1 μg l^{-1}. Cross-reactivity experiments were carried out. Coefficients of cross-reactivity for 12 fluoroquinolones were presented in table 1.
Table 1. Cross-reactivity values of derived antibody to some competitors

FQ	CR, %	FQ	CR, %	FQ	CR, %
enrofloxacin	100	lomefloxacin	0,1	oxolonic acid	<0,1
ciprofloxacin	40	sarafloxacin	<0,1	nalidixic acid	<0,1
ofloxacin	15	danofloxacin	<0,1	pipimidic acid	<0,1
norfloxacin	1	difloxacin	<0,1	flumequin	<0,1

Developed technique was optimized for screening FQs residues in milk and egg . The sample preparation procedures were developed. The limit of detections for ENR in milk, egg were 1 μg l^{-1} and1 μg kg^{-1}. The 50 milk samples and

30 egg and egg powder samples were analyzed and results was submitted by HPLC-MS.
Reference:
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Acknowledgements
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ANALYTICAL APPLICATIONS OF SELF-ASSEMBLING PEROXIDASE-CHITOSAN AND PEROXIDASE-GELATIN FILMS AS THE BASIS FOR OPTICAL BIOSENSORS

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Nowadays, a formation of self-assembling enzyme-polyelectrolyte structures at the nanoscale is one the promising approaches in design of highly sensitive, stable reproducible and cost effective biosensors for the determination of physiologically active compounds (substrates of enzymes).
The goals of this work were to design spectrophotometric and fluorescence biosensors on the basis of self-assembling peroxidase-chitosan and peroxidase-gelatin films acting in aqueous, aqueous-organic, micellar media and to demonstrate their analytical possibilities for analysis of biological and pharmaceutical samples including water-insoluble samples. Horseradish peroxidase was chosen for the investigation as a representative of commercial plant peroxidases.
The technology of the formation of the transparent films from water-organic media on the surface of optical glasses and mirror slides was developed. It has been shown that the biorecognized films generated from water-DMSO are characterized by higher transparency than the films generated from water solutions. The morphology of the films was studied by AFM. The films are characterized by average thickness of 6-8 nm on the surface of optical matrixes and act as the native enzyme in the presence of 70% DMSO and different micellar media.
Analytical properties of the optical biosensors were demonstrated while determining some organic peroxides, phenolic compounds, phenothiazines, catecholamines and their metabolites in different samples.
The authors thank Russian Basic Research Foundation (project 09-03-00-823-a) and Russian Federation Ministry of Education and Science (contract P868 25.05.2010) for financial support of this investigation.

MICROENCAPSULATED TUMOR SPHEROIDS AS AN IN VITRO CELL BASED ASSAY FOR ANTICANCER DRUG SCREENING

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Human tumor 3-dimensional (3D) models as predictive preclinical *in vitro* models for anticancer drug safety and efficacy screening are now routinely used in many scientific laboratories. The 3D models have a potential to improve the physiological relevance of cell cultures and to advance quantitative modeling of biological systems from cells to living organisms. One the well known 3D tumor model is multicellular tumor spheroid (MTS) model system in **which cells grow *in vitro* as 3-dimensional aggregates**. Unfortunately, generation of MTS by classical methods has many disadvantages, and therefore an effective technique for MTS formation is still required. Microencapsulation seems to be a simple method to form MTS.
In this research we were aimed to show that MTS formed in alginate-oligochitosan microcapsules could be proposed as a useful *in vitro* cell-based assay to test doxorubicin derivatives and photosensitizers (PS), namely PPIX, Photosense, Chlorine e6.
Human cervical adenocarcinoma (HeLa) and human breast adenocarcinoma (MCF-7 and doxorubicin resistant MCF-7-DXR subline) were chosen as a model cell lines. The cells were embedded in alginate-oligochitosan microcapsules using electrostatic bead generator, as described earlier [1], and a long-term cell cultivation to generate MTS was carried out. Cytotoxicity of doxorubicin derivatives and photocytotoxicity of PSs were then assessed on the generated MTS. Our results confirmed that 3D organization of MTS leads to the remarkable decrease in anticancer therapy efficacy, compared to 2D monolayer cell cultures.
Thus, biocompartible polyelectrolyte microcapsules with generated MTS could be proposed as a novel *in vitro* cell-based assay to study anticancer therapy effects.
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MACROPOROUS SCAFFOLDS BASED ON MODIFIED POLY(VINYL ALCOHOL) FOR TISSUE ENGINEERING: CYTOTOXICITY STUDY

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Tissue engineering is an interdisciplinary field of medical biotechnology aimed to *de novo* regenerate sick, injured or lost tissues and organs using a novel biomaterials and technologies. Tissue engineering needs the development of a better polymer scaffolds to support cell growth and to provide not only a high surface area for cell attachment, but also a structural morphology similar to the extracellular matrix. However, today the majority of scientific studies in this field are focused on the elaboration of novel synthetic, biodegradable and biocompatible biomaterials for the scaffolds formation. Moreover, a modification of such biomaterials with various charged molecules (e.g., N,N-dimethylaminoethyl methacrylate (DMAEMA) and acrylic acid (AA)) in order to facilitate cell growth on the scaffolds surface is of great interest. In the present research we aimed to examine *in vitro* biocompatibility of poly(vinyl alcohol) (PVA) scaffolds modified with glycedyl methacrylate (GMA) and DMAEMA (1-25% substitution degree) or AA (1-25% substitution degree). The biocompatibility of the scaffolds was studied by microscopic observations and MTT assay in extract-test, direct contact-test and test of cell growth within the scaffolds. Mouse fibroblasts (L929) and mesenchymal stem cells (MSC) from human adipose tissue were chosen as a model cells. For the extract-test, the extracts were prepared by incubating the scaffolds with cell cultivation media for 24 hours. And the cell viability was measured after cultivating L929 cells in presence of the obtained extracts for 2 and 8 days. For the direct contact test, the scaffolds were kept in contact with the cells for 24 hours. In order to observe cell morphology and proliferation of the cells over modified PVA-GMA scaffold surfaces, L929 and MSC were directly cultured on scaffolds and incubated for 1-21 days. The results of MTT-assay and microscopic observations confirmed that modification of scaffolds with DMAEMA or AA didn't lead to any significant cytotoxicity and promoted cell proliferation and growth. Moreover, it was found that the scaffolds provided very significant cell proliferation from day 1 to day 21, respectively. At the same time, it was shown that the maximum viability of L929 and MSC was not on the same scaffolds, viz. modified with 2,5% AA and 12,5% AA, respectively.
Thus, the modifications of PVA-GMA scaffolds with DMAEMA and AA allowed to optimize scaffolds especially for the growth of the selected cell line and therefore could be considered to have a potential for tissue engineering application.

POLYELECTROLYTE NANOCAPSULES, DOPED WITH HIGHLY LUMINESCENT EUROPIUM(III) COMPLEXES

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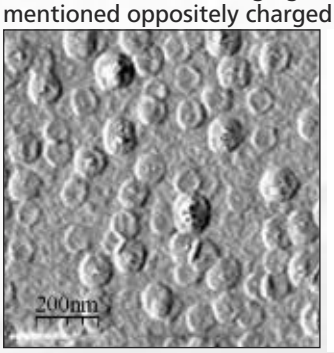
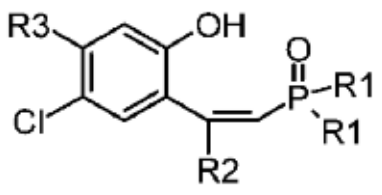
It is well known that lanthanide(III) tris-β-diketonates exhibit perfect luminescent properties. But it is worth noting that direct using of this species in biological and medical aspects is restricted, because of their kinetic lability and low water solubility. Thus the presence of polipeptides, nucleotides and other biological molecules can result in the quenching of lanthanide(III) tris-β-diketonates luminescence, due to the ligand substitution. The synthesis of water soluble forms of lanthanide diketonate complexes is another problem.
Reprecipitation-encapsulation procedure with some modifications was used to prepare nanosuspension, composed of novel highly luminescent europium(III) thenoyltrifluoroacetonate adduct with phosphineoxide **1**, encapsulated into polyelectrolyte capsule fabricated through layer-by-layer procedure. The poly(sodium 4-styrenesulfonate) (PSS) was applied as the first layer. Positively charged polyethyleneimine (PEI) has been deposited onto PSS coated particles resulted in recharging of nanoparticle from minus to plus. In the same route stepwisely five layers of above-mentioned oppositely charged polyelectrolytes were deposited onto $Eu(TTA)_3$**1** particles.





1 - R1 = o-MeOC6H4, R2 = C6H5, R3 = Me
2 - R1 = Me, R2 = C6H5, R3 = H
3 - R1 = o-MeC6H4, R2 = C6H5, R3 = H

Acknowledgement: RFBR (grant 10-03-00352a)

The multilayer polyelectrolyte shell protects highly luminescent core from deactivation and decomposition (due to pH changes or ligand substitution) and also provides colloidal stability of Eu(TTA)$_3$**1** containing capsules in water. Photophysical properties, size and electrokinetic potential in aqueous solutions were studied at the various number of polyelectrolyte layers. AFM images of dried samples were also obtained.
The stimuli responsive colloids, which are able to give luminescent response on the interfacial interactions with substrates are of particular importance as a basis for the development of nanosensors. Therefore the quenching effect of organic dye, namely phenol red on Eu-centered luminescence was studied with the aim to differentiate the outermost polyelectrolyte layer onto Eu[(TTA)$_3$**1**] nanoparticles.

IMMUNOCHROMATOGRAPHIC TESTS FOR THE DETECTION OF SEVEN GROUPS OF DRUGS OF ABUSE IN ORAL FLUID

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In recent years it is observed a significant increase of people using drugs for non medical purposes in many countries. Timely drug addiction diagnostics is very important for drug addiction prophylaxis, drug addicts treatment and control and prevention of accidents committed by drug users under drug intoxication.
The most widespread and inexpensive method for drugs of abuse screening is lateral flow immunoassay (LFIA) in urine. Oral fluid has many advantages in comparison with urine. First of all, oral fluid collection is non-invasive, does not break right of privacy. Second, oral fluid testing is exclude test results adulteration that is widespread in urine tests. And the last, oral fluid tests indicate current drug intoxication while urine tests give positives for several days after drug administration. The drug intoxication determination is essential for drivers, pilots, airline dispatchers, in criminalistics, etc.
All necessary immunoreagents were synthesized for LFIA of seven drugs of abuse: opiates, amphetamines, methamphetamines, cannabinioids, cocaine, methadone, phencyclidine. The conjugated antigens of the analytes with carrier protein and conjugates of specific monoclonal antibodies with colloidal gold were synthesized. The development of LFIA technological stages including selection of materials for test strip, immunoreagents concentrations and assay conditions optimization for drug detection in oral fluid, selection of packing for extended shelf life was performed. As a result immunochromatographic test systems were built up with the following cuts-off for drugs of abuse metabolites in oral fluid: 40 ng/ml for opiates, 50 ng/ml for amphetamines, 50 ng/ml for methamphetamines, 4 ng/ml for cannabinoids, 20 ng/ml for cocaine, 30 ng/ml for methadone, 10 ng/ml for phencyclidine. High specificities of the developed test systems were established: for non-related to the analytes compounds the cross-reactivity percentages were less than 0.5%.
The developed LFIA tests have broad field of application: for mass population checkup, drug intoxication investigations, professional appropriateness assessment in the number of professions (transport, dangerous manufactures, etc.)

MEMBRANE CHROMATOGRAPHY VS COLUMN CHROMATOGRAPHY: THE POTENTIAL USE FOR THE PROTEIN AND POLYPEPTIDE PURIFICATION

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Nowadays the biotechnology and biopharmatech technologist pay most attention to the development of processes optimising them in order to achieve high efficiency, easiness and simpleness of validation. The column chromatography being involved in down-stream processes is sometimes tricky and even if robust is hard to validate, though. In case of protein and polypeptide purification liquid chromatography, especially ion-exchange chromatography, is well established and often used. Our research however was started to show that membrane chromatography might compete with traditional column chromatography, promising the attractive simpleness of validation of both process running and SIP / CIP procedures.
Ion-exchange membranes was studied for the use for protein / peptide purification estimating the speed of the running (i.e. productivity keeping in mind its high recovery), yield, easiness of installation and utilization, and other parameters. It was shown that commercially available membranes posses the smaller loadability compare to that if traditional ion-exchange media. On the other hand, membrane loadability is not influenced with flow rate. Both yield and recovery in case of membrane chromatography were pretty high. SIP and CIP procedures were conducted several times and demonstrated simpleness and reproducibility.

FLUORESCENCE POLARIZATION IMMUNOASSAY FOR THE EXPRESS DETECTION OF BISPHENOL A

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Bisphenol A is used in the production of polymers such as epoxy and phenolic resins, and polycarbonates, as a precursor of flame-retardants. Because of incomplete polymerization or partial hydrolysis of the polymer, bisphenol A migrates from a packaging material to the food. Apart from being a food contaminant, bisphenol A is considered an environmental contaminant as well. Bisphenol A appears to be one of the endocrine disrupting chemicals. It possesses estrogenic activity, induces prolactine secretion, it affects mitosis, bisphenol A metabolites react with DNA inducing the production of DNA adducts. Because of its toxicity, the analysis of bisphenol A residues in food and environmental samples is required. The analytical determination of bisphenol A is usually carried out using gas chromatography-mass spectrometry or high-performance liquid chromatography. These techniques are sensitive and specific, but they don't allow rapid processing of large amount of samples and require complicated pre-treatment, extraction and concentration. Another way of detection of bisphenol A is immunoassay. The most frequently used technique is enzyme linked immunosorbent assay (ELISA). But still the procedure of ELISA includes steps of incubation and washing, that increases the time of assay to several hours. It this research we developed the fluorescence polarization immunoassay (FPIA) for bisphenol A monitoring. This method possesses a number of advantages such as rather high sensitivity and specificity. Also it demands few minutes for entire quantitative and precise analyses and doesn't need complicated sample preparation.
Several derivatives of bisphenol A were used for the synthesis of fluorescein-labeled tracers. The optimal combination of immunoreagents (antibodies and tracer), which is the key factor for any kind of immunoassay, was selected. Moreover phisicochemical parameters of the antigen-antibody system were determined, because they are important for the analytical performance of an immunoassay. Highly specific FPIA for bisphenol A was developed with limit of detection 18 ng/ml in 50 µl of the sample.

Acknowledgements:
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EXPRESS DETECTION OF MYCOPHENOLIC ACID IN SERUM USING METHOD OF FLUORESCENCE POLARIZATION IMMUNOASSAY

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Mycophenolic acid (MPA) is the active metabolite of immunosuppressant drug - mycophenolate mofetil. Since the early 1990s it has been used to prevent rejection in solid organ transplantation. MPA's pharmacological effect is based on inhibition of the inosine-monophosphate dehydrogenase, which controls *de novo* pathway of purine synthesis used in the proliferation of T- and B-lymphocytes. Therapeutic monitoring of mycophenolic acid in serum is really important after organ transplantation. Nowadays the most frequently used methods for MPA quantification are high performance liquid chromatography (HPLC) with UV-detection and liquid chromatography-tandem mass spectrometry. They are very sensitive but have such limitation as complicated pretreatment of samples, high price and long-time experiment. Using of immunochemical methods allow us to decrease price and time of analysis, simplify it, keeping high sensitivity and specificity. Fluorescence polarization immunoassay (FPIA) is one of them which in addition distinguished by express procedure for quantitative analyses. Because of it FPIA showing great promise for therapeutic monitoring.
For the development fluorescence polarization immunoassay tracer for mycophenolic acid was synthesized: MPA was conjugated with EDF – fluorescein based compound. Two kinds of antibodies (mono- and polyclonal) were tested on binding with this tracer and optimal conditions were selected. Using distil water as a model system calibration curves for MPA detection were produced with limit of detection 20 ng/ml and 5 ng/ml for monoclonal and polyclonal antibody respectively. Both systems (tracer – antibody) were tested for quantification mycophenolic acid in serum. Analytical and physic-chemical parameters were determined.

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FIBERS AND NANOCOMPOSITES BASED ON BIODEGRADABLE BACTERIAL POLYESTERS

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It is common knowledge that the majority of modern large-scale polymers, however useful and practical, lack two important properties – environmental safety and production from restorable raw materials. It means that a lot of effort must be applied to disposal of polymer wastes. The polymers are needed that should possess all (or most) of the positive qualities of the today's commercial ones and be ecology-friendly. Polyhydroxyalkanoates seem to be the most probable candidates for the role of "polymers of tomorrow." Poly(3-hydroxybutyrate) (PHB) is the most well-studied of these "green" bacterial polyesters. It is a thermoplastic possessing such properties as biodegradability, biocompatibility, hydrophobicity, UV-stability, gas barrier properties etc. It can be produced, for instance, from cheap methanol or from organic wastes (in particular, of sugar-industry) and degrades in natural environment (or inside a living tissue) to non-toxic rests (H_2O and CO_2).
A disadvantage of PHB is the technological complexity of processing as their melting and thermal degradation temperature ranges overlap. We have successfully overcome this, as well as the unwelcome brittleness reported for isotropic films of PHB.
On the other hand, about 10 years ago an intense investigation of polymer/layered silicate-based composites has started. The samples prepared by the nanotechnology demonstrate, as a rule, unusual mechanical, thermal, barrier, electrical and other properties. To obtain nanocomposites based on PHB, the specially modified layered silicates were used as fillers. One cannot predict but expect that this will improve the mechanical (or other) properties, on the one hand, and reduce the price of the resulting material – on the other. These "green" or biological friendly nanocomposites compromise organic and inorganic materials, which can be degraded under the action of certain micro-biological species (bacteria, mould).

Fibers prepared from biodegradable bacterial polyesters by gel-spinning and melt-extrusion and PHB-based nanocomposites were studied by X-ray analysis, DSC and mechanical tests. The homopolymer fibers from PHB are found to reveal well-pronounced hard-elasticity and reversible formation of the strain-induced columnar mesophase upon elastic drawing. Random copolymers based on PHB, being still crystallizable, show rubber-like behavior similar rather to polyelastomers than thermoplastics. PHB/clay nanocomposites prepared exhibit two-fold increase of modulus (1 GPa), whereas their strength and elongation at break remain similar to those of the neat PHB.

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POTENTIAL OF SYNTHETIC POLYMERS IN TARGETED DRUG AND GENE DELIVERY

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Objectives: Conjugates of *N*-(2-hydroxypropyl)methacrylamide (HPMA) copolymers with anti-cancer drugs proved to be effective nanomedicines in treatment of model tumours in mice. Anti-tumour activity of the conjugates can be improved by using the high-molecular-weight (HMW) polymer carriers enabling effective accumulation of the conjugates in solid tumours due to EPR effect (passive targeting). The same principle was used for passive targeting of polymer-coated gene delivery vectors, e.g. adenoviruses. The multivalent HPMA copolymers were designed to enable coating of surfaces of gene delivery vectors to protect the vector from undesirable interactions during its transport in the body and to release it at its target. Here we present proper design, synthesis and properties of the HPMA copolymers suitable for preparation of effective drug and gene delivery vectors.
Methods: Synthesis of HMW polymer-drug conjugates and polymer-coated gene delivery vectors starts with the controlled synthesis of semitelechelic and multivalent reactive HPMA copolymers using controlled radical polymerization. HMW water-soluble polymer-doxorubicin (DOX) conjugates were synthesized by grafting of DOX-bearing semitelechelic HPMA copolymer precursors on polyamidoamine dendrimer of the 2nd or 3rd generation through spacers degradable either by lysosomal enzymes or degradable in reductive environment of cytosol. In the copolymers DOX was bound to the carrier via hydrazone bond-containing spacers susceptible to intracellular pH-controlled hydrolysis. The conjugates of a star structure were designed to enable intracellular degradation of the HMW carrier to short polymer fragments excretable from organism by glomerular filtration. The multivalent copolymers were used for coating of the vector surfaces forming a polymer layer attached to the vector surface via spacers susceptible to intracellular degradation enabling intracellular liberation of the vector by releasing its protecting polymer shield.

Results: The HMW star conjugates were significantly more effective *in vivo* than single-chain polymer-DOX conjugate or free DOX demonstrating an impact of the EPR effect on the final anti-tumour activity of the conjugates. In therapeutic regimen of treatment of mice bearing EL4 T cell lymphoma all animals were completely cured with a dose of 5 or 10 mg DOX eqiv./kg. Treatment of mice resulted in development of tumour-selective resistance. We have shown that both the cytostatic and immunoprotecting effects are responsible for an excellent anti-tumour activity of the HPMA-based polymer-drug conjugates.
Coating of adenoviruses with HPMA copolymers resulted in ablation of the natural tropism of adenovirus and enabled its specific targeting by in the polymer incorporated targeting ligands, e.g. murine growth factors (EGF, bFGF) or scFv monoclonal antibody fragments. Specific transfection and transduction of the polymer-coated viral systems show that polymer coating and targeting strategies allow significant improvement of versatility of the gene delivery vectors.
Conclusions: Semitelechelic and multivalent HPMA copolymers represent a versatile tool for preparation of efficient drug and gene delivery vectors.

Acknowledgement
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TRANSPORT IN BIODEGRADABLE COMPOSITES BASED ON POLYHYDROXYALKANOATES: FROM BARRIER MATERIALS TO MICROPARTICLES FOR DRUG DELIVERY

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The families of biodegradable polymers, namely poly-α-hydroxyacides [PLA, PGA, and their copolymers] as well as poly-β-hydroxyalkanoates [PHA]): poly(3-hydroxybutyrate) [PHB] and its copolymer with 3-hydroxyvalerate [PHBV] specifically have the superior performance characteristics, which are sufficient to replace a significant portion of petroleum-based plastics used currently in medicine and packaging industry. Along with biodegradability, PLA and PHA are biocompatible and friendly environmental. However, the mechanical deficiency, a narrow processing window as well as the rather high cost of PHB still restrict its application as the friendly environmental, biomedical material. Combining the academic research and the bench-scale testing we have compared the transport phenomena and biodegradation behavior of composites based on PHA or PLA. The PHB and the PHBV were synthesized in Institute Biochemistry, Moscow, RF, and Tianan Co., Ningbo, China, respectively. The biodegradable composites were prepared by solvent cast or melt/solid extrusion and they include the second component, namely the biopolymers from renewable resources (chitosan, cellulose, natural rubber) for reinforcing polymer matrix and a drug delivery control. The microspheres were prepared by oil-in-water double emulsification. The variation of second component with different polarity regulates composite morphologies and, hence, both water and drug diffusion as well as thermophysical and mechanical behavior. Analysis of dependences for "transport coefficient - composite content" relationship combined with the morphology features (controlled by FTIR, SAXS, WAXS, SEM and AFM) and thermophysical testing (DSC, FTIR temperature imaging) enable us to explore the impact of crystallinity and second component nature (polymer polarity) upon kinetics of both controlled release and (bio)degradation. In this report we have successively represented 1) the outlook of production of biodegradable reinforced compositions, 2) the comparison of transport/biodegradation behavior between PLA and PHB/PHBV, and 3) the perspectives of transfer from synthetic polymer composites (erodible composites) to fully degradable natural systems. With the aim of enhancement of bioavailability and drug delivery efficiency the PHB microspheres and the PHB-chitosan microcomposites were processed and characterized by structural and kinetic methods. The areas of biocomposite applications for vascular drug-eluting stents and novel barrier films are shown. **Acknowledgements** We thank Dr. G.A. Bonartseva (IBC, Moscow) and *Tianan biological material Co* (Ningbo China) for providing with PHB and PHBHV copolymer as a stimuli for a novel scientific performance. This work was supported by the Presidium grant of Russian Academy of Sciences 2010 Fundamental science to medicine.

COMPUTER SIMULATIONS OF TRANSMEMBRANE HELICAL DIMERS: FROM STRUCTURE TO FUNCTIONING

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Bitopic membrane proteins (BMP) play an important role in the cell methabolism. They take part in cells proliferation, differentiation, communication, apoptosis, *etc*. Often, these proteins accomplish their biological functions in the dimeric state. Transmembrane helices (TMH) of BMP determine their structural organization and mediate stability of oligomers. Moreover, for several proteins it was shown that dimer of transmembrane helices obtains different conformations on different stage of the protein functioning (for instance active and passive form of the dimer). A number of factors can affect structure and population of different forms of the dimer. Among them lipid

composition of the host membrane is a very important one. For instance, it was shown that some receptor tyrosine kinases form active dimers only in lipid rafts.
This work is devoted to computer simulation methods of prediction and characterization of possible models of TMH dimers of biologically important BMP. Combination of different simulation techniques permits prediction of a small set of possible models, which can be further considered as a candidate of the dimeric structure in different protein states (active, passive intermediate and so on). Robustness of computational approaches verified by consistency of predicted models with experimental structures – in all cases selected set of predicted models includes also structure close to the experimental one. Ranging of the predicted models and influence of membrane environment on structural preferences were performed using calculation of dimerization free energy in different model membranes. According to these calculations, membrane composition played an important role in stability of each particular dimeric conformation. Thus, such characterization of TMH dimers provides important information, which can be useful for understanding of functioning of biologically relevant BMP.

CRYSTALLIZATION AND PORE STRUCTURE FORMING OF CALCIUM-PHOSPHATE GLASS-CERAMIC BIOMATERIALS

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Biomaterials for cortical bone trauma and injury curing must contain Ca^{2+} and P^{5+} ions to allow bone accretion with material. Also biomaterials must possess open pore structure including pores with diameter 50-200 μm to allow blood vessels and bone cells growing inside material, and pores with diameter 1-50 μm to permeate physiological solutions after implantation. To achieve such characteristics crystallizable bioactive calcium-phosphate glasses with CaO/P_2O_5 ratio 1,1 and Al_2O_3, TiO_2, ZrO_2 additives were used as precursors, and ceramic sintering processing was used as method of obtaining porous materials. The present study is devoted to determine optimal sintering conditions of crystallizable glasses to obtain materials with pore structure referred above.
Raws for sintering were formed using nearly monodisperse glasses powders with particle diameters from 90 to 400 μm. Sintering was processed in isothermic conditions at temperatutes from 700 to 1000 °C. To determine materials porosity level hydrostatic and geometrical methods were used. Pore sizes and geometry were determined using optical microscopy analysis. Crystal phases composition and distribution in sintered materials were determined using X-ray diffraction, scanning electron microscopy and local X-ray spectroscopic analysis. Viscosity of glasses was determined using indentor impression and falling ball methods.
Series of materials with open pore structures were obtained: open porosity – 15-30 %, pore sizes – from 5 to 200 μm. Flexural strength of materials reached 20-25 MPa. Main crystalline phases are: $Ca_2P_2O_7$, TiP_2O_7 and ZrP_2O_7. It was indicated that materials optimal sintering temperature range is 900-950 °C. Sintering at lower temperatures doesn't allow to achieve proper mechanical strength, but sintering at higher temperatures results in porosity reducing. The results allowed to formulate main conditions of obtaining porous materials from crystallizable glasses without using any pore-formers:
1) Sintering temperature must correspond to temperature of intensive crystals formation in glass – to allow particles form stiff crystal frame, that prevents shrinkage. The amount of crystals formed must be more than 50 vol.%.
2) Sintering must be leaded in isothermal conditions – to allow stiff crystal frame fast forming.
3) Viscosity of residual glass phase at sintering temperatures must be lower than 10^3 Pa·sec – to allow mechanical strength of material increasing during sintering.

WATER SOLUBLE POLYMERIC PLANT GROWTH REGULATORS AS CONTROLLED RELEASE SYSTEMS

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Polymeric plant growth regulators also referred as phytoactive polymers are a new group of biomaterials designated for use in agriculture. They form a typical controlled release system where an active component is connected to a polymeric matrix with a hydrolytically labile bond. In the presence of water and enzymes the bonds are cleaved with time and regulator is released into surrounding medium. Solubility of the polymer is achieved by addition of a lyophilising component as a comonomer.
Polymeric derivatives of plant growth regulators are noteworthy for their numerous advantages over their low-molecular weight analogues. The principal ones are wide range of active concentrations, elimination of phytotoxicity effects, application of lesser doses and prolongation of action.
Plant growth regulators selected for immobilization in this research were aryl- and aryloxy- carboxylic acids that exhibit biological action similar to that of natural auxines. These synthetic analogues of natural phytohormones include 2,4-dichlorophenoxyacetic acid, 1-naphthylacetic acid, 2-napthoxyacetic acid etc.

Various methods of immobilization were tried and compared including chemical modification of polymer matrix and the use of nanoparticles. The best results were recorded for copolymerization of plant growth regulator derivatives with different lyophilizing agents. Resulting samples demonstrated good solubility in water and contained sufficient quantity of the active component (up to 30 mass percent).
Controlled release behaviour of the samples was confirmed by investigating their hydrolysis rate and its influence on the plant growth and development.

POLYANILINE AND POLYPYRROLE COMPLEXES – THE NEW WATER SOLUBLE MATERIALS FOR MEDICO-BIOLOGICAL USE

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At the present time polyconjugated systems in medicine and biology attract more and more interest. Polyaniline due to its conductivity and its potential biocompatibility is used for production of substrates used for growing of tissues, and also in genetic engineering. A notable property of polypyrrole is its high tromboresistency, therefore it may be used in contact with blood.

The properties of polyaniline depend on its redox and protolytic equilibrium status, which allowed for using it as a component of bioanalytical systems, in particular for the measurement of blood pH, and also for delivery of DNA into the cell by means of DNA-polyaniline complex.
Polyaniline and polypyrrole demonstrate low solubility in most solvents, which limits the possibility of their use, and the interest is focused on water-miscible complexes of polyaniline and polypyrrole with PVP and PVA.
Polyaniline and polypyrrole properties depend on oxidation level and on polymer chain protonation degree, as well as on the presence of complexing agent. The research referred to herein is focused on the influence of production conditions on microstructure and properties of polyaniline and polypyrrole.

NOVEL AMPHIPHILIC POLYMERS FOR MEDICINE AND BIOTECHNOLOGY

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For the recent years the growing attention is paid to nano-scaled and nano-structured materials as novel generation of perspective pharmaceutical systems. These systems possess typical advantages of controlled-release systems. They provide immobilized biologically substances with better water-compatibility, prolonged specific activity, lowered toxicity. Moreover they protect active agents from side inactivation, and with targeted site-specific delivery they secure sufficient preparation concentrations (high therapeutic index) in required area of drug action.
In current study amphiphilic polymers were used for preparation of nano-scaled drug delivery systems characterized by different structure and low molecular weight (2000-12000). Amphiphilic derivatives of N-vinylpyrrolidone and acrylamide polymers were mostly used for this purpose as these polymers are widely applied as components of numerous drug systems. Diblock low-molecular polymers containing different hydrophobic fragment in their macromolecule were synthesized by radical polymerization and copolymerization of listed above monomers in the presence of different chain growth regulators. The further modification of prepared polymers using polymer-analogous transformations allowed introduction of positive and negative charged ionogenic groups in order to obtain amphiphilic macromolecules with required charge.
As it was discovered synthesized polymers possess own biological activity and are able to form nano-saled aggregates in aqueous media, suitable for immobilization of different biologically active substances including DNA and for liposome membranes modification noticeably increasing their stability against different destructive effects.

CROSSLINKED MACROPOROUS HYDROGEL OF POLYVINYL ALCOHOL FOR MEDICINE AND BIOTECHNOLOGY

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The present-day development of medicine and other sciences and technologies connected with human health requires creation of new highly-effective and harmless materials which allow to broaden possibilities of surgical, therapeutic and bio-analytical methods and systems.
In this study novel method of creation of macromolecular materials for medical application on the basis polyvinyl alcohol macroporous hydrogels is proposed. Polyvinyl alcohol finds wide application for medicine, hydrogels on the basis of polyvinyl alcohol also attracts great attention. However, easily prepared physical gels of polyvinyl alcohol formed by freezing of its aqueous solutions are unstable and readily turn reversibly into solution.
Suggested novel method of preparation of polyvinyl alcohol hydrogels consists in formation of polymeric network by cross-linking of unsaturated derivatives of this polymer. Such method allows to form macroporous systems with broad set of pores of dozens and hundreds micrometers size, and stands out due to their high stability and good swelling capacity in water and salt solutions. It is also very important that obtained cross-linked products were made on the basis of beforehand synthesized and characterized polymers and that is why did not contain residua of monomers and other toxic agents.
Investigation of the influence of reaction conditions on the formation of porous gels allowed revealing of the conditions which provides reproducible preparation of the final product with high yield and adjusted overall porosity, pores size, polymer cross-linking degree. Investigation of interaction of synthesized hydrogels with living organism tissues showed that introduction of developed preparation do not provoke inflammatory reaction on the initial stages of traumatic process and during the long-term contact novel hydrogels biodegrades fully with their substitution by conjunctive tissue.
High biocompatibility, biodegradation with adjusted speed, good mechanical properties, stability under the conditions of application of standard sterilization methods, ability to sorb considerable amounts of liquids including salt solutions without changing of volume characteristics, availability of parent substances and of preparation methods allowed to propose obtained materials for medical application, especially in thoracic surgery, for treating of trophic ulcers and burns, in cosmetic surgery, for creation of therapeutic systems with controlled release of active substance and in several other areas.

MACROPOROUS POLYMER HYDROGEL MATRICES TAILORED FOR CELL GROWTH PROMOTION

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Nowadays hydrogels are widely used in medicine and related areas. Macroporous polymer hydrogels which are characterized by an interconnected porous system, are known to be promising biomaterials for tissue engineering due to their ability to support cell growth by providing good diffusion of nutrients and metabolites within the matrix. As was previously shown, introducing charged groups in a matrix surface leads to an increase of cell adhesion. More over, the presence of functional charged groups could help to modify the surface with various growth factors, like proteins or peptides that could also promote cell growth. Thus, for example, the optimal charge of the matrix surface for the dermal fibroblasts growth promotion lays between -30 and -10 mV(1).

The aim of this study was to obtain matrices differed by surface charge and to test cell growth on them. For this purpose we fabricated a series of matrix samples based on a copolymer of the modified poly(vinyl alcohol) with the diethylaminoethyl methacrylate for the positive charge and the acrylic acid for the negative charge, respectively. The hydrogel matrices were prepared in frozen water solutions in the presence of the radical polymerisation initiation system within the temperature range of -5-20°C.The obtained hydrogels contained from 1 to 20 mol.% of the charged groups. The yield of the hydrogels was in function of various parameters of the reaction mixture..The surface morphology of the matrices was studied by SEM. It was shown that the investigated hydrogels had the interconnected porous system with the pore size of tens micrometers. The data of the surface charges of the hydrogels obtained by the zeta potential measurements were in a good agreement with the theoretical charge values optimal for fibroblast growth. The best cell growth of mouse fibroblasts was revealed on the matrices with the charge of -20 mV.

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MACROPOROUS HYDROGELS BASED ON STARCH DERIVATIVES

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Polymeric hydrogels on the basis of natural components due to their properties (biocompatibility, low toxicity, good swallow capacity, high speed of biodegradation etc.) find wide application in medicine. The scientists still face the problem of creation of new hydrogel materials with the improved properties. Additives of synthetic polymers are used to improve operational characteristics and physic properties of starch hydrogels.

2-hydroxyethylstarch with various degree of replacement has been chosen as object of our research. Isotropic gels and porous hydrogels, which are stable when heated and are resistant to diluted solutions of acids and alkalis, have been obtained by means of cryoformation and using different redox systems. The process of gelation has been investigated in order to define the optimal preparation conditions of final products. According to the measurements made the size of the obtained hydrogel pores was approximately 40-60 microns. Two types of hydrogels were obtained: unidirectional and multidirectional.

The biological tests showed the absence of toxicity and high biocompatibility of the developed hydrogel materials. It has been shown that in contact with organism living tissues the synthesized hydrogels practically did not cause inflammatory reaction, and completely degraded, being replaced with organism tissues. Biodegradation of the received hydrogels depends on the porous structure, orientation and takes from 2 weeks to 3 months.

CHITOSAN/POLYESTER COPOLYMERS PREPARED BY SOLID-STATE SYNTHESIS AS PROMISING BIOMATERIALS

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Poly(lactide) and their lactide-glycolide copolymers are biodegradable, biocompatible and nontoxic materials produced from renewable resources. Polylactides have a long-standing history of safe use in medical applications, such as pins, plates, screws, intra-bone and soft-tissue implants, and as drug controlled delivery systems. However, a lack

of functional groups for covalent cell-recognition signal molecules to promote cell attachment limits their usage in some biomedical fields, for example for tissue engineering. One of key parameters promoting cell attachment is the presence of adhesion moieties on the surface. Grafting of natural polymers, such as chitosan, gelatin with synthetic polyesters could overcome some of these drawbacks.
The novel approach to produce new chitosan-based materials is Solid-State Reactive Blending (SSRB). This simple one-step technique was employed to obtain chitosan/polyester systems under conditions of shear deformation using a twin-screw extruder. The entire modification proceeds in the solid state of the components, and does not require catalysts or any solvents as reaction medium. These conditions are especially desirable for biomedical applications and provide numerous possibilities to circumvent many processing obstacles typical for preparation of natural-polymers-based materials.
Chitosan with low deacetylation degree (0.03-0.10), low crystallinity and Mw 60 kDa prepared from crab chitin by SSRB was used. Biodegradable polyesters - semi-crystalline poly(L-lactide) (PLLA) and amorphous poly(lactide-co-glycolide) (50/50 mol-%) (PLGA) were used to prepare chitosan-based copolymers. Gelatin was also adopted to modify the copolymers in order to control their bioreactivity. Solid-state synthesis of chitosan/polyester systems was carried out in a twin-screw extruder at various temperatures 50-150°C and considering different weight ratios of the two raw materials.
Conventional organic analytical techniques in combination with IR analysis, X-ray diffraction measurements, DLS, DSC, DMTA and SEM were employed to characterize the materials.
Under well controlled processing conditions without any addition purification step, we have been obtained graft copolymers as a main weight fraction of the entire blend. As an immediate positive outcome the graft-copolymers have demonstrated amphiphilic properties forming micelle-like stable ultra fine dispersions (a mean particle size of 200-400 nm) in organic medium. NMR data and IR-ATR analysis confirmed that the polysaccharide chains are mainly internalized within a core of the chitosan-polyester nanoparticles generated within organic solvents. Physical, mechanical and relaxation properties of the graft-copolymers were also studied.
The obtained materials can be transformed into films, microfibers and microparticles and are therefore promising raw materials for numerous applications. Copolymers were assessed for the preparation of biodegradable microcarriers tailored for tissue engineering applications.

EXAMPLES OF LIPOPLEX MORPHOLOGY INFLUENCE ON TRANSFECTION EFFICIENCY

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Lipoplexes, cationic lipid/DNA complexes, are used as transfection agents. While gene therapy is already the nearest future, the detailed understanding of lipoplex formation and acting is still a challenge. Lipoplex composition, lipid-to-DNA charge ratio, the size of complexes, their morphology and zeta potential affect transfection efficiency. The morphology of lipoplexes is difficult to study because of the great variability of structures observed.
To target the issue we have a) compared complexes of different morphology but equal composition and b) screened through various lipoplexes for morphology with the highest transfection efficiency.
Different types of complexes were prepared from a cationic cholesterol derivative, dioleoylphosphatidylcholine and DNA. Depending on the preparation procedure complexes were either dense lipid drops aggregated on DNA (type A) or multilayer liposomes with DNA between the layers (type B). The transfection efficiency of the former is low but positive. The transfection efficiency of the latter is zero, although they demonstrate better DNA release upon interaction with anionic liposomes. The significant difference can be ascribed to the varying degree of DNA shielding by lipids. In the case of type A complexes, the better shielding results in lower DNA release upon interaction with anionic liposomes and higher transfection efficacy.
The screening through different lipoplexes did not reveal any "etalon" morphology which would lead to increased transfection efficiency. On the contrary, it was shown that starting from different lipid emulsions, complexes of similar morphologies could be obtained. Among those, lipoplexes based on lipids self-assembling into highly curved structures in water demonstrated the highest transfection efficiency. Thus, the surface energy of the complexes, but not the morphology as such, seems to be of importance for the development of efficient transfection agents.

SHORT-CHAIN POLYMERIZABLE LIPID AS A BUILDING BLOCK FOR POTENTIAL DRUG CARRIERS

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Polymerizable lipids attract attention due to the necessity to stabilize lipid based structures such as micelles and liposomes. It is usually assumed that phase behavior of a long-chain lipid bearing double bonds at the end of each tail should be very close to the behavior of a saturated analog. On the other hand, the shorter lipid acyl chain is the more significant is the influence of the polymerizable moiety (e.g. double bond) on lipid packing. Here we report properties of disorbylphosphatidylcholine (DiSorbPC).
Sorbyl (2,4-hexadienoyl) chains are rigid due to conjugated double bonds. This leads to packing restraints and re-

sults in the unique behavior of DiSorbPC in water. The lipid was shown not to form regular micelles and area per lipid on air/water interface is as big as 100 A^2 (in contrast to 50-70A^2 for a common phosphatidylcholine). At high concentrations (0.1 M) some aggregates could be registered using DLS technique, but neither size nor quantity could be reliably determined. The possible reason could be either the size of the aggregates being too small, below 3 nm, or their life time, too short.

On the contrary, being mixed with a long chain lipid DMPC (dimyristoylphosphatidylcholine) DiSorbPC forms well-defined particles. The diameter of the particles is determined by the DiSorbPC/DMPC ratio. The ratio 2:1 yields particles ~40 nm in diameter while 1:2 ratio yields ~200 nm particles. As revealed by 31P NMR, both lipids have equal mobility inside particles. With 31P NMR signal being isotropic, the lipid phase across the particle should not be lamellar.

The two-component particles can be stabilized by radical polymerization, which leads to decrease in the average diameter. Polymerization does not involve DMPC. This lipid can be referred to as a template distributed within the particle on which polymerization occurs.

After polymerization is complete, DMPC can be removed from particles through washing with ethanol yielding porous particles with amphiphilic interior suitable for various cargo.

LASER-ABLATIVE SYNTHESIS OF ULTRA-CLEAN COLLOIDAL NANOMATERIALS FOR BIOLOGICAL APPLICATIONS

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Inorganic nanoparticles (plasmonic nanoparticles, semiconductor-based quantum dots etc) are known to offer novel promising properties for biological sensing and imaging, as well as for therapeutics. However, these applications are often complicated by potential toxicity issues, arising as a result of inadequate purification procedures of nanoparticles obtained via synthetic pathways using toxic or non-biocompatible substances. As an example, despite natural biocompatibility and biodegradability, Si nanoparticles cannot be chemically produced in pure state, as all chemical synthesis routes inevitably lead to their contamination by toxic by-products (HF derivatives etc).
Pulsed laser ablation in liquids has recently emerged as a novel "green" tool for synthesis of colloidal nanomaterials, which offers a breakthrough in the solution of the toxicity problem. In this method, laser radiation is used to ablate a solid target in liquid ambience to form nanoclusters, which are then released into the liquid forming a colloidal nanoparticle solution. A huge advantage of this "physical" synthesis route consists in its independence on colloidal chemistry that enables one to avoid the employment of toxic substances or by-products. Indeed, nanomaterials are directly created from the bulk state, while the fabrication procedure can be carried out in clean environment (deionized water or aqueous biocompatible solutions).
This presentation will review a series of laser-ablative methods for nanosynthesis in aqueous solutions developed recently by our group. The essence of our approach consists in the employment of ultra-short (ps, fs) laser radiation for both laser-ablative nanofabrication and secondary fragmentation of already formed nanoparticles. This makes possible a purely physical control of size characteristics of synthesised nanomaterials (the size can be tuned from few nm to hundreds nanometers) and the reduction of nanoparticle size dispersion. In addition, taking advantage of unique surface chemistry and reactivity of laser-synthesized nanomaterials, we employ different chemical substances (biopolymers, oligosaccharides etc) to control the growth of nanoparticles and functionalize their surface for various applications. In particular, such approach can lead to formation of unique nanostructures without any intermediate group, as, for example, in cases of Au nanoparticle – Polyethylene Glycol (PEG), Au nanoparticle – dextran or Au nanoparticle – Cyclodextrin complexes, suggesting the involvement of new chemical principles associated with "bare" nanomaterial surfaces. Exhibiting unique purity in the absence of even a trace of contaminant, the synthesized nanomaterials look extremely promising for biological imaging and therapeutics and are now tested in cancer research.

FATE AND TOXICITY ASSESSMENT OF NANOPARTICULATE DRUG CARRIER COMPLEX DELIVERING ORAL INSULIN

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At BIONANOTOX 2010, we presented a description of a new nanoparticulate multilayer structure developed for oral delivery of insulin and potentially other peptide/protein-based biopharmaceuticals. Formulation methods involved one or a combination of: nanoemulsion dispersion/triggered *in situ* polymer gelation; ionotropic colloidal pregel/polylectrolyte complex coating; and nanospray drying. The most effective polymeric formulation involves an insulin-loaded alginate-dextran nanoparticulate core, complexed with a chitosan-PEG shell and finally with an albumin coat.
The formulation was shown to reduce glycaemia in diabetic rats over a 24h period following a single oral administration, in a dose dependent manner. Pharmacological activity was by far the highest (42%) of any reported oral dosage form for insulin, and bioavailability was 30% relative to subcutaneous administration.
Nanoparticles and insulin were independently labelled and tracked through the gastrointestinal tract, and following internalization via the intestinal mucosa and enterocytes, into the mesenteric blood, thus through the portal-hepatic route of adminstration.
In vitro simulations were also conducted by measuring insulin nanoparticulate permeation through intestinal membrane models including: i) Caco-2 cell monolayer simulating the small intestinal epithelial layer; ii) Caco-2/HT29 cell co-culture to include the goblet, mucus-secreting cells, and; iii) in excised rat intestinal mucosa to more fully simulate the mucus and epithelial layers and enzymatic barrier of the small intestinal mucosa. It was seen that Caco-2/HT29 cell monolayers more closely simulated nanoparticulate permeation through the animal model intestinal mucosa, showing the importance of mucus-secreting cells for nanoparticles constructed of mucoadhesive biomaterials. Improved and intimate contact between the nanoparticles and mucosal layer thus appear to promote nanoparticle permeation, certainly in comparison to insulin alone which was poorly absorbed. In addition, chitosan as a coating polymer is known to open tight junctions between enterocytes, and the albumin coating was shown to protect insulin from proteolytic enzymes. Co-localization of the labels show that insulin is translocated along with the nanoparticle carriers likely through the transcellular route.
Detailed toxicological assessments have now been conducted short term (15 days) following daily dosing of two different forms of nanoparticulate insulin for glycemic management in diabetic rats. Haematological, biochemical

and urine-based assays, and organ and tissue histology show absence of toxicological effects, and no mortality was observed. Some observed effects were attributed to diabetes physiopathology, inducement or evolution status and thus not directly associated with oral administration of the nanoparticulate drug.

MOLECULARLY IMPRINTED POLYMERS AND THEIR APPLICATIONS IN DRUG DISCOVERY

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Molecularly imprinted polymers (MIP) are biomimetic polymer materials with molecular recognition properties, i.e. ability to interact selectively with molecules of specific shape, size and functionality. MIPs are often referred to as receptor mimics or synthetic receptors, since they share this common feature of molecular recognition with natural receptors. The potential of MIPs' applications in isolation of new bioactive compounds that aim selected molecular targets has been poorly appreciated until. MIP materials have the advantage of simultaneous identification (as receptor mimic) and isolation (as separation phase) of bioactive compounds. It is also important that screening and isolation processes with the use of MIPs can be automated and serve as basis for high throughput screening devices. In these devices MIPs can be used in dual mode. Firstly, these material can be used as separation media and secondly as detectors (sensors) in the same devices. Here we present examples from synthesis of MIPs and their applications as separation media or as parts of sensor devices for search and isolation of new bioactive compounds.

NANOMATERIALS ON THE MARKET

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Nanomaterials may offer benefits for the society as a whole as well as citizens, but may also pose risks to human health and the environment. There is a unanimous need to get a better overview of what types of nanomaterials are on the market.
This paper presents a preliminary overview of the current situation on the nanomaterials on the market based on available information obtained from industry associations, international organisations and research projects or individual companies. Due to the lack of a commonly agreed definition for nanomaterial, this preliminary assessment uses the definition applied by many data sources, usually referring to approximate external size range of 1-100 nm of nanomaterials. Furthermore, it assesses the kind of information can be expected from the regulatory reporting in REACH and CLP on the basis of current provisions.
Some nanomaterials, such as carbon black and silica have been produced since 1900 and 1940s, respectively. Nanoforms of titanium oxide and zinc oxide came to market in large scale during 1970s. The most common current ones, already in a variety of applications, are ceramic and metal nanoparticles, nanoporous materials, carbon nanotubes, fullerenes used as fillers in cosmetics, nanowires, nano-polymers and bionanomaterials, products derived from nanoencapsulation of liposomes, micelles, solid lipids, polymersomes, emulsions, and silica shells etc
The estimate about the marketed nanoapplications from 2007 indicates that one fourth of the applications are used in health care and life sciences, around one tenth in ICT and consumer goods and chemicals. Defence and security, energy, environment, construction and automotive and transportation each account for 7-6%. (Technology Transfer Center, 2007).
There seems to be a convergent view regarding nanomaterials on the market for R&D and industrial purposes. Some of the materials have also been in use for fairly long time. Majority of nanomaterials currently on the market seems to be produced together with the respective bulk substance. Therefore they are covered by the CLP and REACH obligations.
So in principle REACH and CLP should cover also specific hazards and risks related to the nanomaterials. However, as neither the regulatory text nor the guidelines address specifically nanomaterials it remains to be seen to which extent nanospecific aspects in relation to hazard and risks from nanomaterials on the market presently are adequately implemented through the current legislation.

SELF-ASSEMMBLING ANTIVIRALS AGAINST INFLUENZA

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We synthesized oligoglycines, both linear and branched with 2-4 Gly_n chains (n=1-10), and coupled them with sialooligosaccharides, synthetic analogues of receptors used by influenza viruses upon attachment to target cells. The obtained sialoglycopeptides with the chains built from more than six Gly residues were capable of spontaneous self-assembly in aqueous solution forming flat aggregates with planar sizes ranged from 50 to 1000 nm. The aggregates proved to be 2D nano-crystallites with the interior formed by the coiled into 3_1-helixes oligo-Gly chains, which are arrayed to built hexagonal lattice and stabilized by extensive network of intermolecular H-bonds (so called polyglycine II structure), and the outer surface covered with the sialic moieties.
The sialoglycopeptides were tested as blockers of influenza virus in a solid phase assay and in experiments by neutralization of virus infectivity in MDCK cell culture. The associating compounds blocked virus at low micromolar concentration range (IC_{50}=5-50 mM); their antiviral activity was raised three orders of magnitude comparing to that of the non-associating counterparts. Obviously the glycopeptide aggregates are capable of tight multivalent binding with influenza virus particles and steric prevention of interactions between virus and cell.
We optimized surface density of sialic moieties on the surface of the aggregates preparing them from the glycosylated and non-glycosylated peptides; this allowed enhancing the antiviral activity additionally in 10-50 times. Also, we varied structure of the branched molecules (nature of branching core, number and length of oligoglycine antennae) in order to tune their potency of self-assembly and managed to get a glycopeptide that aggregates only upon interaction with influenza virus whilst remaining not associated in solution.
The described observations can be used to get a novel type of chemotherapeutics for treatment of seasonal and pandemic flu.

IMMOBILIZED ENZYMATIC REAGENT FOR BIOLUMINESCENT ECOLOGICAL MONITORING

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The goal of the study is to develop an enzymatic reagent for environmental monitoring provided an alarm detection and quantitative measurement of integral toxicity levels caused by chemical or biological threats. It includes co-immobilized into dried starch or gelatin gels bacterial coupled enzymatic system: NADH:FMN-oxidoreductase (R) and luciferase (L) and their substrates (mirystic aldehyde and NADH). The bioluminescent immobilized multi-component reagent controls the effect of the sum of toxicants. The reagent is formed as a dried disc with a diameter of 6-7 mm; its dry weight is 1.5 ± 0.2 mg. The reagent maintains the high enzymatic activity in a wide range of temperatures, pH and ion concentration.
The reagent' sensitivity to toxic substances depends on composition and concentrations of enzymes and substrates inside the reagent; priorities for the control and analyzed samples, the sequence of injection for components of reaction mixture, ratio of the reaction mixture and sample volume and incubation time (1- 5 minutes).
The effect of toxicants (phenols, quinones and heavy metal salts) on reagent' activity has been analyzed. We determined EC_{50} and EC_{20} constituted 50% and 20% of the loss of reagent's luminescence in comparison with the maximum permissible concentration (MPC) for each of the analyzed substances. Reagent has been shown to be more sensitive to quinones. The sensitivity of detection for naphtoquinone, benzoquinone, toluquinone and thymoquinone (0,01, 0,003, 0,05 and 0,03 mg/L, correspondently) were less than their MPC. The reagent was much more sensitive to heavy metal salts than soluble enzymes. When dithiotreitol, mercaptoethanol, or bovine serum albumin were inserted to the reagent we observed the increase of its bioluminescent activity, higher stability of immobilized enzymes during storage, but decrease of the reagent's sensitivity to toxic substances.
There is a good correlation between the results of assay obtained with the reagent and chemical analyses of the industrial waste waters of pulp-and-paper plant (Krasnoyarsk, Russia). Application of the multi-component immobilized reagent improves the characteristics of the enzymatic bioluminescent analysis, particularly in terms of accuracy and simplification of the measurement procedure. The reagent can be used as biological module for the enzyme-based biosensors.

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MODELS OF ENZYMES' FUNCTIONING INSIDE THE LUMINOUS BACTERIA USING BIO-MATERIALS: NEW APPROACH FOR APPLICATION IN BIOENGINEERING

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The new approach to the modeling the living cell has been suggested to research the mechanisms coupling and regulation of enzyme metabolic chains and other chemical processes inside the cell using bio-materials. The approach consists in a design of simplified model of cell matrix as an experimental tool. The four prototypes of experimental models were developed. The coupled enzyme system: NADH: FMN-oxidoreductase -luciferase from luminous bacteria was reconstructed in the solutions of high viscosity (sucrose and glycerol) and in starch and gelatin gels. The models manifest the bioluminescent activity and simulate vicious microenvironment of enzymes in the cell protoplasm and their association with the cellular membranes and among enzymes.
Comparative analysis of characteristics (quantum yield, residual enzyme activity, the rate of decay of reaction intermediate, pH-optimum, thermostability, activation energy, constant of thermoinactivation, and Michaelis constant and some other parameters) of the coupled enzyme system in the prototypes of experimental models and soluble ones revealed advantages and disadvantages of the models. Analysis of fluorescent spectra of bioluminescent reaction components (FMN) in the models indicates the stability of the proteins' conformation and could not be the main mechanisms by which the microenvironment influences the enzymes. The best experimental prototype among the four ones was the potato starch experimental model. The thermodynamic and mathematical models to describe the mechanisms coupling and regulating enzyme metabolic chains inside the cell for all experimental models have been developed. The perspectives of applications in bioengineering to design the molecular and cellular experimental models for researching the enzyme-substrate interaction within the cell, intra-cell synthetic processes, and transition of the cell to anabiotic state were estimated. The other applications are to design the cost-competitive bioluminescence-based biosensors based on prototypes of experimental models using bio-materials for medical, environmental, and industrial applications. Bioluminescent express signal laboratory utilizing new bioluminescent biosensors has been developed.
This research was supported by Russian Foundation for Basic Research (grant 07-04-01340-), the Federal Agency for Science and Innovations (Contract No 02.740.11.0766), the RF Ministry of Education and Science and CRDF (grants No 2.2.2.2/5309), CRDF (RUX0-002-KR-06/BP4M02), the Russian Academy of Sciences (Program "Molecular and Cell Biology"), and the President of the Russian Federation (Grant "Scientific School" 64987.2010.4).

STIMULI RESPONSIVE LANTHANIDE DOPED NANOPARTICLES

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Multifunctional stimuli responsive nanoparticles gain much attention as the basis of nano-materials for drug delivery and bio-sensing. The present report represents some of potential ways to obtain lanthanide doped core-shell nanoparticles. The first of them is the the doping of luminescent lanthanide complexes into silica nanoparticles through the microemulsion and Stober procedure. The main advantages and shortcomings of microemulsion and Stober procedures will be discussed. The approaches to get dual luminescent (both visible and near IR) silica nanoparticles through the doping of two luminophoric metal complexes will be also represented. The second way to get core-shell luminescent nanoparticles is to encapsulate the repricipitated luminescent Eu(III) complex as a core into polyelectrolyte capsule fabricated through the layer-by-layer (LbL) procedure. Long life times of the excited state, narrow intensive emission bands, low rates of leakage and photobleaching are the main advantages of lanthanide doped nanoparticles. The size variation from 30 to 300 nm has been got through the use of various procedures. The wavelength of the emission bands has been modified from visible to near IR, as well as dual visible-near IR by the variation of lanthanide ions (Eu(III), Tb(III), Yb(III), Nd(III)) and/or ligand environment.
The non-covalent adsorption of surfactants at the silica/water interface of lanthanide doped silica nanoparticles and LbL polyelectrolyte assembly are represented as possible ways to modify the shell of core-shell nanoparticles. The substrate induced quenching or sensitizing of the lanthanide centered luminescence will be also represented as a basis to gain sensing function.
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BIOMATERIALES IN BIOANALYSIS METHODS

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Toxic compounds in medicine, food and environmental must be controlled in global scale with high-throughput screening (HTS). The common used methods of assays like chromatography techniques have several limitations for HTS. In modern time the Bioanalysis methods are the most developed and applied for HTS. These bioanalysis based on the special biomaterials as recognition materials. The recent progress for production and properties of antibodies (polyclonal, monoclonal, recombinant) and so named "synthethic antibodies" like molecularly-imprinted polymers (MIP), aptamers (DNA), peptides and another synthetic binders were discussed. More details could be found in our new publications [1-6] and this year reviews [7-9].

Acknowledgement
The research was supported by Grant of Russian Foundation for Basic Research (11-04-91189) Mechanism of the enantio-selective molecular recognition between chiral hapten and antibody: ofloxacin as model.

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DEVELOPMENT OF MAGHEMITE COLLOIDAL NANOCLUSTERS AS MRI CONTRAST AGENTS

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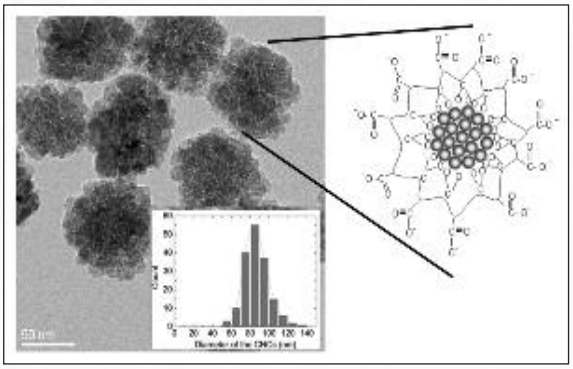
The synthesis of monodispersed magnetic nanoparticles (NPs) is a particularly important area of research and attracts a growing interest because of the materials' diverse applications, spanning from ferrofluids and magnetic memory devices to biotechnology or biomedicine. Here we report on a high-temperature colloidal chemistry method for the growth of iron-oxide nanocrystal clusters (CNCs); a secondary structure with tunable dimensions (ranging from 40 to 120 nm). Our transmission electron microscopy (TEM) results suggest that the as-made CNCs are a large ensemble of nanocrystals self-assembled in a superstructure (Fig. 1). It is worth noting that depending on the choice of the synthetic parameters, CNCs can be grown to incorporate different size primary NPs. Our Mossbauer studies prove that the NPs' chemical nature is solely that of the maghemite structural type. The use of an amphiphylic polymer (i.e. polyacrylic acid) as a surfactant allows for the oriented aggregation of the NPs within the CNCs, but importantly gives rise to a negatively charged surface rendering the nanoclusters highly dispersible in aqueous

media. Such a capability is a critical parameter if the materials' exploitation aims at biomedical fields.



Despite the increasing volume size of the CNCs, SQUID magnetometry shows that they display super-paramagnetism at room temperature (attain no agglomeration because of attractive magnetic forces), which further supports their prospects for biomedical applications (for example, as smart MRI contrast enhancers, in targeted delivery of drugs etc). In view of the CNCs beneficial magnetic and morphological characteristics, the longitudinal (r_1) and transverse (r_2) nuclear magnetic relaxation dispersion (NMRD) profiles have been measured and compared with those of the commercial contrast agent Endorem®. We reveal that the determined r_2 nuclear relaxivity is almost four times that of Endorem®, allowing us to propose the CNCs as effective magnetic resonance imaging (MRI) contrast agents.

Figure 1. TEM image of purified colloidal nanocrystal clusters (CNCs) (grain size ~12 nm). Inset: estimated average size distribution, 86 nm. Schematic: depicting the secondary structure as an assembly of maghemite nanoparticles covered with a functional polyacrylate layer.

DESIGN OF DRUG DELIVERY SYSTEMS USING HYDRAZONE CHEMICAL LIGATION

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Delivery of low molecular weight drugs to target cells and intracellular sites of action is a well-established approach to increase their efficiency and reduce side effects. Advanced drug delivery systems comprise several functional units, including cell surface receptor ligand and other vector molecules, such as nuclear localization signal (NLS). The practical utility of complex multicomponent systems depends on availability of simple and reliable technique to assemble different building blocks in one molecule and displace them according to mechanism of desired biological effect. Here we describe advantages of hydrazone chemical ligation as an efficient and selective method for the synthesis of multifunctional peptide carriers and their conjugates with different therapeutic agents.
The practical utility of this approach was confirmed by the synthesis of GnRH analogs for the targeted delivery of antitumour compounds to cancer cells and model RGD peptides conjugated with cytotoxic agents. Considering that hydrazone ligation technique implies incorporation of keto or hydrazide group into carrier molecule we developed simple protocols for aminomethyl polymer modification and subsequent synthesis of peptide hydrazides. Suggested technique was successfully applied to the preparation of NLS from large T-antigen of SV40 virus, containing hydrazine-sensitive amino acid residues. Conjugation of deprotected peptide hydrazide with GnRH or RGD analogues, modified by pyruvic acid resulted in hydrazone bond formation in mild acidic conditions. This chemoselective reaction is especially useful for coupling of peptide fragments containing multiple arginine and lysine residues typically present in NLS. Synthesized peptide conjugates form stable complexes with DNA and can serve as carrier molecules for targeted suicide gene delivery to cancer cells.
It is known that many GnRH and RGD analogues conjugated with cytotoxic agent efficiently suppress tumour growth both in vitro and in vivo. In order to investigate the scope and utility of hydrazone ligation for immobilization of different biologically active compounds we prepared a set of GnRH analogues, modified by pyruvic acid, hydrazide of glutaric acid, hydrazinoacetic acid and aminooxyacetic acid. Synthesized peptides were used as carriers for the delivery of 5-FU derivatives and model analogue of steroid estrogens into cancer cells expressing GnRH receptors.
Finally, application of new polymer for the synthesis of peptide hydrazides in conjunction with assembly of carrier molecule by means of hydrazone or oxime ligation permits significantly simplify development of multifunctional drug delivery systems.

BIODEGRADABLE MICROCARRIERS WITH ENTRAPPED BIOACTIVE PEPTIDES FOR TISSUE ENGINEERING

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Presently microcarriers are widely used for cell expansion in vitro but also offer an approach for combining cell transplantation and tissue engineering. Microcarriers are employed in diverse applications of tissue repair, including bone, cartilage, skin, vascular, central nervous system, adipose tissue, and liver repair. They can be also used to bulk-culture and deliver stem cells for tissue regeneration. The main advantage of microcarriers over other scaffolds is the possibility to be injected into wound area in a minimally invasive manner. Microcarriers can be designed to promote cell attachment, proliferation and differentiation. Thrombin, a serine protease of trypsin family plays a key role in wound healing by interacting with cells via cell receptors and stimulating cell adhesion, proliferation of fibroblast and other cells, synthesis of collagen by fibroblasts etc. Some bioactive peptides, such as thrombin receptor agonist peptide (TRAP-6) and its close analogues could replace thrombin in terms of accelerating tissue repair being less expensive and more stable [Markvicheva E. et al, 2006].The aim of the study was to develop and to optimize biodegradable poly(D,L-lactic) acid (PDLLA), poly(L-lactic) acid (PLLA) and poly(D,L)-lactide-co-glycolide (PLGA) microbeads as microcarriers for tissue engineering. The surface of these microspheres have been modified with polycationic polymers (chitosan, chitosan-g-PLA copolymers, PDMAEMA), in order to promote enhanced adhesion of fibroblasts. TRAP-6 and TRAP-6M were entrapped in the microbeads at preparation step to promote cell growth. The release kinetics of the peptides was evaluated by HPLC. Mouse fibroblasts L-929 were used as a model cell line. The surface topography of the microcarriers was studied by scanning electron microscopy. Cell growth was observed by optical microscopy, and cell proliferation index was estimated by MTT-assay. An *in vitro* study of the microcarriers demonstrated that both surface topography and surface chemistry affect the cell attachment, spreading and proliferation on the microcarriers.

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EXPERIENCE OF SIBERIAN FEDERAL UNIVERSITY IN THE BIOLOGY TEACHING – TRAINING OF SPESIALISTS IN BIOMATERIAL SCIENCES

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Siberian Federal University was established by the Ministry of Education and Science of the Russian Federation on the 28th of November, 2006. The institution integrated four large higher education institutions (Krasnoyarsk State Technical University, Krasnoyarsk State Academy of Architecture and Civil Construction, Krasnoyarsk State University, State University of Non-Ferrous Metals and Gold) into one 43 000-student university. The first two institutions can trace their roots back to 1956 when Krasnoyarsk Polytechnic Institute, the predecessor of these institutions, was founded. The Institute of Nonferrous Metals was set up as a branch of the Moscow Mining Academy, which was founded in 1918. Krasnoyarsk State University was established in 1969 as an institution working in close partnership with the Russian Academy of Sciences. The aim of the merger was to build a pool of skilled specialists to contribute to the emergence of the area as a significant industrial centre, with the well-qualified workforce, natural resources and industries to compete globally.
At the present time, Siberian Federal University includes 40 R&D subdivisions such as Research Institutes, Design Bureau, multiple-access centers, REC, laboratories, Innovation Centers, technology parks, Centers for Technology Transfer, pilot factories, etc.

03.00.00	Life Sciences
03.00.02	Biophysics
03.00.04	Biochemistry
03.00.07	Microbiology
03.00.12	Physiology and Biochemistry of Plants
03.00.16	Ecology
03.00.18	Hydrobiology
03.00.37	Biological Resources

The number of full-time students in SibFU – 43000 people.
The number of the faculty — more than 3300 people.
Total quantity of faculty and staff — more than 8000 people.
The Institute of Fundamental Biology and Biotechnology offers a variety of 4-year Bachelor's Degree programs in biology (bioengineering and biotechnology, biophysics, biochemistry, bioecology), 2-year Master's Degree programs in biology (biophysics; microbiology and biotechnology; plant physiology; biochemistry and molecular biology; hydrobiology and ichthyology), 2-year Master's Degree programs in physics ((biophysics; radioecology) and 5-year Specialist's Degree programs in biology; biochemistry and biochemical physics. There are Doctoral Programmes in the Institute of Fundamental Biology and Biotechnology:
Specialists with diplomas of The Institute of Fundamental Biology and Biotechnology SibFU work in medical and research foundations of Siberia, RF, and abroad.

DEGRADATION OF POLYHYDROXYALKANOATES IN A FRESHWATER RESERVOIR

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Dynamics and specific rates of polyhydroxyalkanoate (PHA) degradation were studied experimentally during three summers in a small recreational eutrophic Siberian reservoir. To fit the degradation kinetics a model that describes active consumption of the study (tested) substrate by the bacteria that grow on another substrate was used. It has been shown that biodegradation of PHA in the natural reservoir was determined by the structure and physico-chemical properties of the polymer and by environmental conditions in the aquatic ecosystem. Species (genotypes) of bacteria able to utilize PHA in the reservoir were identified using molecular phylogenetic analysis of 16S rRNA genes.

APPLICATION OF HYDROPHILIC IONIC LIQUIDS FOR THE REACTIONS CATALYZED BY PLANT PEROXIDASES, NATIVE AND ENCAPSULATED IN A CELLULOSE MATRIX

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Nowadays, ionic liquids (ILs) are often considered as an alternative to molecular organic solvents for catalysis, including biocatalysis in monophasic as well as biphasic systems. The investigations of the reactions catalyzed by plant peroxidases, which are commonly used in chemical analysis, in the hydrophilic ILs are still sketchy. At the same time the significant drawback of traditional polar organic solvents is their denaturing effect on the catalytic activity of native horseradish peroxidase (HRP) and soybean peroxidase (SBP). In this report the results of the kinetics study of the reactions of oxidation of the model phenolic substrates (quaiacol, *o*-chlorophenol) by *t*-BuOOH catalyzed by HRP and SBP in the presence of hydrophilic IL: 1-butyl-2-methylimidazolium ([BMIm]) and N-butyl-3-methylpyridinium ([BMPy]) tetrafluoroborates, and polar organic solvents (DMSO, acetonitrile) are presented.
Due to the optimal order of the components introduction into the indicator systems and the proper choice of optimal buffer solutions, which are co-solvents of ILs, the rate of the indicator reactions in the presence of≥60 vol% of hydrophilic ILs was controlled by spectrophotometry. The catalytic activity and substrate specificity of the considered plant peroxidases were found to depend significantly on the nature of the enzyme, IL cation, and a buffer solution. Replacing the organic solvent on hydrophilic IL and optimization of the reaction medium formulation allowed us to observe the oxidation of phenol compounds catalyzed by peroxidases in the presence of 60 – 80 vol% IL and to develop the procedures for the determination of the substrates in the samples with low water concentrations.
During last few years there has been a considerable interest in the application of hydrophilic ILs as solvents for cellulose, polymers, tetraethyl orthosilicates, and etc. with the aim of obtaining various composite materials for electrochemical and optical biosensors. We optimized in detail the conditions of the formation of peroxidase-cellulose-IL-based film. To estimate the catalytic activity of the resulting composite material with immobilized peroxidase a spectrophotometric technique was used. The oxidation of TMB with H_2O_2 was chosen as an indicator reaction. Peroxidase encapsulated in a cellulose matrix was found to retain ≥95% of its original activity.
This work was supported by the Russian Foundation for Basic Research (grant no. 09-03-00823-a) and the RF Ministry of Education and Science (contract no. 991, 2010, 27 May).

PREPARATION AND CHARACTERIZATION OF ACYL-β-CYCLODEXTRIN NANOCAPSULES LOADING 4 – THIOUREIDOIMINOMETHYLPYRIDINIUM PERCHLORATE

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Many drugs have unwanted side effects on the human organism. Reduction of these effects is possible with encapsulated drugs. In addition, the use of nanocapsules based on β-cyclodextrin not only significantly reduces the systemic toxicity of the drugs, but also makes it possible targeting and retard release in the organism. New antitubercular drug 4 – thioureidoiminomethylpyridinium perchlorate was used for encapsulation.
The ability to incorporate various molecules inside the cavity, as well as transport properties of amphiphilic compounds allow to use cyclodextrins to obtain new supramolecular structures, such as nanoparticles. In order to facilitate the interaction of natural cyclodextrins with biological membranes, it is useful modification to enhance the amphiphilic properties of cyclodextrins. The ability of amphiphilic derivatives of β-and γ-cyclodextrin to the formation of nanoparticles has been shown in various studies. The purpose of this work - synthesis, study of new amphiphilic β-cyclodextrins and evaluation of their ability for 4 – thioureidoiminomethylpyridinium perchlorate nanocapsulation. Partially substituted amphiphilic β-cyclodextrins were synthesized, modified with acyl residues of fatty acids (myristic and stearic). Acylation reactions of β-cyclodextrin were carried out in various ways - in the presence of hydrogen chloride acceptor (pyridine), and without the acceptor (in DMF).
It was estimated the average degree of substitution of β-cyclodextrin (according to elemental analysis), in a medium of pyridine was for myristic and stearic acid 1,6 and 1,8 respectively, and in the DMF - 1,3 and 1,1 respectively. In the IR spectra obtained derivatives presents a signal of the carbonyl group at 1735 cm-1, characteristic for ester bond. In the NMR spectrum of amphiphilic cyclodextrins appears intensive signal of –CH2– groups (1.28 ppm), signals at 2.32, 1.54, 1.19 ppm correspond to nonequivalent methylene fragments near the ester group, the signal 0.9 ppm refers to the methyl fragment at the end of the chain. Nanocapsules were prepared by the method of spherical crystallization. SEM was used for determination of size of nanocapsules (50-150 nm). The degree of nanocapsules loading with 4 – thioureidoiminomethylpyridinium perchlorate was evaluated using conductometry and reached for at least 42%. Thus, it was shown the possibility of amphiphilic derivatives of β-cyclodextrin for 4 – thioureidoiminomethylpyridinium perchlorate nanocapsulation.

BIENZYME NANOSCALE COMPLEXES FOR MEDICAL APPLICATIONS

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Method of enzyme encapsulation with block ionomers was developed for drug target delivery for post apoplectic period therapy, Alzheimer's disease, Parkinson's disease, neurosis, vascular dementia, inflammation etc. Bienzyme systems generation considered to be perspective. In one particle, there are antioxidant enzymes (catalase, SOD, glutathione peroxidase) catalyzing sequential reactions of reactive oxigen species ROS elimination. A wide range of enzyme or bienzyme containing systems with block-ionomer was obtained: polymer shell composition, charge varied. Bionanosystems based on complexes of an enzyme (catalase, SOD, glutathione peroxidase) and a block ionomer with different length and branching of the charged chain termed "nanozymes". [Brynskikh A., Zhao Y., Mosley R., Li S., Boska M. , Klyachko N., Kabanov A., Gendelman H., Batrakova E. Macrophage delivery of therapeutic nanozymes in a murine model of Parkinson's disease.// Nanomedicine (Lond). 2010. 5(3). P. 379–396].
Polymer shell formation with protein core is based on the electrostatic interactions of oppositely charged groups of the components. For crosslinking, one can use well known crosslinking agents, the developed technique preserve system stability and enzyme activity after encapsulation. We demonstrate that enzyme-ionomer nanoparticles display better protease stability. Use of block ionomer opens possibilities for surface modification and supposed to be perspective for drug delivery through the BBB. Investigations were financially supported by Russian Ministry of Science and Education (grant No.02.740.11.5231, grant No.11.G34.31.0004).

A METHOD TO PRODUCE BIOLOGIGALLY ACTIVE NANOCOMPLEXES BY NON-COVALENT CONJUGATION OF PROTEINS WITH VIRAL PARTICLES

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Currently, a range of biologically active molecules have been attached to plant and bacterial viral nanoscaffolds, yielding stable nanoparticles that display multiple copies of the desired molecule. In this paper we propose a new method for non-covalent attachment of peptides to the surface of virions. We showed that this method is efficient in a model system including tobacco mosaic virus particles, synthetic polycation (quaternized poly(4-vinylpyridine), carrying ethyl ethyl pendant radicals) and model polypeptide. This principle of step-by-step binding on the the surface of virions was used for electrostatic association of hydrophilic fragment of influenza virus hemagglutinin. As a result it was found significant increase of immunogenic activity of this artificial vaccine protein.

STUDY OF NANOSIZED FERRIOXIDE SYSTEMS IN THE REACTION OF THE METHYLBUTENE DEHYDROGENATION

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Ferrioxide systems could be the basis for the development of catalysts which are cheap and competitive for ones from global producers. Multicomponent dehydrogenation catalysts of olefin and alkyl aromatic compounds contain transition metals of variable valency, alkaline, alkaline-earth and rare-earth elements besides ferrioxide compounds. So far there is no consensus about the nature of the active component of the catalyst and about the role of inputs in its composition. The aim of this work is to study the shape and the size of particles of complex iron oxide systems and to evaluate a systems catalytic activity in the reaction of the methylbutenes dehydrogenation. Explored catalytic systems consist of iron oxide compounds and their mixture with compounds of potassium, cerium, and molybdenum. Initial iron oxide compounds are prepared by deposition of iron hydroxide (II) from solution following by its oxidation with subsequent filtration, washing, drying and calcination. Study of the shape and size of particles of catalytically active iron oxide systems was carried out by intermittent-contact atomic force microscopy.
The initial ferrioxide system includes spherical particles with an average size 60 nm. An addition of an alkaline metal, particularly potassium, to the system results in an enlargement of the particles up to 130 nm with preservation of their form and their agglomeration. An addition of transition metals such as cerium and molybdenum also leads to increase of the particles size up to 190 and 250 nm respectively, and to agglomeration. In the case of cerium change in the shape of the particles is observed. They get planes. Examination of catalytic activity was carried out in a laboratory flow apparatus at 600 ° C. The molar dilution of the raw material by vapor was 1:20. Study of catalytic activity showed that the conversion and the selectivity of initial iron oxide system are about 18% and 66% respectively. An addition of cerium or molybdenum increases the selectivity to 84% or 78% with some decrease in the conversion to 11%.The conversion and the selectivity of the iron oxide system contained potassium are 35% and 74% respectively. Analysis of the phase composition of synthesized samples showed the presence of spinel like γ-iron oxide (III), solid solutions on its basis, as well as alkaline metal ferrites in comparison with X-ray diffraction method.

PROPERTIES OF LUMINESCENT TB-DOPED SILICA NANOPARTICLES WITH ADSORBED SURFACTANTS ON THEIR SURFACE

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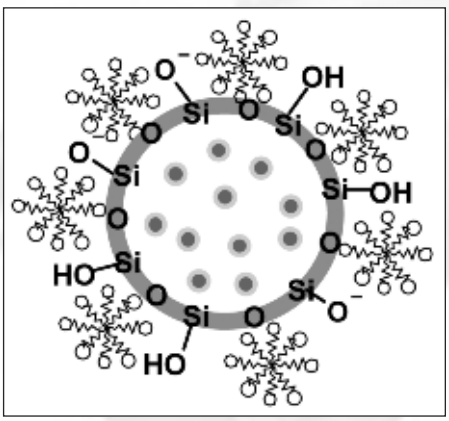
Smart colloidal systems, which are temperature, pH, or substrate responsive, gain much attention due to their possible application in bioanalysis, medicine and technology. Luminescent lanthanide-doped silica nanoparticles have great perspectives in practical application. The metal complex-doped nanoparticles have an advantage over a single complex, since the silica shell protects the metal complex from photodegradation, while the surface of the nanoparticle can be functionalized by various anchoring groups. Lanthanide complexes have gained a great deal of attention as dopants owing to their unique spectroscopic characteristics, including long fluorescence lifetime, large Stokes shift, and sharp line-like emission bands.



The silica surface decoration is aimed to increase the colloidal stability of nanoparticles, as well as to develop their receptor properties towards biotargets. The decoration of the silica surface through the non-covalent interactions represents more convenient alternative to covalent anchoring due to the lack of multistep purification procedures.
The approaches to sense the adsorption of various surfactants onto silica surface of Tb-doped nanoparticles will be discussed. The methods of dynamic light scattering and luminescent spectroscopy were used. The development of temperature responsive colloidal systems with the use of nanoparticles and nonionic surfactants or pluronics as main building blocks will be introduced within the present report. The decoration of silica nanoparticles by cationic surfactants will be also represented as a convenient way to get non-aggregated positively charged silica nanoparticles, which are able to bind anions. The regularities of the "on-off-on" luminescence switching as an active response on the binding versus elimination of anions will be also discussed.

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HYDROPHOBIC ANISOTROPY OF SCORPION α-TOXINS SURFACE IS INTERRELATED WITH SPECIES SELECTIVITY AND TOXICITY

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Voltage-gated sodium channels (Na_Vs) are large integral membrane proteins that initiate action potential in excitable cells, what makes them a primary target of numerous neurotoxins, such as polypeptide toxins from scorpion venom. Some of them, α-toxins, bind with high affinity to extracellular S3–S4 loop of domain IV of Na_Vs α-subunit (referred to as site 3), slowing channel inactivation and causing a prolonged action potential. α-Toxins may be mammals-selective ("classic" α-toxins, binding to one or several of nine mammal Na_Vs subtypes), insects-selective ("insectotoxins" that bind the sole insect Na_V channel) or acting on both phyla ("α-like" toxins). The search of structural and dynamic features of related toxins that define selectivity to channels' subtypes is not only fundamental to neurobiology and revelation of Na_Vs binding surfaces, but also leads the way to novel potent insecticides that are safe for humans and cattle.
α-Toxins (approximately 55–65 residues long) seem to be composed of two evolutionary independent and functionally different "domains": Core-domain, which includes common to all scorpion toxins βαββ-fold, and so-called RC-domain, which comprises N-terminal reverse turn and C-tail of the polypeptide that are pulled together by disulphide bond. Core domain most probably is responsible for binding to conservative channel surfaces that are invariant in either Na_V subtype; RC-domain is believed to determine species and channels' selectivity.
Here we studied hydrophobic/hydrophilic properties and conformational mobility of number of scorpion α-toxins by means of molecular dynamics and molecular hydrophobicity potential approach. For group of "classic" mammalian toxins it was discovered that molecules are non-uniformly polar: RC-domain appears to be significantly more hydrophilic and flexible, as compared to Core-domain, and the magnitude of this "anisotropy" is related to half-lethal dose (LD_{50}) of corresponding toxin. For two other groups that have insect activity there's no such difference between "domains". These peculiarities should reflect some features of their channels' binding surfaces, and may serve a starting point for further discovery of species selectivity mechanism and also for design of engineered analogs of toxins that selectively bind to insect Na_V. Moreover, existence of two functional domains sheds some light on molecular evolution of toxins, and, therefore, sodium channels.

LIPID-PROTEIN NANODISCS – PROMISING MEDIUM FOR STABILIZATION IN SOLUTION AND STRUCTURE-FUNCTIONAL STUDIES OF MEMBRANE BIOMOLECULES

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Membrane proteins and membrane-active peptides (MPs) play key roles in many biological processes essential for living cells, whole organisms and their communities. These molecules are responsible for cell energetics, reception of intercellular signals, as well as for functioning of nervous, endocrine and immune systems of higher animals. Moreover MPs provoke much interest due to their perspective application in biotechnology (membrane enzymes), bio-nanotechnology (chemical sensors, photoactive proteins), pharmacology and medicine (membrane receptors, membrane-active drugs, delivery of hydrophobic compounds). Presently, the practical applications and fundamental studies of MPs are significantly complicated. The main difficulties in this field are connected with the requirement of biological membrane or suitable membrane mimicking medium for stabilization of MPs with native spatial structure in solution. The commonly used membrane mimetics (low-polarity organic solvents, detergent micelles and bicelles) display some serious shortcomings and in many cases do not able to adequately represent membrane environment and provide enough stability for encapsulated MPs. On the other hand, the real bilayered systems (in form of lipid vesicles) are too large to be used directly in biotechnological and pharmacological applications and in fundamental structure-functional studies.
The present work is devoted to the study of possible applications of a new membrane mimicking medium – reconstituted high density lipoprotein particles or Lipid-Protein Nanodiscs (LPNs). Each LPN represents a fragment of lipid bilayer (~160 lipid molecules) stabilized by a dimer of human apolipoprotein A1 or its synthetic analogue. These particles have discoid shape with characteristic dimensions 10x4 nm. In principle, the LPNs could provide superior membrane mimicking characteristics and enhanced sample stability as compared with conventional membrane mimetics. The applicability of LPN based membrane mimetics for stabilization in solution of functional MPs was studied using Bacteriorhodopsin, bacterial K+ channel KcsA, isolated voltage-sensing domain of the K+ channel KvAP, tarantula membrane-active voltage sensor toxin VSTx1 that inhibits KvAP, and hydrophobic antibiotic antiamoebin I. The complexes of these MPs with LPNs containing lipid molecules with different properties (anionic, zwitterionic, saturated, unsaturated) were formed. The hydrodynamic characteristics, stoichiometry of LPN/MP complexes, and structural and functional properties of encapsulated MPs were studied using gel-filtration, ^{31}P- and ^{1}H,^{15}N-NMR spectroscopy, and ligand-binding experiments. Obtained data point to applicability of LPN based membrane mimetics for long-term stabilization of MPs in solution. The usage of LPNs provides a new framework for structure-functional studies of membrane proteins and membrane-active peptides and opens new frontiers for applications of membrane biomolecules and other hydrophobic compounds in biotechnology and pharmacology.

LARGE-SCALE CELL-FREE PRODUCTION OF MEMBRANE PROTEINS

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Applications in biotechnology and pharmacology as well as functional and structural investigations of membrane proteins (MPs) require large-scale systems for their production. The traditionally used cell-based expression systems have serious shortcomings in application to the production of membrane proteins. For example, the high-level membrane targeted expression in the mammalian, insect, yeast or bacterial cells was found possible only for limited set of MPs, while in a majority of cases the expression within the cell membrane provides modest quantities of a recombinant protein with insufficient yield. On the other hand the production of MPs in a form of inclusion bodies requires the effective protocol of refolding to endow the recombinant MPs with functionality. The difficulties in production of MPs are conditioned by requirement of membrane-like environment for stabilization of correct spatial structure and support of functional activity of these hydrophobic proteins in solution. Cell-free (CF) expression systems are promising alternative to cell-based systems. In CF systems production of MPs in a soluble form could be facilitated by addition of membrane mimicking components e.g. detergent micelles, liposomes or lipid-protein nanodiscs (LPNs) directly into a reaction mixture (RM).
In the present work the different approaches for CF production of helical MPs were studied using three model proteins: transmembrane (TM) domain of human receptor tyrosine kinase ErbB3 (TM-ErbB3, 1TM), isolated voltage-sensing domain of K+ channel KvAP (VSD, 4TM), and bacteriorhodopsin from *Exiguobacterium sibiricum* (ESR, 7TM). Successful production of the TM-ErbB3 with the yield ~ 2 mg/ml of RM was achieved in three different ways: (1) in a soluble form in the presence of Brij detergents, (2) in a soluble form in the presence of LPNs, and (3) in a form of RM precipitate with subsequent refolding. The functional active ESR in a soluble form was synthesized only in the presence of LPNs (0.4 mg/ml of RM). At the same time the production of the VSD in a soluble form in the presence of detergent micelles or LPNs led to incorrectly folded domain. Successful refolding of the VSD with ~ 70% efficiency and the final yield 0.6 mg/ml of RM was achieved by solubilization of RM precipitate in urea/SDS mixture followed by refolding on Ni^{2+}-NTA column. Obtained results indicate that CF synthesis represents the promising approach for large-scale production of MPs in the functional form and opens broad perspectives for their fundamental studies and applications in the field of biotechnology and pharmacology.

THE NOVEL DIAGNOSTIC METHOD FOR THE EARLY DRUG ADDICTION REVEAL

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Drug addiction nowadays is very acute problem in most countries of the world. Early, episodic drug usage reveal is of great importance as drug addiction starts with occasional drug intakes. This relatively short period transforms to systematic drug usage with clinical signs of drug addiction, while chances of recovery are dramatically decrease. Most drugs of abuse are excreted by organism in several days. The common methods for drug metabolites detection are not suitable for early diagnostics as episodic drug intakes is typical for starting drug users. In Russian Academy of Sciences' Institute for Physiologically Active Compounds (IPAC) fundamental research of drugs metabolisms and mechanisms of anti-drugs antibodies formation was performed. In the course of multi-stage drugs transformations natural conjugates are being formed and induce the specific antibodies raising. The antibodies were isolated from drug addicts' serum, their immunochemical properties were investigated. The performed research resulted in the creation of diagnostic test systems for the detection of antibodies forming after drug usage. They are formed after several occasional drug administrations and remain in blood serum even in 2-4 months after last drug intake. The developed method was registered as "Dianark".

The production technology for test systems "Dianark" was created in The Moscow Research and Practical Center for Narcology and IPAC. The diagnostic ELISA kits allow to reveal users of most widespread drugs: opiates, cannabinoids, amphetamines, cocaine, barbiturates, ephedrone.

"Dianark" has great positive application experience. It was successfully approved in different Russian clinics and abroad. It has been used since 2003 at Federal Security Service of Russia, at airlines and other companies for professional appropriateness assessment of employees. It is used in Narcology dispensaries and clinics for treatment effectiveness assessment and remission determination in drug addicts. The method is used for drug addiction prophylaxis in students. Its application ones in 6-8 months results in 4-7 times decrease of drug users number.

The "Dianark" method has great perspectives for drug addiction prophylaxis and early diagnostics in different people categories: schools students, applicants and employees of the professions related to hard and highly responsible work, risk to other people, i.e. force and security organizations, transport, energy stations, great manufactures, banks, etc.

Posters

P01

BIOCIDES FOR PRESERVATION OF THE HISTORICAL MONUMENTS

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Biological corrosion becomes the defining factor of safety and durability of buildings and constructions. Inhabited, public buildings, history and culture monuments are subject to defeat by microorganisms. The greatest damaging action is rendered by microscopic mushrooms, high which destructive activity is caused by presence of well developed fermental complex.
Wood materials are especially strongly subject to biocorrosion. E.N.Pokrovskaya used ethers of acids of phosphorus as effective biocides. Splitting process glikozide communications by enzymes is well enough studied. Enzymes, for example, lysacine contain amino acids, in particular glutamine and aspergillic acids. The rupture mechanism glycoside communications of a molecule of cellulose begins with interaction with carboxylic groups of these acids. The first carboxylic group protoniring atom glikozide oxygen as the acid catalyst. Further the water molecule cooperates with C-1 atom, is thus realized S_N1 the mechanism hydrolytic splitting glikozide communications.
Research of IK-spectra of the cellulose allocated from historical and modern woods has shown the following. In some cases the increase in peaks of optical density in the field of 3350 sm^{-1} in IK-spectra of cellulose of historical monuments, and also in the field of 1640 sm^{-1} is noted. The first peak is characteristic for valence fluctuations of group OH^-, the peak of 1640 sm^{-1} corresponds to fluctuations of molecules of the adsorbed water. Thus it is shown, cellulose of historical wood is exposed to hydrolysis with splitting glikozide to connection and formation hydroxylderivative. To reduce activity of enzymes it is possible by suppression of acid activity and blocking groups OH^- at atom C_6 with formation of volume assistants. These requirements are answered with phosphorus acids. On the basis of ethers phosphorist acids have been created biocide - MIPOR. It shows high biocide activity and promotes decomposition micromushrooms. Approbation biocide structure MIPOR actions was spent within 10-11 years, thus was always observed high biocide activity and duration of protective action. Structure MIPOR was used for protection against biodamages of buildings and constructions Piously-Troitsk Sergieva Laurels, the Diveevsky female monastery, of some temples in Moscow, etc. Monitoring of bioprotective action on the specified objects confirms duration biocide structure MIPOR actions. The studied mechanism of protective action can be applied to protection against biodestruction polysaccharides, hitozane, and also polypeptides.

P02

POLYMERIC MICRO SPHERES AS ANTISTATIC COMPONENTS OF PROTECTION LAYER FOR LIGHT-SENSITIVE MATERIALS

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Synthesized polymeric micro spheres with different structure of surface, narrow distribution of particles dimensions, having "nucleus – envelope" structure.
Determined colloidal chemical characteristics of 2D layers formed from polymeric microspheres with different structure. Indicated that surface-active properties of polymeric particles could be changed over a wide range
Studied rheological parameters of interfacial adsorptive phase composed of gelatin and polydimethylsiloxane (PDMS) at interphase boundary water/xylol. Approved that rheological flow curves has a limits of yield specific for visco-elastic objects.
Polymeric micro spheres applied into protection layers of emulsion photographic materials. Studied the influence of polymeric micro spheres to sensitometric characteristics of light-sensitive photographic materials and approved the possibility to use it as antistatic components.

P03

THE INVESTIGATION OF PHOTOCATALYTIC PROPERTIES AND STRUCTURE OF PORPHYRIN-CONTAINING SYSTEMS ON THE BASE OF BIODEGRADABLE POLYMERS FOR USE IN PHOTODYNAMIC THERAPY

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Porphyrin photosensitizers, which being excited produce singlet oxygen, are successfully used in photodynamic therapy, an effective method for treatment of oncological diseases. The application of porphyrins, immobilizated on polymer carries of different nature allows one to solve some problems of photodynamic therapy: there is no need to introduce the porphyrins into the patient organism and the poisoning by the porphyrin photodestruction products does not occur. Biodegradable, non-toxic and biocompatible polymers, for example chitosan containing functional amino groups and forming from nature polysaccharide chitin and polylactide – polyether forming from milk acid are of special interest for these purposes. In the present work the photocatalytic activity of some porphyrin photosensitizers in the model reaction of tryptophan photooxidation, a test reaction for the activity of photosensitizers in generating singlet oxygen, in the presence of citosan and polylactide was investigated. It was shown that in the presence of these polymers photocatalytic activity decreases due to the aggregation of porphyrins, accompanied by the change of their electronic absorption spectra. Such influence of the polymers on the photocatalytic activity of porphyrins can be related with interaction of the macromolecule fragments with the porphyrin molecules and depends on the polymer nature, so the chitosan interaction with porphyrins is much higher than polylactide. However, the preliminary solubilization of porphyrin by pluronic F-127 (copolymer of ethylene oxide and propylene oxide) allows one to significantly increase the catalytic activity of system. The catalytic activity of porphyrins in the presence of chitosan depends also on its molecular weight. The catalytic activity of porphyrin decreases with chitosan concentration increasing in the presence of both high molecular and low molecular chitosan samples due to formation of ionic complexes between chitosan amino groups and porphyrin functional groups. But the pluronic addition leads to increase of porphyrin activity especially for low-molecular chitosan that as it was shown by atomic force microscopy (AFM) data connects with their better compatibility. The investigated systems can be used for the superficial tumors, wounds, and burns treatment via photodynamic therapy method.

P04

BENZODIHYDROTHIO(SELENO)CHROMILIUM SALTS AS NOVEL SYSTEMS FOR ANTIMICROBIAL DRUG DESIGN

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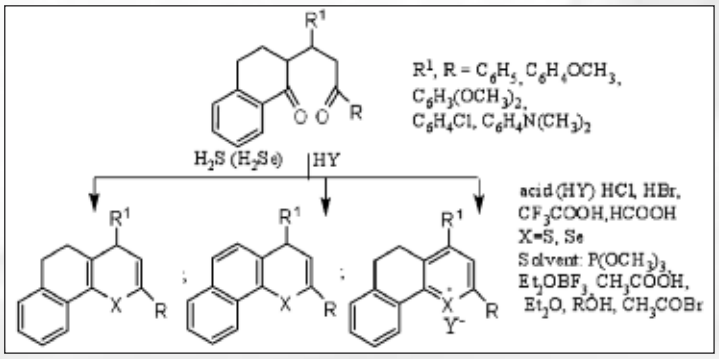
Searching for new synthetic biologically-active substances is a most important lead in the development of modern organic synthesis. It is normally conducted by screening of newly synthesized compounds, especially among those belonging to promising series. Such are thiochromenes, thiochromilium salts and their Se-containing analogs, which are related to natural flavones and anthocyanes and show a wide spectrum of pharmacological action.
Our synthesis of a new series of benzodihydrothio(seleno)chromilium salts and the products of their reduction (benzodihydrothiochromenes) was performed by means of heterocyclization of propanonyltetrahydronaphthalinones under the action of sulfur hydride (selenium hydride) and acids, or according to an original technique *in situ*.



The antimicrobial activity of the compounds synthesized was estimated by the double series dilution method in Hottinger's broth with pH = 7.2–7.4 for *St. Aureus 209P, E.Coli 675, 5716, Pr. Vuligaris 38, 49, Ps.pyoceaneum 165, Cand. Albicans 45, Bacillus cereus, Pseudomonas aeruginosa,* and *Yersinia enterocolitica.*
Our analysis of the data obtained shows that the substrates (1,5-dicarbonyl compounds) are low-active. The antimicrobial activity of the derived benzodihydrothiochromenes for the test microbes used increases, with the rigidity of the molecule apparently playing a significant role. The maximum activity, noted in the series of thiochromene-containing compounds for the first time, is displayed by 2-phenyl-4-*n*-methoxyphenyl-7,8-benzo-5,6-dihydrothiochromene (0.3-0.7 μg/ml), which can be explained by the increased electronic density in the molecule due to the +E effect of the methoxylic group and, hence, the raised oxidizing capability of the substance in the whole. Dimethoxybenzodihydrothiochromene is of interest with respect to Gram-negative bacteria (*Pr. vulgaris, Ps. Pyoceaneum*). Aromatization of the alicycle in dihydrothiochromene results in a considerable increase in its antistaphylococcus activity, bringing it at the level of tetracycline preparations. All the tested 7,8-benzodihydrothiochromilium salts have shown an exclusively high antimicrobial effect for Candida spp. and staphylococcus (0.15-6 and 0.15-1.56 μg/ml, respectively).
For getting correlations, the antimicrobial dependence of their selenium analogs for *E. Coli, Klebsiella oxytoca, Pseudomonas aeruginosa* (extracted from the urine of patients with the diagnoses of bladder stones, acute pyelonephritis, and prostrate adenoma) was studied. Benzodihydroselenochromilium salts have been found to possess the most expressed bacteriostatic action for Gram-negative strains at concentrations of 0.1-0.01 μg/ml, in contrast to formiate, which showed activity to Gram-positive strains. Thus, benzodihydrothio(seleno)chromilium salts are shown to be promising antimicrobial preparations.

P05

DESIGNING OF THE PROLONGED FORM OF THE CYTOSTATIC DRUG ENCAPSULATED IN RESORBABLE POLYMERIC MATRIX

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Designing of drug delivery system is very important concept up-to-date biotechnology and pharmacology. Such systems are especially actual for treatment oncological and long current infectious diseases. Perspective material for creation such system are polyhydroxyalkanoates (PHAs). These polymers are biocompatible and inert towards animal tissues; in biological environments they are degraded to end products (CO_2 and H_2O).
Doxorubicin (DOX) is one of the most effective anthracycline antibiotics effective against a wide range of cancers. The purpose of this study is to evaluate the *in vivo* efficacy, unwanted toxicity of a doxorubicin-loaded polyhydroxyalkanoates particle (PHA-DOX) formulation in a murine solid tumor model after intratumoral injection. PHA-DOX was prepared by the solvent evaporation technique, using a double emulsion with a mean diameter of 0.34 ± 0.03 μm. Solid tumors were obtained by injection mouse Erlich solid carcinoma intramuscularly into off hind legs of BALB/c mice. PHA-DOX and a free DOX were injected intratumorally on 7 days after injection cancer cells. *In vivo* efficacy of treatment was measured by tumor growth delay, the condition of animal in experimental groups, structure of peripheral blood, change diameter of a hip in a place where was inoculation a tumor. Signs of unwanted drug toxicity, the histology and morphology of tumor and heart tissues were examined and monitored.
At the analysis of a picture of blood at animal experimental groups are not exhibit the regular changes which are overstep the bounds of physiological norm. The present study demonstrates that introduction of cytostatic drug experimental animals the free DOX was comparable with PHA-DOX and hampered development of a tumor concerning control group. Results of the first experimental estimation of antineoplastic efficiency DOXs in a murine solid tumor model have not given unequivocal result that does necessary carrying out of the further researches.

P06

STABILIZATION OF LYSK, THE ENZYME FOR STAPHYLOCOCCAI INFECTIONS TREATMENT

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In our days, increase a number of diseases caused by one of the most dangerous of gram-positive organism, staphylococci, is observed. Staphylococcal infections (pneumonia, mastitis, phlebitis, meningitis, endocarditis, etc.) are the most serious hospital infections including those caused by the formation of biofilms of staphylococci on different surfaces. For example, in the United States more than 100,000 cases of staphylococcal infection are registered per a year. Among patients infected with methicillin-resistant strains, death rate is equal to 31%.
Traditional methods of staphylococcal infections treatment involve the active use of antibiotics, but the widespread use of antibiotics leads to a rapid increase in the number of bacterial strains that are resistant to them. Almost 90% of Staphylococcus aureus strains are resistant to methicillin (MRSA) and other antibiotics.
Bacteriophages are viruses of bacteria, producing in the process of life-cycle enzymes that can destroy bacterial cell walls and can be regarded as a serious alternative to antibiotics. In this study the enzyme, carrying out the destruction (lysis) of the cell wall by hydrolysis of chemical bonds in peptidoglycan, the main component of cell walls of gram-positive bacteria, is considered. LysK is able to effectively lyse cells of Staphylococcus aureus, including strains resistant to methicillin and vancomycin.
The main problem restricting the use of enzyme in medicine is the absence of information about it as biocatalysts, its low storage stability and the absence of data on kinetic characteristics and mechanism of inactivation. The aim of this work was to study mechanism of LysK inactivation and develop approaches toward effective stabilization of bacteriolytic enzyme.
Dependence of LysK residual activity on time was described by the equation of second order in the temperature range 20 - 40°C, pH 6 - 9, the concentration range 0.05 - 0.5 mg/ml. Inactivation by aggregation was confirmed by sedimentation analysis and electrophoresis. Stability of the enzyme is insufficient for medicine (LysK loss 50% of its original activity after several hours of incubation at 37°C and after several days at 22°C).
Influence of different compounds on LysK stability was studied at 37°C (high temperature inactivation) and 22°C (storage temperature inactivation).
Decrease in the enzyme concentration, as well as addition of low molecular mass polyols (glycerol, sorbitol, sucrose, trehalose), Ca^{2+} cations and polycation (polybrene, 5 – 10 kDa) resulted in an enhanced (more than 100 times) stability of LysK.

P07

SYNTHESIS AND PROPERTIES OF STATIONARY PHASES BASED ON SILICA AND GOLD NANOPARTICLES STABILIZED BY DIFFERENT ORGANIC LIGANDS FOR HPLC

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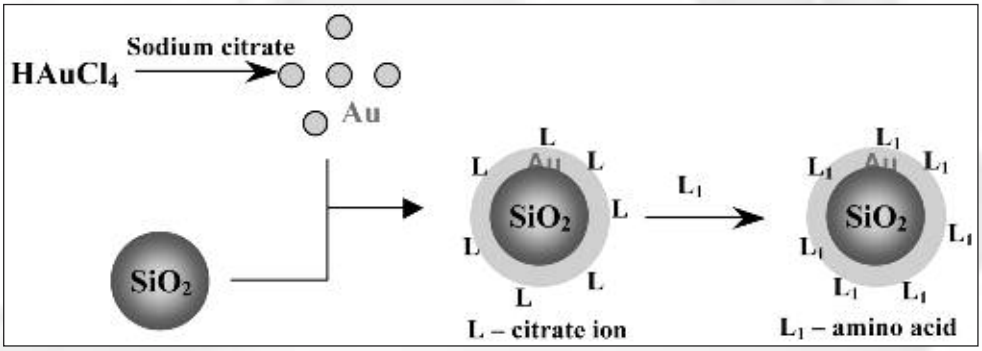
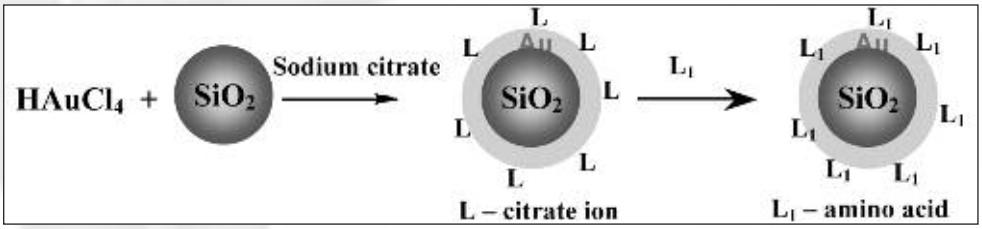
High-performance liquid chromatography (HPLC) is a chromatographic technique that can separate a mixture of compounds and is widely used in biochemistry and analytical chemistry to identify, quantify and purify the individual components of the mixture. Direct chiral separations are essential especially in biochemistry. The two enantiomers of racemic chiral compounds often show different physicochemical properties, pharmacological, toxicological and metabolic activities in living systems. That's why the method of chiral chromatography is very important and deserves the attention of scientists.
In this study, we report two new methods of synthesis carrier for HPLC. Our sorbent has a «core-shell» structure SiO_2@Au, where silica is a core of particle and gold nanoparticles, stybilized by different organic ligands, formed shell. For best results and various applications of the nanomaterials we have synthesized gold nanoparticles of different size, stabilized by different organic ligands containing appropriate functional groups, as well as vary the concentration of gold nanoparticles on the surface of SiO_2.
There are various methods syntheses core-shell SiO_2@Au nanoparticles, but here, we demonstrate two our new methods. The first method (scheme 1) is founded on the deposition of gold nanoparticles on the surface of SiO_2.

Gold Nanoparticles have been prepared by reduction $H[AuCl_4]$ in an aqua solution by sodium citrate, and then they were modified by different organic ligands (L-cystein, D-cystein, methyl ester of L-cystein, Boc-L-cystein and els.). The size of gold nanoparticles were varied by addition of different concentration of sodium citrate, which are reductive agent and stabilizing ligand. Prepared nanoparticles have been adsorbed on silica gel.



Scheme 1 The method of synthesis SiO_2@Au based on deposition of gold nanoparticles on the surface of silica.
Another method (scheme 2) is founded on synthesis in one pot gold nanoparticles and then SiO_2@Au particles. $H[AuCl_4]$ acid, sodium citrate and silica simultaneously introduced into the reaction.



Scheme 2 The method of synthesis SiO_2@Au based on reduction gold in the presence of silica.

Prepared Nanomaterials SiO_2@Au have been characterized by physical and chemical methods. Coating of SiO_2 cores by gold nanoparticles was confirmed by SEM (fig.1) The concentration of gold nanoparticles on the surface of SiO_2 was determined by atomic adsorption spectroscopy about 1,8 mg Au/1g SiO_2 (first method) and 4,7 mg Au/1g SiO_2 (second method). SiO_2@Au have been used like stationary phases for HPLC, that showed good results in separation of enantiomers (fig.2).

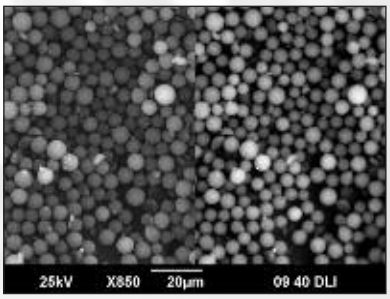


Figure 1

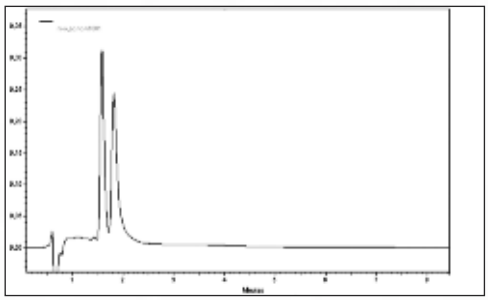


Figure 2

Figure 1
SEM images of SiO_2@Au nanoparticles

Figure 2
Chromatogram of a racemic mixture of pindolol. Column 100*4, 6. Mobile phase: acetonitrile/methanol/acetic acid/triethylamine (60/40/0,01/0,01). The velocity of flow 2 ml/min, ∂ = 254nm.

P08

THE DEVELOPMENT OF HILIC METHOD OF PROTEIN AND POLYPEPTIDE AGGREGATION ANALYTICAL CONTROL AND QUANTITATION

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Hydrophilic Interaction Liquid Chromatography based on HPLC silica sorbent modified hydrophilically with diol ligand was employed to analyze the recombinant proinsulin fusion protein obtained during the process of refolding and the following ion-exchange purification. The assay was qualified as a control method estimating its accuracy, precision, linearity, limit of detection, limits of quantitation, specificity, and robustness. The results show the reliability for the intended use.
The method allowed to thoroughly study the process of folding / unfolding of recombinant proinsulin fusion protein paying most attention to the optimization conditions such as influence of different buffer systems on the separation, different reducing agents such as dithiothreitol and dithioerythritol with addition of chaotropic substances (urea, guanidine-HCl), the performance of the refolding either with or without various oxidized/reduced paires (cysteine/cystine; ox. glutathione / red. glutathione etc).
The analytical method developed was approved on the other systems with MW in the range of 15 to 35 kDa including human insuling analogues precursors and recombinant histone proteins.

P09

NANOTECHNOLOGY OF DESIGN OF PHARMACEUTICAL BIOTRANSPLANTANTS FOR SOLVING PROBLEMS OF REGENERATIVE MEDICINE

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The papers discusses studies on the design of equivalents of dermal systems (pharmaceutical bio transplants) with the use of biocompatible and biodegradable chitosan-based polymeric matrices of various morphological forms (powders, fiber structures), biologically active substances, and cultivated cells for wound surface regeneration.
Conditions for obtaining elastic, air-permeable and water-absorbing film matrices by means of formation from a polymer solution in organic medical-purpose acids or by vapor or liquid-phase modification with biologically active substances have been elaborated.
The rheological and fiber-forming properties of a wide range of multicomponent spinning compositions of chitosan with inert polymers were examined. Optimal polymeric additives were selected, their molecular-mass characteristics were estimated, and the compositions of the spinning solution were determined for electroformation of fiber. For the first time, nanofibers of chitosan and samples of unwoven linen on their basis with a small amount of an auxiliary polymer were obtained.
The physicochemical, optical, physicomechanical and biochemical properties of our new biomaterials were studied, analyzed, and generalized. A high ability of the samples to absorb wound exudation has been established. The influence of the chemical form of chitosan on the sorption and diffusion parameters of our biocoatings was found. Peculiarities of the surface structure morphology of our matrices were analyzed. The dependence of their biocide properties on the nature of the acid used, molecular mass, dehydration degree, and the optical activity of the polymer was revealed. The high biocide activity of our matrices was confirmed on an expanded series of model and clinical strains of wound-infecting microorganisms.
The influence of the surface pH, thermal and chemical modifications of samples on their ability to promote adhesion and proliferation of epithelium cells of various origin was found. The conditions of the formation of a monolayer of human basal keratinocytes and fibroblasts were optimized. The principal possibility to transfer the grown intact plast to a wound was shown.
For the first time, the cytokinetic response of isolated cultures of keratonocytes to their introduction to the cultivation medium of our chitosan matrices of various morphological forms was examined. The character of immunomodulation activity of our matrices was found to be expressed as significant inhibition of pro-inflammation cytokine production and prevention of apoptosis initialization. A possible mechanism of chitosan influence on anti-inflammatory, immunomodulation and regeneration processes is proposed.
For the first time, examinations of our innovative biodegradable wound bandage (film and unwoven nanofiber coatings) at healing burns, donor sites, chronic wounds, and other skin defects were conducted in clinical conditions. The usage of these coatings was found to promote the healing process (in comparison with traditional ther-

apy), to create an optimal medium for regeneration, to protect the wound from inflammation and traumatization, to prevent the formation of rough scars. In some cases, full restoration of the lost skin coating was observed after single application of our bio transplant.
The work was supported by RFBF, grant # 09-03-12193 ofi_m.

P10

SOME ASPECTS OF APPLICATION OF POLYANILINE IN MEDICAL AND BIOLOGICAL AREAS
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Polyaniline finds application in medico-biological areas as a component of biosensor controls, matrices for tissue engineering, substrates possessing high biocompatibility, electroconducting material, capable to modify the cellular activity. Its properties defining the possibility of an effective use in these areas depend upon the structure of a macromolecule, level of difference of chain rings type, and molecule-weight distribution.
These characteristics are appreciably defined by conditions of a polymer synthesis, the efficiency of which depends upon the scope of the study of mechanism of polymerization of this biologically important polymer.
In this research we proposed a new mechanism and kinetic model of polymerization of aniline and its structural analogs - anthranilic acid, 2,4,6-trimethylaniline, and N-ethylaniline.
It was shown that when the substances which can form complexes with components of reaction systems are introduced in the system the properties of prepared polymers cardinally change.

P11

POLYANILINE AS A MATERIAL THAT MAY BE USED IN BIOSENSORS AND GENE ENGINEERING
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Due to its chemical stability and low toxicity polyaniline demonstrates high biocompatibility. The redox activity of polyaniline and also the dependence of its visible absorption on media pH, stemming from the presence of quinodiimine fragments in its polymer chain, allows for application of polyaniline in production of biosensors which may be used, among other things, for measuring of blood pH.
The ability of polyaniline to form water-soluble polymer-polymer complexes with PVA, PVP, and DNA was also demonstrated, therefore polyaniline may be used in gene engineering.

P12

EXPERIMENTAL EVIDENCE OF SOME UNUSAL FEATURES IN PREPARATION AND BIO-PROPERIES OF POLYANILINE AND POLYPYRROLE
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In spite of numerous publications describing oxidative polymerization of aniline, pyrrole, and other heterocycles, some uncertainty remains concerning the overall mechanism of polymerization and chemical properties of their polymers. The kinetic studies of the oxidative polymerizations of aniline and its homologs, such as methoxyaniline, and anthranilic acid, revealed the importance of charge transfer complex formation between the monomers and quinodiimine units in the polymer chains arising from additional oxidation of polyaniline molecules. The rate constants of single electron transfer for the reaction were calculated and the experimental data were compared with theoretical predictions. On the contrary, the oxidative polymerization of N-ethylaniline in HCl-water medium in the presence of ammonium peroxodisulfate proceeded without autocatalytic acceleration due to the absence of such quinodiimine structures. The key role of proteolytic equilibrium was evidenced for this reaction and the kinetic model was proposed as well as the main kinetic parameters were determined.
The appearance of stable water-based PVP/polyaniline and PVP/polypyrrole systems was observed both in the course of polymerization of aniline and pyrrole and during dissolving of the polymers in water solution of PVP. The re-

markable influence of PVP in the reaction mixture on polymerization kinetics of those monomers was discovered and explained as a result of complex formation between polyvinylpyrrolidone and the above mentioned polymers. The PVP/polyaniline and PVP/polypyrrole water-based systems are of considerable interest for biomedical application.

P13

NANO SIZED OPEN POROSITY IN ULTRA HIGH MOLECULAR WEIGHT IMPLANTS PRODUCED BY COMPACTION TECHNIQUE

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Commercial solid (nonporous) implants based on Ultra High Molecular Weight Polyethylene (UHMW PE) exhibit serious disadvantage for human life such as generation of fine polymer particles which migrate in the body and cause some negative even lethal effect. These fine solid particles generate as the result of high friction between the implant's parts because of absence of internal natural lubricant (synovial liquid) inside the implant body as the natural implants have. The external lubrication of implant's surface is not enough to prevent mechanical erosion of implants. Extremely high viscosity of UHVW PE melt makes impossible to produce the porous structure of implants by regular foaming techniques. To make an open pore structure of implants which should be fully permeable for synovial liquid and delivery synovial liquid from inside to outside surface of implant, it has been developed a novel family of implants based on UHMW PE fibers. These open pore implants have controllable nano sized pores produced by compaction technique and they promote to migrate of lubricate to the external surface of implants for prevention of generation of fine solid polymer particles.

P14

A TISSUE-ENGINEERED ARTIFICIAL SKIN GROWN TO RESEMBLE THE NATIVE SKIN

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The aim of this study was to fabricate an artificial skin for the development of a new treatment for deep burns. In the current treatment for an deep burns is the early necrectomy with autodermaplasty. However, the mortality of seriously ill still remains fairly high, which is associated with high rates of infectious complications against the background of the prolonged existence of burn wounds and the inability to timely and effective implementation of the free autodermaplasty due to the lack of free intact skin. Our group has been developing an artificial skin on base of macroporous PVA hydrogels that resembles the native skin in both function and morphology. Sixty white adult rats were performed third-degree burns damage. Thirty of the burned wounds are covered with 3D bioabsorbable scafold. Thirty animals, the controls, were covered with the hydrated cellulose. The neo-skin was removed at the pre-determined time points and investigated histologycally. All sixty animals survived untill their sacrifice at 1st, 3d, 7th, 14th, 21st day and 3 month. In the first (purulent - necrotic) phase of wound healing wounds are characterized by a high degree of hydration of the wound and beside tissue structures in violation of local hemocerculation, in the experimental group observed a pronounced dehydration of the tissue structures with elimination of toxins and mediators of wound inflammation. At 7 and 14 days (prolifiration phase) wounds were characterized by the absence of perifocal edema and hyperaemia. Hystologycal examination revealed initiate epitheliazation of the neo-skin. The scaffold is also protect granulation tissue from mechanical trauma, drying and preventing re-infection. At 21 days (epitheliazation phase) and 3 month the wound exhibit a morphology almost identical to that of the native skin. Difference were found between the controls and scaffold covered group, in the control epitheliazation occurred on the thirtieth day of treatment with the formation of scar that rises above the healthy tissues. These results show that the artificial skin thus fabricated can serve as a substitute for the native skin. On the other hand the material, as well acts as a bandage protects the wound, supports local homeostasis.

P15

CYTOTOXICITY STUDY OF LIPOSOMAL FORMULATION OF METHOTREXATE DERIVATIVE USING MICROENCAPSULATED MULTICELLULAR TUMOR SPHEROIDS AS 3D *IN VITRO* MODEL

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Today, low therapeutic indices of most of the drugs due to high toxicity and poor selectivity, severe side effects, and often, difficulties in the preparation of pharmaceutical form remain among the major drawbacks of cancer therapy as well as treatment of various inflammatory diseases. Anticancer drug entrapment into nanocarriers including liposomes is widely used in biomedicine. It allows to decrease systemic toxicity of drugs through 1) lower concentration of the intact drug in circulation and 2) passive targeting by means of enhanced permeability and retention effect in a tumor tissue. Correct in vitro assessment of novel drug delivery systems as well as intact drugs is a complicated and time-consuming procedure. Evaluation of the anticancer drug cytotoxicity is commonly performed on 2D *in vitro* models (as monolayer culture).
In the current study multicellular tumour spheroids (MTS) microencapsulated within alginate-chitosan microcapsules were used as 3D *in vitro* model for preclinical cytotoxicity study of liposomal formulation of a lipophilic methotrexate (MTX) derivative.
MTS were generated by cultivation of human breast adenocarcinoma MCF-7 cells in biocompatible alginate-chitosan microcapsules with a mean size of 200 μm produced using an electrostatic droplet generator. To test the MTX liposomal formulation using MTS, a preliminary study of liposome penetration through both the microcapsule membrane and MTS was performed. A fluorescent bilayer-linked dye (BODIPY) was observed inside MTS already in 15 min after incubation of MTS with placebo BODIPY-labeled liposomes. After 2 hours of incubation the dye was revealed within spheroid core. The liposomes loaded with MTX (90 ± 33 nm) were tested both on MTS and monolayer culture (as a control) after 48 hours of incubation. The cytotoxicity of the liposomal formulation was less than that of the intact MTX. We suggest that it is due to the changing internalization mechanism and additional stage of prodrug release from the liposomes. At MTX concentration of 1000 nM in the liposomal form, cell viability in MTS was 1.4-fold higher than that in the monolayer culture. In the case of liposomal formulation of MTX derivative the IC50 was 0.49±0.02 μM and 26.4±1.0 μM for monolayer culture and MTS, respectively.
MTX liposomal formulation was shown to have lower cytotoxicity on MTS compared to intact MTX. Moreover, MTS were more resistant to both MTX and MTX liposomal formulation than the monolayer culture. Thus, microencapsulated MTS could be proposed as a more adequate 3D *in vitro* model for anticancer drug testing.

P16

LANTHANIDE DOPED NANOPARTICLES AS A BASIS TO SENSE BIORELEVANT ANIONS

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The development of nanosized sensors is a top of current interest today. Multifunctional core-shell nanoparticles are widely applied in biomarking, while nanoparticles with biosensing function are not so common as biomarkers. Herein we represent silica nanoparticles doped with Tb(III) and Yb(III) luminescent complexes, which are enable to sense Fe^{3+} and Ag^{+} in aqueous solutions. The sensing of Fe^{3+} is based on the luminescent response of lanthanide doped nanoparticles on the aggregation of nanoparticles, which in turn results from the specific adsorption of iron ions onto silica surface. The aggregation of nanoparticles is reversible and the whole reestablishment of luminescence intensity is achieved by the competitive binding of Fe^{3+} with anions. For example ethylediamine-tetraacetate anions can be used for stripping of Tb(III) doped nanoparticles. The competitive binding of Fe^{3+} with anions as a basis to sense some biorelevant anions will be also discussed. The sensing of Ag^{+} is based on the formation of heterometallic complexes Ag^{+}-Tb^{3+} within silica matrix, resulted from the adsorption of Ag^{+} onto silica surface. Though the adsorption metal ions on silica is well known and widely applied in extraction, the represented results are rather rare examples of the sensing function based on metal ions adsorption on silica.
We thank RFBR (grant N 10-03-00352) for financial support.

P17

USING ANTIOXIDANT ENZYMES FOR DIAGNOSTIC BIOMATERIALS INCLUDING BIODEGRADABLE POLYMERS AND NANOMATERIALS

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Analysis of development trends in the desining of new drugs shows that in the past decade there was seen an increased interest in biodegradable biopolymers, which are capable of target delivery of drugs to organs.
Biomaterials, regardless of how they are imposed and function, are alien substances to the human body which may themselves or by means of their biotransformation products cause both positive and negative effects. For toxicological researches of biomaterials the use of complex methods which allow estimating their cytotoxicity and influence metabolic processes at target cells. In this regard, the assessment of toxicological properties of biomaterials is an obligatory stage. One of the key toxicological parameters is a state of antioxidant protective system including assessment production of active forms of oxygen, content of products of lipid peroxidation and antioxidant enzymes activities. However using the colorimetric methods for these enzymes are laborious and require large sample volume.
In this regard, the purpose of our research was to minimize volumes of the investigated samples for methods of antioxidant enzymes by using biochemical analyzer.
Studies have been conducted on nonlinear white rats weighting 180-200 g. We modified techniques for determining activities of superoxide dismutase [Sirota, 1999], catalase [Slaughter, 2000] and glutathione-S-transferase [Beutler, 1990]. Activity of enzymes was determined by the end-point method using the biochemical analyzer Sapphire-400 (Tokyo BOEKI LTD).
As a result of our study adapted methods for determining the activities of antioxidant enzymes for biochemical analyzer: minimizing volume of biological samples (3-10 µl) and using reagents. We demonstrated its application to plasma, blood cells and liver. Also composition of the incubation samples was optimized. Comparison of modified methods with the original is the evidence of their interchangeability.

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P18

INTEGRATED MANAGEMENT OF INDUSTRIAL SECURITY INCLUDING BIOMEDICAL PRODUCTION

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According to the authors, it is important to give students training not only as highly skilled but relatively narrow specialists, but also as future leaders of companies or large departments capable to make the right decisions in crisis situations. They should be able to find ways to continuously improve both customer satisfaction and maximizing profits (including through the quality management system) as well as ways to reduce unplanned losses due to incidents, accidents, failure to comply with environmental legislation and other requirements (including the use as a tool continual improvement of environmental management systems and management of occupational safety and health).
So, today's university graduates are more prepared to work in academia, they do not always represent themselves clearly the real demands of practice and its capacity organically "fit" in a modern production and management structures, as well as a career until the position of first class business leaders. But if the graduate understands the need for continuous improvement, including through the development of adjacent fields and self, then he pushed off from the more he knew of technological, environmental and industrial (manufacturing) security will certainly come to the idea of comprehensive security management companies. His career may be as follows: technologist or

a specialist department of environmental protection (EP) - Head of Environmental Protection - Head of the Department of Environmental Protection, Safety (Industrial Safety), OT (occupational safety) and emergency - Technical Director of the company - Head of the company.
Furthermore, nowadays the circumstances demand entrepreneurial skills, challenge, and the ability to be a leader, independence in making innovative solutions, often unconventional, but reconciled and progressive. This allows the head of the company led by such a winner in the tough competition.
Bearing in mind the relevance of the above problems, the authors have developed a lecture course for students of different specialties, allowing making additions to the knowledge and outlook of the graduates. The course consists of relatively theoretical and practical parts. The implementation of this course will contribute to guidance of students as future managers and leaders (or managers) of their departments (services) environmental, industrial, fire safety, health and the prevention of emergency situations (analogues Services «Health, Safety, Environment, Fare, Emergency» in Western companies), as managers of integrated security companies that have, including knowledge of business management in crisis situations.

P19

CALCIUM-PHOSPHATE CERAMIC, GLASSCERAMIC AND COMPOSITE MATERIALS IN *IN VIVO* EXPERIMENT

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Neorganic materials, containing calcium phosphates, are able to form direct bonds withnatural bone without forming connective tissue capsule. For prosperous use of such materials in clinical practice it is desirable that the resorbtion rate corresponded to new bone generation rate in the defect area. Comparative analysis of three types of materials (see table) were examined by *in vivo* studies.

Type of material	**Ceramics**	**C-P Glass-Ceramics**	**Composite material**
Crystal phases composition	$Ca_{10}(PO_4)_6(OH)_2$: $Ca_3(PO_4)_2$ = 50:50	$Ca_2P_2O_7$	$Ca_{10}(PO_4)_6(OH)_2$ / glass-ceramics, $Ca_{10}(PO_4)_6(OH)_2$ / glass
Porosity, %	70-75	40-60	> 90
Pore sizes, mm	200-400	500 - channel 20-150 - interchannel	up to 500

Chinchilla rabbits aged from 10 months to 1 year were taken for experiments. Materials with 3 mm in diameter were placed in cortical bones of rabbits. Controlling roentgenograms were taken at 5-7 days, 2, 4, 6, 8 and 12 months of implantation. Species decalcification was carried out by means of standart methods in trilon-B solution, histological thin sections with 10 mm thickness were colored with hematoxylin and eosin.
Researches showed that all of studied materials provide biointegration – i.e. bone cells and blood vessels growing inside implant pores. Biointegration rate is determined by chemical composition of material and it's pore sizes. Highly porous composite material "$Ca_{10}(PO_4)_6(OH)_2$ + glass-ceramics" possess maximum rate of bone cells proliferation and fixation inside pore space – the process is finished to 6 months of implantation. Biointegration of bone cells inside C-P glass-ceramics can be determined after 2 months of implantation, and biointegration inside $Ca_{10}(PO_4)_6(OH)_2$ + $Ca_3(PO_4)_2$ ceramics – only after 4 months. Completion of bone cells filling inside pore structure of these materials and new bone tissue forming occurs to 12 months of implantation.
Despite proper biocompatibility of studied materials with bone cells a number of reasons limits wide use of calcium-phosphate materials clinival practice.
Low resorption rate of studied materials and consequently asynchrony of biodegradation and osteoreparation processes leads to biomaterial particles forming inside new natural bone fragment, so they appear to be imbedded inside bone and can cause complications after long time of implantarion.
Materials creation, that possess regular pore structure up to 90-95 vol.% will allow to align biodegradation and osteoreparation rates and significantly improve operational properties of implantation materials.

P20

DETERMINATION OF THE METAL NANOPARTICLE SIZE IN THEIR COMPLEXES WITH SELF-ASSEMBLED STRUCTURES

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An important task in the investigation of nanodispersion systems is the determination of the size of their component particles. The most famous and valuable method for analyzing the structure of such objects is a transmission electron microscopy. In the case of the reduction of metal ions in polymolecular systems, which are formed by self-organization of components (micelles, vesicles, membranes, etc.), on the electron micrographs of the samples metal nanoparticles bound with the surface of the obtained associations are clearly visible. However, the size and size distribution of the nanoparticles cannot be measured correctly due to their high concentration on the surface and difficulties arising during microscope focusing.
We have developed an approach to the estimate the thermodynamic stability of complexes polymeric aggregates with metal nanoparticles by "pulling out" the last from self-assembled structures for reliable measurement the size of single metallic nanoparticles using electron microscopy. The approach is based on the selectivity of the interaction of nanoparticles with regard to chemical structure of the system components each of which taken separately is able to shadow the nanoparticles. Nanoparticles selectively bind the chains of most "strong" polymer competitor. The selectivity can manifest itself either in the course of the growth of a nanoparticle in simultaneous presence of macromolecules of two or more polymers of different chemical structure (the recognition of the strongest complex former), or in the substitution of polymer chains in protective screen of a nanoparticle with the chains of another structure. The size of single nanoparticles associated with the macromolecules of the strongest competitor can be determined easy by the electron microscope method.
If the stability of the complexes of nanoparticles with macromolecules of both polymers is similar, the nanoparticles turn out distributed between the chains of both polymers. The use of this approach allowed us to determine size characteristics of respective nanoparticles (and then to estimate thermodynamic parameters of respective interactions), obtained by the reduction of Cu^{2+} ions in micellar aqueous solutions of polyethylene glycol monolaurate or polyethylene glycol monostearate, as well as in aqueous dispersions of liposomes.

P21

THE INFLUENCE OF SURFACTANT TYPE ON MIDDLE PARTICLES SIZE OF PLGA MICROSPHERES AND ENCAPSULATION EFFICIENCY OF MODEL DRUG

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Introduction. Poly(D,L-lactide-co-glycolide) (PLGA) is a biocompatible, bioabsorbable, and biodegradable polymer that is used to formulate many types of implantable and injectable drug delivery systems for humans and other animals. PLGA microspheres have been reported as carriers for site-specific delivery of various drugs.
Objective. The purpose of the study has been to exhibit the effect of the surfactants on a particle size of poly-(D,L-lactide-co-glycolide) (PLGA) microspheres and encapsulation efficiency of model drug.
Materials and methods. PLGA was from Boehringer Ingelheim (Ingelheim, Germany). Mannitol was from Roquette (France). Sodium chloride, methylcellulose were of pharmacopeias grade. Polyvinyl alcohol (PVA) was obtained from SD Fine-Chemicals Ltd (Mumbai, India), and halocarbon was obtained from Allied Chemical Corporation (Vadodara, India). Both PVA and halocarbon were of analytical reagent grade. PLGA microspheres were prepared using diffusion solvent technique. The model drug was encapsulated either single oil-in-water (o/w) emulsions (drug-base) or water-in-oil-in-water (w/o/w) emulsions (salt). Particle size distributions of PLGA microspheres were obtained using Laser Light Scattering. The encapsulation efficiency of model drug in the microspheres was calculated after determining the actual drug loading of microspheres. The actual drug loading of microspheres was determined by HPLC.
Results. Variable processing parameters are: the type of surfactant, the presence osmotic-active substance (sodium chloride), the encapsulation method. The emulsification was realized by static mixer (400 – 700 rpm). External phase was hydrocolloid, which concentration was 2% wt/vol. The concentration of surfactant was 2% wt/vol.
For preparation of microspheres was used double emulsification method. PLGA was dissolved in organic solvent and emulsified with drug solution. The polymer solution obtained was then drop-wise added into surfactant aqueous solution with hydrocolloid and sodium chloride, mannitol. Obtained microspheres had middle particle size about 77 mm. Encapsulation efficiency was about 17,66±0,2 %.

Single emulsification: The model drug base was solved in organic PLGA solution. The drug and polymer solution obtained was then drop-wise added into surfactant aqueous solution with hydrocolloid and mannitol. In case of PVA usage the middle particle size was 54 mm, and encapsulation efficiency was about 80,17±0,02%. In case of Lutrol F68 NE usage the middle particle size was 41,7 mm, and encapsulation efficiency was about 28,23±0,01%.
Conclusion. The optimal method of encapsulation of model drug was single emulsification. Particles with assigned size were obtained by use PVA as surfactant.

P22

NEW DELIVERY SYSTEMS FOR HYDROPHOBIC DRUGS BASED ON MODIFIED AMYLOSE

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The ability of amylose to form inclusion complexes with various hydrophobic compounds makes it possible to develop drug delivery system based on amylose. For increase of solubility and complex formation ability, amylose was subjected to hydroxyethylation to substitution degree 0,3 (NMR) and subsequent partial acidic hydrolysis to molecular mass value 45 kDa (GPC).
Ability of modified amylose to form complexes was studied using 2,6- isopropyl phenol (propophol) as a guest molecule. Formation of the inclusion complex was registered according to the absorption spectrum change. At increase of the ratio "hydroxyethylated amylose (HEA) : propophol" from 1:1 to 10:1 (base-mol: mol), the intensity of propophol absorption band (430 nm) increased by 28,7 times, which reveals increase of its concentration in the solution.

P23

DETERMINATION OF MONOMERIC COMPOSITION OF THE SOVIDON BY NMR 13C SPECTROSCOPY METHOD

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The copolymer of N-vinyl-pyrrolidone and 2-methyl-5-vinylpyridine (Sovidon) is interesting as an efficient immune adjuvant, cytostatic agent, radio protector, activating agent of phagocytosis. So long as, the type of this copolymer is statistical, varying of monomeric composition may takes place from one to another synthesis in spite of accurate validity of conditions during the copolymerization process. Therefore, design of modern and suitable composition control method of copolymer is actual.
For this purpose NMR ^{13}C spectra of different specimens of the copolymer in D_2O were interpreted. Method for determination of molar ratio of monomeric links by ratio of integrals from methyl-group of methyl-vinylpyridine fragment and from methylene group of pyrrolidone ring has been worked out. Molar fraction of methyl-vinylpyridine links was close to 0,35 and have little difference from value what has been determined by non-liquid titration method. Bulk analyses of copolymer specimens had been carrying out for the accuracy and validity tests. Those tests have good results.
Conclude of this research we may say that NMR ^{13}C approach may be using along with non-liquid titration method for the control of monomeric composition of Sovidon in laboratory and industrial conditions.

P24

SYNTHESIZE AND MOLECULAR WEIGHT CHARACTERISTICS OF POLYHEXAMETHYLENE GUANIDINE HYDROCHLORIDE

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The Polyhexamethyleneguanidine (PHMG) samples with different molecular-weights synthesized from Hexamethylenediamine and Guanidine Hydrochloride were investigated by NMR 13C, ultracentrifugation and capillary viscosimetry. It was found that PHMG Hydrochloride has 0,16-1,08 branching points per molecule. Number-average molecular weights *Mn* and weight-average molecular weights *Mw* were calculated from NMR 13C and ultracentrifugation data accordingly. Comparing of these characteristics show that synthesized polymers have a wide molecular-weight distribution ($M_W/M_N=5,4 \div 9,3$).

P25

POLYPYRROLE – MATERIAL FOR MEDICINE AND BIOLOGY

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Polypyrrole finds application in medico-biological areas as a component of bioanalytics systems, substrates possessing high biocompatibility and tromboresistency, electroconducting material, capable to modify the cellular activity.
Polypyrrole demonstrate low solubility in most solvents, which limits the possibility of their use, and the interest is focused on water-miscible complexes of polypyrrole with PVA and PVP.
These characteristics are appreciably defined by conditions of a polymer synthesis, the efficiency of which depends upon the scope of the study of polymerization mechanism of pyrrole.

P26

STRUCTURAL AND FUNCTIONAL RELATIONSHIPS OF NEW TYPES OF SILKS, PROSPECTIVE FOR BIOMEDICAL APPLICATIONS

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Silks are fibrous proteins composed of repetitive sequences of both crystalline and amorphous domains. Various types of silk are naturally produced by Arachnidae, Insectae, and some Amphipodae and free-living Nematodae. It is well known that silk materials possess impressive mechanical properties, such as high tensile strength, that is comparable to steel, and extensibility that exceeds rubber. Due to these unique properties in combination with biocompatibility, ability to biodegrade and the easiness of tailoring the sequence via genetic control, silk materials have been of specific interest for the researchers in the past decade. Recently, it has been shown that some quarternary structures (nanofibrils), formed by silks may possess amyloid properties. The most interest attracted the proteins, produced by silk worms (fibroins) and spiders (spidroins). Yet the ability to secrete protein fibers is peculiar also for a whole range of marine organisms. The amphipod crustaceans Dulichia spinosissima (Amphipoda, Podoceridae) live on the sticks which they made of the claw gland secret. Bivalve byssus, used by mollusks for attaching themselves to the substrate also contains fibrous proteins. Byssus is fame due to its excellent adhesion capabilities. However, a systematic comparative study of different types of silks hasn't been carried out yet, and neither have been thoroughly studied the physical and biological properties of silks, produced by marine invertebrata.
In the present work we have performed the evolutionary and structural study of various types of silks, produced by marine Ecdysozoa and Trochozoa, including extensive database search for analogs of silk proteins with new properties (e.g. adhesive). We have developed method for rapid fixation of organisms, attached to the slide or sand grains to study them by means of electron microscopy. We have studied the difference in the mechanical and chemical properties of different silks. It has been demonstrated that nematode from the White Sea produce a fiber-like structures that possess a double light refraction capability, which is characteristic feature of amyloids.
Thus the natural polymers produced by marine invertebrata have some remarkable properties which may be use-

ful for biotechnology. Certainly, the range of the organisms able to secrete fiber compounds is much wider, and it is possible to find more materials for further biomedical applications.

P27

RECOMBINANT SPIDER SILK PROTEINS FORM NANOFIBERS AND SURFACE-INDUCED CRYSTALLINE LAMELLAE

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Spider dragline silk proteins have attracted much attention as promising biomedical materials due to their outstanding toughness and biodegradability. Natural spider dragline silk comprises two major structural proteins - spidroins 1 and 2. Both proteins exhibit a periodic pattern that contains hydrophobic poly-A segments and hydrophilic Gly-enriched segments. This pattern is important for protein solubility. In the natural protein binding of water molecules prevents its premature crystallization in a very concentrated spider dope. The unique structure of spider silks accounts for their impressive mechanical properties.
In the current work two recombinant analogs of spider silk proteins, 1F9 (analog of spidroin I) and 2E12 (analog of spidroin II), were studied by atomic force microscopy (AFM) and transmission electron microscopy (TEM). In water solution both proteins exist in two forms: single molecules (presumably in random coil conformation) and nanofibers. The latter are beta-sheet-rich twisted aggregates of 0,2-1 um long. When exposed to strong chaotropic agents (e.g. 6M GdmSCN) they are dissolved into single molecules which slowly aggregate after gel-filtration or dialysis, and the aggregation can be accelerated by mechanical stirring. Nanofibers are observed by AFM on different substrates and by TEM (both cryo-TEM and negative staining). Both methods prove that the nanofibers have helical twist with ~40 nm pitch.
When the solution of denaturated 1F9 or 2E12 proteins have been deposited on mica, single molecules aggregated and formed lamellae of two types (type I and type II). Type I was a monolayer lamella, typically 0,7±0,2 nm in height, 8-10 nm in width and up to 1 um in length. Type II lamellae are formed by aggregation of protein molecules on Type I lamellae. Type II lamellae are 2,5±0,4 nm in height, they are segmented, and the volume of each segment coincides with the expected volume of a single molecule. Presumably the lamellae of both types are stabilized by hydrogen bonds like in antiparallel beta-sheet. The observed lamellae formed by 1F9 and 2E12 are morphologically similar to the lamellae formed on the substrate surface by synthetic polymers and beta-sheet forming peptides.

P28

VARIOS METHODS OF DEFINITION OF DEGREE OF TOXITY

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Various methods of definition of degree of toxicity and biocompatibility of the materials used for transplantation are considered. It is possible to allocate some stages in research of biomaterials. The first stage consists in definition of degree of toxicity of a biomaterial. The dynamic method of definition of toxicity is based on registration of dynamics of behavior of cells in culture in the presence of the investigated sample of a biomaterial. In a cup of Petri with culture of cells the sample of a biomaterial is located. Registration of behavior of cells is carried out by means of Biostation IM firms Nikon. Speed of destruction of the cells which are near to the control sample, corresponds to degree of toxicity of the sample. If cells about the sample don't necrosys – that the sample isn't toxic. If the material is toxic, the material is excluded from consideration. If the material isn't toxic, the following investigation phase of a material on biocompatibility is spent. By means of a special technique the culture of cells is grown up on a surface of an investigated material. Biocompatibility degree is estimated on degree stick cells on a surface of the sample. Quantitative methods of an estimation of the biocompatibility are developed, allowing to pass from subjective and quality standard to an objective and quantitative estimation of biocompatibility.

P29

POLYMER MORPHOLOGY IN CONFINEMENT AND CLOSE TO SURFACES

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Polymer / layered silicate nano-composites constitute an interesting class of materials which allow the investigation of basic scientific problems and, at the same time, are utilized in many applications. Mixing polymers with layered inorganic materials can lead to three types of structure, depending on the interactions between the two components: the phase separated, where the two components are immiscible, the intercalated, in which the polymer chains form thin films inside the inorganic galleries, and the exfoliated, where the interactions between the chains and the surfaces are very favorable so that the inorganic layered structure is destroyed resulting in dispersed platelets within the polymer matrix. Despite the large number of studies in this area, the influence of the addition and the state of dispersion of the nanofillers on chain conformation has been overlooked. In this work, we will systematically study the effect of incorporation of inorganic material and/or elucidate the influence of the severe confinement on the structure and conformations of polymer chains in PEO / Na^+-MMT nanohybrids.
Poly(ethylene oxide), PEO, with molecular weight M_w=100,000 gr/mol, glass transition temperature, T_g, -67°C and melting temperature, T_m, of 65°C, was utilized and mixed with a hydrophilic montmorillonite, Na^+-MMT. A series of composites with PEO content from pure polymer to pure clay were prepared and were characterized by X-ray diffraction, XRD, and differential scanning calorimetry, DSC. Moreover, the conformations of the polymer chains in the crystal and in the amorphous state were investigated utilizing Raman and infrared spectroscopies.
XRD measurements reveal that for all hybrids, intercalated nanocomposites with mono- and bi-layers of PEO chains are obtained. Moreover, for nanohybrids with low polymer concentration, where all polymer chains are intercalated or in close proximity to the inorganic surfaces, the peaks that correspond to the crystalline structure of PEO can not be observed indicating that PEO is purely amorphous. It is only when there is plenty of excess polymer outside the completely filled galleries that polymer crystallization is observed. These results are fully supported by DSC. To investigate the conformations of the chains in the hybrid material in relation to that of pure PEO, Raman and IR spectroscopy have been applied, which show that, indeed, it is only at high polymer concentrations that sharp peaks attributed to crystalline PEO are observed. Moreover, quantitative analysis reveals that the intercalated chains possess different conformations than the ones of the pure PEO even in at high temperatures.

P30

DEVELOPMENT OF BIODEGRADABLE POLYMER SCAFFOLDS WITH TWO CONTROLLED PORE SIZE DISTRIBUTIONS

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Scaffolds are playing a crucial role in tissue engineering, providing the adequate conditions for tissue regeneration to be performed in vitro or in vivo. They are formed in either a fibrous or a porous structure, thus acting as a "mould", offering space for the cells to be cultivated in them, directing their growth. As the cell culture grows, the scaffold gradually decomposes granting more space, consequently leaving finally the tissue pure [Griffith LG, Naughton G. Science 2002;295:1009–14, Dietmar W. Hutmacher Biomaterials 21 (2000) 2529}2543].
The biodegradation rate as well as the size and morphology of the vacancies are the key features for a material to be used as scaffold, and in order to select the cell types that can be cultivated. In addition, pore interconnection and different pore size distribution, are significant properties of this temporary extracellular matrix, which determine cell migration, growth and cell adhesion, respectively.
So far, several polymeric and ceramic materials are proved sufficient and numerous techniques to form the desirable structure have been proposed, some of them already successfully applied to humans, mostly considering skin and bone tissues. Polymers suitable for scaffolding can be either natural (cellulose, collagen, chitosan) or synthetic (PGA – poly(glycolic acid), PCL-poly(caprolactone), PLA- poly(lactic acid)). Numerous methods were applied to polymers in order to create the desired porosity[J.M.Desimone *Science 2002, 297,* 799, E. J. Beckman *Environ. Sci.*

*Tech.2002, 36,*347A]. These include either the use of organic solvents, or organic solvent free methods such as supercritical fluid processing, which offer certain physical, chemical and toxicological advantages as alternative solvents [A.I.Cooper ''Porous Materials and Supercritical Fluids", Advanced Materials]. A supercritical fluid is a fluid at conditions of temperature and pressure beyond its critical point. At the critical point the vapor and liquid phase become identical.
In this current research work, PCL-poly(caprolactone) and PLA- poly(lactic acid) were examined as a scaffold material due to their biocompatibility, biodegradability, tensile strength and other significant parameters, such as their melting point, crystallinity and glass transition temperature. Porous scaffolds have been manufactured combining two methods to create two different pore size distributions. Primary pores are formed in microscale by salt leaching and constitute room for the cells. Secondary pores are formed by foaming with supercritical carbon dioxide. The pores created from both salt leaching and CO_2 foaming can be altered to give various structures with two pore size distributions, such as interconnected structures or structures with a nanoscale roughness on the walls of the large pores (e.g. for facilitating the adhesion of the cells on the scaffold). PCL, PLA and their blends are mostly studied, also focusing on bonding possibilities without involving any non-biocompatible substances. Two different pore size distribution and nanoscale roughness were achieved. As a final object, human fibroblasts will be cultivated into some of the produced scaffolds to examine how certain process parameters affect the cell growth.

P31

SYNTHESIS AND CHARACTERIZATION OF HYDROXYAPATITE BIOMORPHIC BIOCERAMICS FROM NATIVE WOOD
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Since hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) has excellent bioactivity, porous hydroxyapatite (HAP) ceramics have been intensively studied for bone regeneration scaffolds. During the last few decades, a variety of inorganic and polymeric substrate has been developed in order to reach a structure similar to bone micro- and macro-porosity. In contrast to most engineering materials, the hierarchically built morphology of biological materials, is arranged in a complex porous anatomy. Specifically, bioorganic substances like wood are characterized by a strongly anisotropic structure, where the basic units are elongated channels, assembled parallel to the growth direction. In the present study, highly oriented pore tube anatomy of native wood (poplar, pine, beech, spruce) was used as a template to fabricate biomorphic hydroxyapatite ceramics. After a series of preliminary experiments, the chemical conversion of wood into hydroxyapatite was determined as follow: 1) Impregnation of wood with the reagents, at first with $CaCl_2$ and then with $NαH_2PO_4$. Impregnation process was carried out under strictly controlled conditions of temperature, PH and stoichiometric ratio Ca/P. 2) Pyrolysis of impregnated samples at 300 ^oC, in order to increase the porosity of wood. 3) Resumption of impregnation process. 4) Rinsing the samples with water to remove the produced NaCl. 5) Heating the samples at 1150 ° C in air, to achieve the sintering of HAP crystals and the total degradation of wood, due to the oxidation of carbon skeleton. The chemical composition of the obtained ceramic is examined by X-ray Diffractometry (XRD), according to the results the dominant crystalline phase is HAP. The ceramic structure was analyzed with optical and scanning electron microscopy (SEM). It is noted that the porous microstructure of raw wood, which is characterized by parallel elongated tubes, is maintained in the final material.

P32

IN VIVO EVALUATION OF GENOTOXICITY OF IMIDACLOPRID
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Skepticism has gradually developed over studying the synergistic action of pesticides and their genotoxic side effects to humans and other organisms. Many variables intervene in the study system, rendering it too complex, not easily reproducible, and increasing the workload exponentially. In addition, scientists agree that the synergistic effects of pesticides mixtures on human health are controversial and further studies on this issue are needed.
Neonicotinoids, including imidacloprid, are the most important new class of insecticides, increasingly replacing the organophosphates and carbamates. Although it is considered to be friendlier towards humans and environment there is no extensive knowledge about its genotoxicity. In previous studies, it has been shown that the combination of "harmless" environmental factors with non genotoxic with imidacloprid may result in the alteration of the

pesticide's physicochemical properties. Such alteration may convert harmless-to-humans pesticides into harmful one with unidentified side effects. It is also suggested that the strong chemisorption of imidacloprid at T<10 °C under reducing conditions is related with the high specific insecticide activity of imidacloprid in cool-blooded insects as contrasted to its low efficiency in warm-blooded organisms.
The present *in vivo* research poses an additional speculation on studying the genotoxic effect of the imidacloprid to rabbits. Chronic exposure was studied in concentrations 1/30 and 1/15 of the LD_{50}. The administration was done orally through the drinking water and the experimental period lasted six months. After a six-month period of pesticide administration, rabbits were sacrificed. Blood and bone marrow was taken for the Micronucleus Assay in Lymphocytes (MN) and Polychromatic Erythrocytes (PCEs), respectively**.** In addition acute genotoxicity of imidacloprid was studied after administration of a single high dose lower than LD_{50} taken only once, 24 hours after the administration. Parameters of genotoxicity and cytotoxicity are estimated by measuring binucleate cells and the Cytokinesis Block Proliferation Index (CBPI) respectively. Lymphocytes obtained from rabbits are analyzed in order to estimate the concentration of imidacloprid inside the cells.
The purpose of the current study is to establish relationship between exposure (pesticide doses and dose duration) and genotoxicity (viability, number of mutation). Last but not least, the creation, establishment and validation of an appropriate index for genotoxicity GPI (Genotoxicity Potency Index) is an open area for scientific investigation and discussion.

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P33

CRYSTALLIZATION KINETICS IN POLYMER / LAYERED SILICATE NANOCOMPOSITES

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Polymer crystallization is a very interesting and widely studied subject since it determines the final properties of these technologically and scientifically exciting materials. There is a hierarchy in the formation of a polymer crystal with the repetition of the unit cells forming the polymer crystallites which sequentially form what is called spherulites. The complete characterization of polymer crystallization requires a different technique for each hierarchical step, due to the different length-scales involved. On the other hand, addition of inorganic nanomaterials and more specifically layered silicates, has been recently widely used to optimize polymer properties. Nevertheless, despite the fact that the desired structure and inorganic dispersion has been frequently achieved and the improvement of various properties has been reported, the behavior has not been fully understood. Moreover, in the case of semi-crystalline polymers, the influence of the addition and the state of dispersion of the nanofillers on the

crystallinity and the crystallization kinetics and characteristics has been largely overlooked. In this work, the structure, morphology and crystallization behavior of a semi-crystalline polymer, poly(ethylene oxide), PEO, with molecular weight M_w=100,000 gr/mol, glass transition temperature, T_g=-67°C and melting temperature, T_m=65°C, when mixed with natural hydrophilic montmorillonite (Na^+-MMT) are investigated in compositions that cover the whole regime from pure polymer to pure clay. The structure of the hybrids was investigated by X-ray diffraction, and the kinetics of crystallization by Small Angle X-Ray Scattering (SAXS), Polarized Optical Microscopy (POM) and Differential Scanning Calorimetry (DSC). In all cases intercalated structure with mono- and bi-layers of PEO were obtained. For low polymer concentrations where all the polymer chains are intercalated, or close to the inorganic surfaces, PEO is purely amorphous and it is only when there is plenty of excess polymer outside the full galleries that the bulk polymer crystallinity is recovered. The time resolved measurements reveal the effect of clay on crystallization and crystallization kinetics. Even very small amount of the inorganic can cause a significant decrease of the spherulite size and an increase of the spherulite number whereas it affects their radius growth. The crystallization time depends on the clay content even at the same supercooling. Both DSC and POM give very similar activation energies for the crystallization process. Moreover, a change is found in the crystallization mechanism from sporadic nucleation for pure PEO to two-dimensional growth with predetermined nuclei for low clay concentration.

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