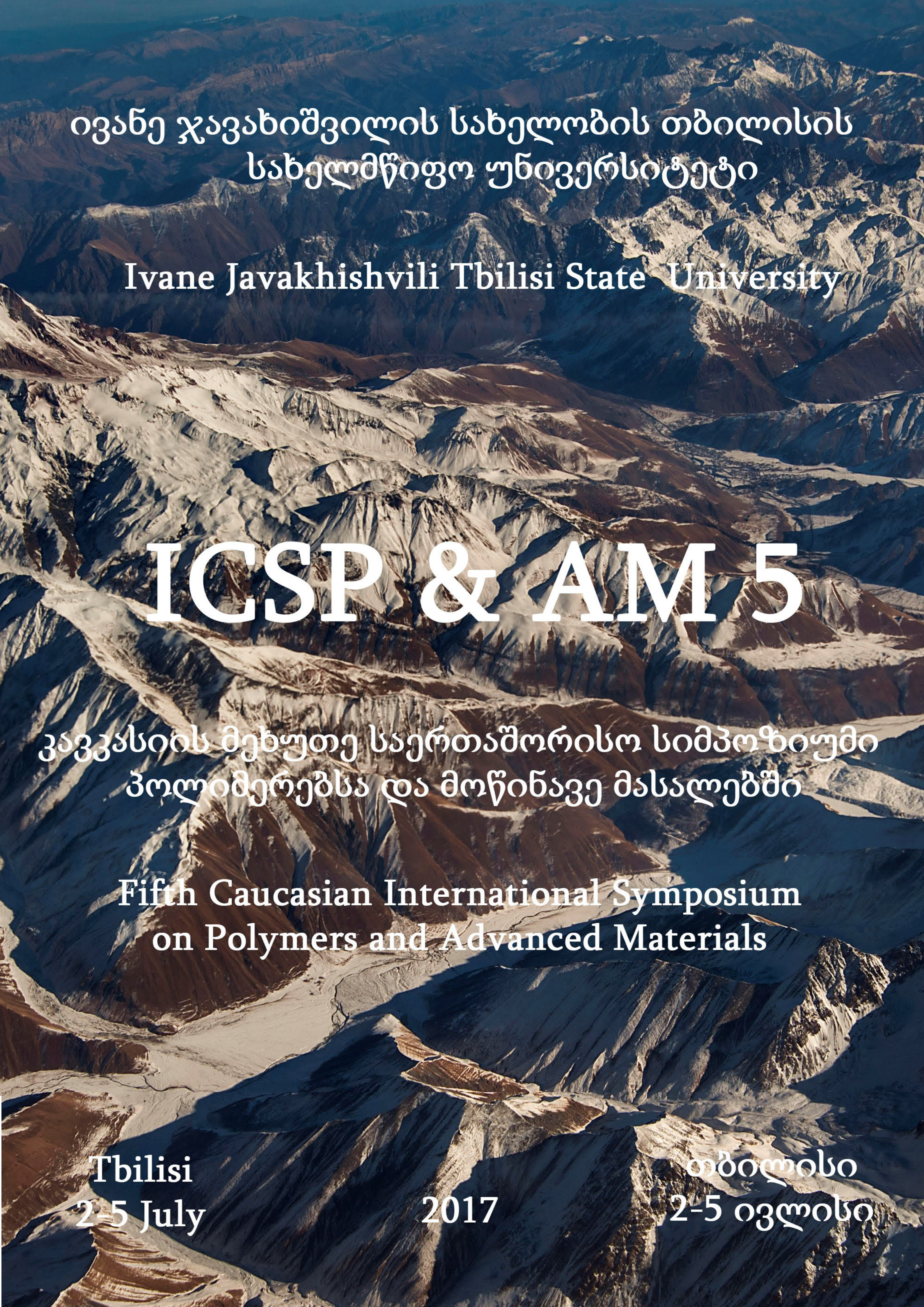

ივანე ჯავახიშვილის სახელობის თბილისის
სახელმწიფო უნივერსიტეტი

Ivane Javakhishvili Tbilisi State University

ICSP & AM 5

კავკასიის მეხუთე საერთაშორისო სიმპოზიუმი
პოლიმერებსა და მოწინავე მასალებში

Fifth Caucasian International Symposium
on Polymers and Advanced Materials

Tbilisi
2-5 July

2017

თბილისი
2-5 ივლისი

Welcome

Dear Colleagues,

On behalf of the Organizing Committee I wish to extend cordial welcome to all participants of the 5th International Caucasian Symposium on Polymers and Advanced Materials. Ten years ago, 2007, this symposium took place in Tbilisi, Georgia. We are delighted to host you in this year in very beautiful Georgia

The purpose of the conference is to encourage scientists working in polymer chemistry and advanced materials to present their investigations dedicated to problems and discoveries in above mentioned fields. Also "ICSP&AM 5" will help to introduce effectively innovative scientific researches of Georgian, Caucasian and neighboring scientific teams, which are less known for world scientific society.

We hope that this year meeting, gathering almost 120 participants, shall provide a good platform for academic and industrial scientists to discuss recent advances in the area of polymers and advanced materials.

Professor Omar Mukbaniani

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SYMPOSIUM SCHEDULE

2 July		
11.00–16:0 0	Registration	
18:00–22:00	Welcome reception	
3 July		
9.00:10.00	Opening ceremony Rector of Tbilisi Javakhishvili State University Chairmen and Co-chairmen of Symposium	
Invited Presentations		
Co-chairmen: Prof. Helena Janik, Prof. Nodar Lekishvili		
10.00:10.20	*Marc J.M. Abadie* – "Controlling interface/interphase - a challenge for composites and nanocomposites". *Institute Charles Gerhardt of Montpellier - Aggregates, Interfaces and Materials for Energy (ICGM – AIME, UMR CNRS 5253)* *University of Montpellier, Place Bataillon, 34095 Montpellier Cedex 5, France*	1
10.20:10.40	*Ullrich Scherf* – "Electrogenerated thin films of microporous polymer networks with remarkably increased electrochemical response to nitroaromatic analytes". *Chemistry Department, BUWMakro group, and Institute for Polymer Technology, Bergische Universität Wuppertal (BUW), Gauss-Str. 20, D-42119 Wuppertal, Germany*	2
10.40:11.00	*Helena Janik* – "Aliphatic polyurethane scaffolds for bone tissue engineering". *Gdańsk University of Technology, Chemical Faculty, Polymer Technological Department. 11/12 Narutowicza Street, 80-232 Gdansk. PL*	3
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11.20:11.40	*Jozef Haponiuk* – "Use of algae biomass liquefaction products to obtain polyurethane foam materials" *Gdansk University of Technology, Chemical Faculty, Polymer Technology Department, Narutowicza 11/12 St., 80-233 Gdansk, Poland,*	4
11.40:12.00	*Marta E. Plonska-Brzezinska* – "Composites containing carbon nano-onions and polymers". Faculty of Biology and Chemistry, University of Bialystok, Ciolkowskiego 1K,15-245 Bialystok, Poland	5
12.20:12.40	*M. Bratychak* – "Azocompounds with epoxy groups and oligomers on their basis" *Lviv Polytechnic National University, S.Bandery St., 12, 79013 Lviv, Ukraine*	6

12.40: 13.00	*Krzysztof Brzezinski* – “Exploring the nature of biological macromolecule- ligand interactions through multidisciplinary approaches”. *Faculty of Biology and Chemistry, University of Bialystok, Ciolkowskiego 1K,15-245 Bialystok, Poland*	7
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14.00:14.15	*S. Grabska* - “Characterization of 3d collagen materials with magnetic properties”. *Nicolaus Copernicus University in Toruń, Faculty of Chemistry, Department of Chemistry of Biomaterials and Cosmetics, Gagarin 7, 87-100 Toruń, Poland*	8
14.15:14.30	*I. Savchenko* – “Lanthanide coordination polymers based β-dicarbonyl ligands”. *Kyiv National Taras Shevchenko University, Depatment of Chemistry*	9
14.30:14.45	*J. M. Hutchinson* – “Thermal conductivity of epoxy-thiol composites filled with boron nitride**”.** *Departament de Màquines i Motors Tèrmics, ESEIAAT, Universitat Politècnica de Catalunya, Colom 11, 08222 Terrassa, Spain*	10
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15.45:16.00	*Funda Aydin* – “Synthesis, characterization , and application for solid phase extraction of trace metals combined with faas of a new silica gel-immobilized Schiff base derivative”. *Yüzüncü Yıl University, Faculty of Pharmacy, Department of Basic Sciences, 65080, Van, Turkey*	15
16.00:16.15	*V.M. Farzaliyev* - “Chemically modified viscous additive polyalkylmethacrylate type”. *Institute of Chemistry of Additives named after Academician A.M.Quliyev of National Academy of Sciences of Azerbaijan Republic, Az1029, Baku, Beyukshor highway, quarter 2062*	16
16.15:16.30	*J. Aneli* – “Absorbing radio waves polymer composites with electrical and magnetic fillers”. *R. Dvali Institute of Machine Mechanics, Mindeli Str.10, Tbilisi 0186 Republic of Georgia*	17
16.30:16.45	*T. Agladze* – “The mechanism of silver core-oleic acid shell interactions”. *Department of Chemical Technology and Biotechnology, Georgian Technical*	18

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12.05:12.20	*S. Kobauri* – "Engineering positively charged biodegradable nanoparticles for potential applications in nanotherapy". *Institute of Chemistry and Molecular Engineering, Agricultural University of Georgia, Kakha Bendukidze University Campus, # 240 David Aghmashenebeli Alley, Tbilisi 0159, Georgia*	31
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POSTER SESSIONS I

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2	PREPARATION OF POLYCONJUGATED COOLIGOMERS OF 2-METHYL-1,4-BENZOQUINONE WITH PHENYL ACETYLENE **G.S. Akhmedova[1], M.K. Mirmekhtieva[1], Ch.O. Ismailova[2], B.A. Mamedov[1]** *[1]Institute of Polymer Materials of Azerbaijan National Academy of Sciences, S.Vurgun Str.,124, Az5004, Sumgait, Azerbaijan* *[2]Azerbaijan Medical University, , S.Vurgun Str.167, Az1022, Baku, Azerbaijan*	43
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POSTER SESSIONS II

CONTROLLING INTERFACE/INTERPHASE - A CHALLENGE FOR COMPOSITES AND NANOCOMPOSITES

Marc J.M. Abadie

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Fibre-reinforced polymer composites (FRPCs) are still an emerging class of engineering materials as well as Nanofiller-reinforced polymer nano-composites (NFRPNCs). In polymer composites or nano-composites, the interface/interphase is the major issue of which depends the performance of the materials, but not for the same reason.

For the composites the interface/interphase is a key issue since it garanties the necessary stress transfer from the matrix (weak part) to the reinforcement (strong part). In the nano-composites, the main issue is the homogeneous dispersion of the nanofiller (NF) into the matrix due to its nano size and low % used (1-5 wt.%) ; therefore a good control of the interface/interphase will strongly help in the homogeneity and performance of the materials.

After defining interface/interphase in such materials, we will describe the recent progresses in chemical treatments of inorganic fillers (glass, clay, POSS) as well as organic fillers (aramid, NFs : carbon CNFs - CFs - CNTs – graphite - graphene).

SEM for composites, TEM and XRD analysis for nano-composites will be discussed in order to control the performance properties of both composites and nano-composites.

We will end up by presenting the new generation of hybrid laminates *viz*. GLARE, CARAL, ARAL which have deeply revolutionized the aircraft manufacturing.

ELECTROGENERATED THIN FILMS OF MICROPOROUS POLYMER NETWORKS WITH REMARKABLY INCREASED ELECTROCHEMICAL RESPONSE TO NITROAROMATIC ANALYTES

Ullrich Scherf

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Microporous Polymer Networks (MPNs) represent a rapidly growing area of materials science. Thin films of microporous polymer networks (MPN) have been generated by electrochemical polymerization of a series of multifunctional carbazole- or thiophene-based monomers. The microporous films show high S_{BET} surface areas up to 2200 m^2/g as directly measured by krypton sorption experiments. A correlation between the number of polymerizable carbazole or thiophene units of the monomer and the resulting surface area is observed. For thiophene-based monomers electrochemical polymerization in boron trifluoride diethyletherate (BFEE)/dichloromethane (DCM) mixtures allows for the generation of MPN films with optimized porosity.

Electrochemical sensing experiments with 1,3,5-trinitrobenzene or TNT as prototypical nitroaromatic analytes demonstrate an up to 180-times increased current response of MPN-modified glassy carbon electrodes in relation to the non-modified electrode. We expect a high application potential of such MPN-modified electrodes for boosting the sensitivity of electrochemical sensor devices. [1-5]

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ALIPHATIC POLYURETHANE SCAFFOLDS FOR BONE TISSUE ENGINEERING

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Segmented polyurethanes (PURs) are a synthetic multiblock materials widely used for different medical purposes. Due to the possibility of designing various chemical compositions of hard and soft segments they can be applied in medicine as stable vs time materials and biodegradable ones. Polyurethanes are synthesized by the polyaddition of three basic components: olygodiol (polymeric polyol), isocyanate with at least two functional groups and a low molecular weight chain extender (diols or diamines). Hard segments (HS) are the reaction product of diisocyanates and a chain extender, and soft segments are a combination of diisocyanates with olygodiols. Current research on polyurethane biomaterials are strongly oriented toward the tissue engineering, thus the biodegradable materials are searched from which porous materials (called scaffolds) with the proper pours' type and porosity are obtained. In bone tissue engineering, as polyols are mainly used poly(ε-caprolactone) (PCL), poly(glycolic acid) (PGA), poly(lactic acid) (PLA) and their copolymers, because they are susceptible to hydrolytic degradation and poly(ethylene glycol) (PEG), which increases the hydrophilicity of the PURs. From cytotoxicity point of view the isocyanate used should be of aliphatic types. The bone tissue scaffolds in order to fulfill its function have to be characterized by the appropriate mechanical properties and promote bone cells proliferation and calcification. Bone scaffolds should have the adequate rigidity and strength, to provide sufficient mechanical support, adjusted to the mechanical properties of bone tissue. In the presentation the overview of chemistry of hard and soft segments, their modification, the way of obtaining the proper porous morphology of PUs scaffolds and biological testing will be provided. The discussion will concentrate on the literature data and own results from experimental data.

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MODIFICATION REACTIONS OF POLYMETHYLHYDRO(VINY)SILOXANES

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Macromolecular grafting is a synthetic approach that involves the functionalization of a preformed polymer backbone containing reactive groups with an appropriate reagent. There is an increasing interest in catalytic grafting of polyhydrosiloxane as to an alternative route for the synthesis of organic–inorganic hybrid polymers, owing to the complexities involved in direct generation of well-defined linear hybrid polymers. Besides the process of equilibration, the hydrosilylation process is the most widely used method of preparing organofunctional polymethylsiloxanes starting from poly(methylhydro)siloxanes.

From this point of view the chemical modification reactions of poly(methylhydrosiloxanes as well as polydimethyl(methylvinyl)siloxanes is very interesting.

Presented paper is dedicated to the chemical modification reactions of poly(methylhydro)siloxanes and polydimethyl(methylvinyl)siloxanes for obtaining of new thermoreactive methylsiloxane oligomers with reactionable side groups, filled composite materials on their basis and investigation of their electro conducting properties.

The financial support of the Georgian National Science Foundation Grant #STCU, 5892 and 6301 is gratefully acknowledged.

COMPOSITES CONTAINING CARBON NANO-ONIONS AND POLYMERS

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In the recent years, the ability of carbon to exist in different allotropic forms has provided, besides C_{60} and the other fullerenes, many new varieties of nanoscale sized shapes with fascinating properties, such as the “higher” fullerenes, endohedral fullerenes, carbon nano-onions (CNOs), and single and multi-walled carbon nanotube, among many [1, 2]. Within this large group of allotropic carbon nanomaterials, we focus on the onion-like layered structures [3].

Carbon nano-onions are spherical and typically 4-25 nm zero-dimensional particles, consisting of concentric shells of graphitic carbon, that can also be described as multi-shelled fullerenes [4]. That is why they are referred to as “nano-onions”, “onion-like carbon”, multilayer fullerenes, multi-layered round carbon particles or “buckyonions”. In this study, we discuss the preparation and characterization of carbon nano-onions, their structural, physical and chemical properties as well as of their derivatives, mainly composites, and their potential applications.

Composite materials based on the integration of carbon nanostructures with other substances can lead to materials possessing properties of the individual components. During the modification of carbon materials many parameters, such as the degree of hydration and crystallinity of transition metal oxides [5] the potential degradation of conducting polymers [6-8] and the decrease of the surface area of the composites, have to be taken into consideration for the preparation of optimal composite electrodes for capacitors. Research indicates that composites containing polyelectrolytes can be also used in detection of neurohormones, such as dopamine [9].

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AZOCOMPOUNDS WITH EPOXY GROUPS AND OLIGOMERS ON THEIR BASIS

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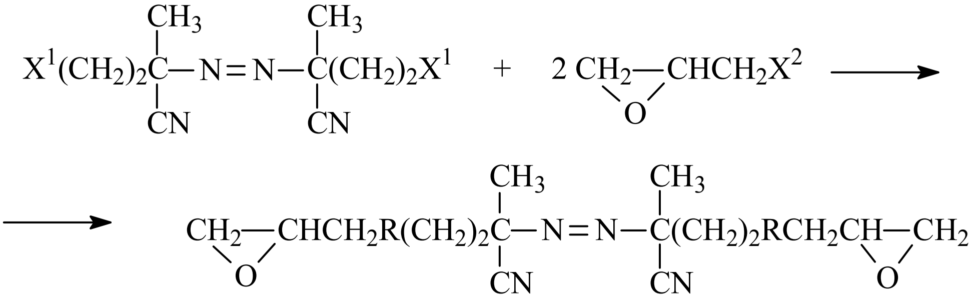
Functional azodinitrile compounds, along with the compounds containing peroxy groups in their structure, are used in different radical processes, in particular for obtaining monomer-based oligomers and polymers with carboxy, hydroxy, peroxy and other end-groups.
In this work we show the possibility of creating azodinitrile compounds with epoxy groups (ACEG), as well as obtaining oligomers and polymers with epoxy end-groups on their basis.
Generally the synthesis of ACEG is described by the following equation:



$$\mathrm{X^1(CH_2)_2}\underset{\mathrm{CN}}{\overset{\mathrm{CH_3}}{\mathrm{C}}}\mathrm{-N=N-}\underset{\mathrm{CN}}{\overset{\mathrm{CH_3}}{\mathrm{C}}}\mathrm{(CH_2)_2X^1} + 2\,\underset{\mathrm{O}}{\mathrm{CH_2{-}CH}}\mathrm{CH_2X^2} \longrightarrow$$

$$\longrightarrow \underset{\mathrm{O}}{\mathrm{CH_2{-}CH}}\mathrm{CH_2R(CH_2)_2}\underset{\mathrm{CN}}{\overset{\mathrm{CH_3}}{\mathrm{C}}}\mathrm{-N=N-}\underset{\mathrm{CN}}{\overset{\mathrm{CH_3}}{\mathrm{C}}}\mathrm{(CH_2)_2RCH_2}\underset{\mathrm{O}}{\mathrm{CH{-}CH_2}}$$

The initial compound for the synthesis was azocompound with carboxy and hydroxy groups. 2,3-Epoxypropanol, epichlorohydrin and diepoxy derivatives of amines were used as epoxy components. The main kinetic regularities were determined for obtaining ACEG and methods of their synthesis were proposed.
Oligomers and polymers with epoxy groups were obtained via radical polymerization in the solution using the synthesized ACEG as an initiator. Divinyl, isoprene and styrene were the monomers. The structure of the synthesized oligodienes with epoxy groups was confirmed by the spectroscopy. The synthesized oligomers were found to be stereonon-regular compounds, 80% of which were chains of 1,4-addition.
By means of gel-permeation chromatography the oligodienes polydispersity was found to be 2.12. To decrease the polydispersity and increase the yield of multifunctional oligomers we propose to synthesize the mentioned oligomers by metered supply of ACEG.
The resulting oligomer has molecular weight of 4000 g/mol, functionality of 1.86 and polydispersity of 1.58.

EXPLORING THE NATURE OF BIOLOGICAL MACROMOLECULE-LIGAND INTERACTIONS THROUGH MULTIDISCIPLINARY APPROACHES

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Drug-resistant bacteria are an important healthy issue, as many human pathogens have gained resistance to a wide range of commercially available pharmaceuticals. *Pseudomonas aeruginosa* has a natural resistance to many antibiotics and disinfectants. This opportunistic pathogen causes a myriad of infection to immunosuppressed patients, including endocarditis, microbial keratitis of eye, pneumonia, urinary tract infections and chronic lung infection in patient with cystic fibrosis or cancer. Numerous virulence factors, the large number of multi-drug efflux systems, as well as the low permeability of the outer membrane are key factors in pathogenesis of *P. aeruginosa*. Moreover, *P. aeruginosa* is capable of growing in complex bacterial communities, called biofilms, which makes them more resistant to antibiotics than single-grown cells.

S-adenosyl-L-homocysteine hydrolase (SAHase) catalyzes the reversible breakdown of *S*-adenosyl-L-homocysteine (SAH) to adenosine (Ado) and homocysteine (Hcy). SAH is formed in methylation reactions that utilize *S*-adenosyl-L-methionine (SAM) as a methyl donor. Therefore, SAHase is an essential enzyme involved in the regulation of methylation reactions. This applies to both, healthy host cells and their invading pathogens form. Therefore, selective inhibition of SAHases in targeted cells is an excellent possibility for a drug intervention at the molecular level of cell metabolism. SAHases are highly-conserved enzymes with almost identical organization of the active site. This fact practically precludes design of highly selective inhibitors against the enzymes of pathogenic origin that would not affect the human cells. Therefore, our study are not focused only on the active site of the enzyme, but also on a formation of the active site during ligand binding and a regulation of the access to the catalytic centre.

A lecture will present how the dynamics of bacterial SAHase (*P. aeruginosa*) - ligand interactions can be elucidated at atomic level with a combination of structural and biophysical methods in solution and solid state, including X-ray crystallography, ^{23}Na-NMR, Isothermal Titration Calorimetry, Dynamic Light Scattering and Enzyme Kinetics and how these results could be applied for a selective inhibitors of bacterial SAHases.

Acknowledgements. This project is supported by a grant OPUS 2013/09/B/NZ1/01880 to KB from the Polish National Science Centre.

CHARACTERIZATION OF 3D COLLAGEN MATERIALS WITH MAGNETIC PROPERTIES

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Magnetic nanoparticles are being extensively studied due to their interesting magnetic properties and technological applications. Small iron oxide nanoparticles have been applied in biomedical field for about 50 years due to their non-toxicity, biodegradability, biocompatibility, chemical stability and non-carcinogenic character [1,2].

Collagen (COL) is biopolymer widely used in several biomedical and cosmetic applications. This polymer occurs naturally in living organisms or is produced by living organisms. This is attractive material for biomedical and cosmetic industry, due to its unique properties, namely bioactivity, biodegradability, biocompatibility, fiber-forming and film-forming [3,4].

In this study matrices based on collagen were prepared and modified with magnetic particles. Magnetic particles were obtained by chemical precipitation method. Ferric chloride and ferric sulfate was solubilized in 1% aqueous solution of chitosan. Next the resulting solution was chemically precipitated at room temperature by adding dropwise 25% solution of $NH_{3(aq)}$. A black mixture was separated by filtration, then was washed by deionized water and it was dried under vacuum. Matrices were obtained by the lyophilization process of collagen solution with addition of magnetic particles. Physical and chemical properties of 3D materials were tested be several techniques. Magnetic properties of the material were studied using electromagnetic field.

The results showed, that the addition of magnetic particles to polymeric matrices based on collagen led to modification of their properties. Moreover, the materials obtained exhibit magnetic activity. New materials based on collagen with magnetic particles can be potentially used in medical and cosmetic field.

Acknowledgments. Financial support from the National Science Centre (NCN, Poland) Grant No UMO 2013/11/B/ST8/04444 is gratefully acknowledged

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LANTHANIDE COORDINATION POLYMERS BASED β-DICARBONYL LIGANDS

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Lanthanide coordination polymer (CP) is an important class of organic-inorganic hybrid materials formed by the coordination of lanthanide ions with organic linkers. They have shown a number of promising applications; these applications are ascribed to the best properties of organic and inorganic components and decrease their drawbacks by a synergic effect [1]. In order to get functional lanthanide materials, appropriate synthetic strategies are critical [2, 3]. Compared with first-row transition metal ions, lanthanide ions usually display high coordination number and variable coordination geometries, and they will make lanthanide ions become excellent spacers in assembling fascinating coordination polymers [4]. As a subset of such materials, lanthanide CPs continue to attract an escalating attention, owing to their unique optical, electronic, and magnetic properties [5–7].

The complexes of Ln^{3+} with 2-methyl-5-phenylpenten-1-3,5-dion (mphpd) $Ln(mphpd)_3 \cdot nH_2O$ were synthesized. The polycomplexes and copolymers with methylmethacrylate in ratio 5:95 were obtained by free-radical polymerization and the kinetics of polymerization was studied by dilatometric method at the first time. The method of dynamic light scattering and the results of electronic microscopy showed that the obtained polymer systems are nanoscale. The luminescent spectra of obtained metal complexes in solid state are investigated.

The electroluminescent spectra of organic planar heterostructure ITO/PEDOT:PSS/ $[Ln(mphpd)_3]_n$/Al are examined and analyzed.

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THERMAL CONDUCTIVITY OF EPOXY-THIOL COMPOSITES FILLED WITH BORON NITRIDE

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Within a broader study of epoxy-thiol "click" systems [1], we are interested here in the fabrication of epoxy-thiol composites filled with boron nitride (BN) for use as insulated metal substrates. For such an application, the material must display high thermal conductivity and low electrical conductivity. In this work we examine the effect of the BN filler on the epoxy-thiol curing reaction and on the thermal conductivity of the fully cured samples.

Composite samples are prepared by mechanically mixing the BN particles, in the desired proportion (up to 34 vol%), with the stoichiometric amounts of epoxy (DGEBA) and thiol (pentaerythritol tetrakis) and an initiator (encapsulated imidazole). The BN particles are obtained commercially (Saint Gobain) in different forms: hexagonal platelets of sizes 2 µm and 6 µm, and spherical agglomerates of size 80 µm. The curing reaction is monitored by differential scanning calorimetry (DSC) in both isothermal and non-isothermal mode, and the thermal conductivity of cured samples is measured by the Transient Hot Bridge method [2] using the HotPoint sensor calibrated with 5 different materials over the range from 0.2 to 20 W/mK.

The DSC results show that the cure reaction is first accelerated by a low vol% of BN and is then retarded at higher BN contents; this is evident from the peak exotherm temperature in non-isothermal cure and in the time to the peak exotherm in isothermal cure. The effect is more pronounced with the 80 µm BN agglomerates, and even more so with a hybrid of 80 µm agglomerates with 2 µm or 6 µm platelets. Despite the change in the cure kinetics with the addition of BN filler, the heat of reaction and the glass transition temperature of the fully cured systems is always the same. Furthermore, the effect is not observed when the epoxy is cured with an amine. Accordingly, we attributed it to a physical effect associated with the heat transfer into the sample, which appears to be better in the epoxy-thiol system, and would therefore anticipate an enhanced thermal conductivity in the composites with 80 µm agglomerates and in the hybrids.

The measurements of thermal conductivity show that this is indeed the situation. For all samples, the thermal conductivity increases with BN content in a non-linear manner, but the increase is greatest for the hybrids, followed by the 80 µm agglomerate samples. For example, for the hybrid with 34 vol% BN, the thermal conductivity is 4.0 W/mK. The thermal conductivities of the samples with 6 µm and 2 µm platelets are somewhat lower, but nevertheless greater than those obtained with an epoxy-diamine matrix. The enhanced thermal conductivity is attributed to an improved matrix-filler interaction in the epoxy-thiol composites, which could be associated with Lewis acid-base coordination.

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THE CHARACTERIZATION OF CHITOSAN/COLLAGEN SCAFFOLDS WITH GLYCOSAMINOGLYCANS ADDITION

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Chitosan and collagen are natural polymers widely used in biomaterials science [1]. They can be isolated from different types of natural sources. As an example, chitosan is mainly isolated from crustacean shells [2] and collagen from bovine skin [3], fish scales [4] or rat tail tendons [5]. Chitosan and collagen are biocompatible, biodegradable and non-toxic for human body [6].

The examples of natural compounds from glycosaminoglycans (GAGs) group as hyaluronic acid and chondroitin sulfate [7]. They have appropriate biological properties as biocompatibility and biodegradability. Moreover, they do not cause any immunological reactions after implantation. The increasing interest in their application in regenerative medicine is currently observed.

For the experimental studies collagen was isolated from rat tail tendons [8] and glycosaminoglycans were isolated from fish *Salmo salar* skin [9]. Chitosan with low molecular weight was purchased from Sigma-Aldrich company (Poland). Collagen and chitosan were dissolved in 0.1M acetic acid in 1% concentration. Isolated mixture of glycosaminoglycans was dissolved in distilled water in 1% concentration as well. Chitosan and collagen were mixed in the weight ratio 50/50 and the GAGs mixture was added in 1 and 5 wt%. Obtained polymeric solutions were frozen and lyophilizated. As a results 3D porous structures called scaffolds were obtained. Scaffolds were characterized by the infrared spectroscopy, porosity and density measurement and mechanical tests. The results showed that the addition of glycosaminoglycans changes the position of collagen and chitosan characteristic peaks in IR spectra what suggests that new interactions between polymers are formed. Moreover, the GAGs presence in biopolymer blends improves the mechanical resistance of the material on the applied force. The density increases after the glycosaminoglycans addition and the porosity of material was above 90%. Obtained results justified that the scaffolds based on chitosan, collagen and glycosaminoglycans can be potentially applied in regenerative medicine.

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GENERAL METHOD FOR AROMATIC IMINO GROUP CONTAINING POLYMERS SYNTHESES

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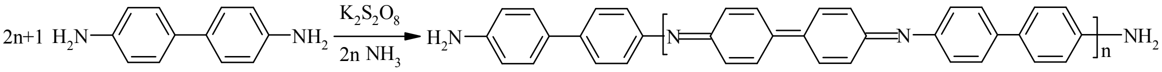
Electroactive polymers synthesized by oxidative polymerization technique from aromatic amines are of huge interest due to the easy method of preparation, stability and possibilities of application in different areas of industry [1,2]. It had been shown, that the method proposed on basis of oxidative condensation of PFDA is a convenient one step and unique method for the synthesis of the polymer having structure similar to that of fully oxidized state of polyaniline–pernigraniline[3]. Investigation of oxidative polycondensation of benzidine using the same reaction conditions as for polycondensation of PFDA revealed, that the reaction processed by the similar same mechanism and as a result polymer 1 was obtained.



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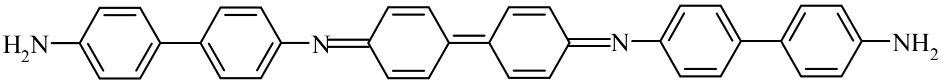
As structural elucidation of obtained polymer was complicated due to bad solubility, the oligomer with following structure have been obtained and characterized by UV, IR and PMR spectral methods.



The fact of synthesis of both polymer and oligomer is exciting, first of all, due to the ordered structure, that would be complicated to obtain by other methods, and then, due to the fact of evidence of generality of proposed method for the syntheses of quinonediiminic structures on the base of aromatic diamines.

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ONE STAGE PRODUCTION OF SUPERCONDUCTING MgB_2 AND HYBRID POWER TRANSMISSION LINES BY THE HOT SHOCK WAVE CONSOLIDATION TECHNOLOGY

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The rapid development of research of conductors based on superconducting compound MgB_2 makes them a real prospect for technical applications of temperatures below 30 K.

The technology of development superconductive materials belongs to traditional powder metallurgy: preparing and densification Mg – B powder blends in static conditions with their further sintering processes.

The application of shock wave consolidation technology to fabricate high-dense MgB_2 billets with maximal critical temperature $T_c = 40K$ was also used but required a sintering to be applied after a shock wave compression to fabricate high dense MgB_2 billets.

We applied the original hot shock-wave consolidation method combining a high temperature with the two-stage explosive process without any further sintering which produced superconducting materials with a high density and integrity. The consolidation of MgB_2 billets was made at temperatures above the melting point of Mg up to 1000°C in partially liquid condition of Mg-B blend powders. The influence of isotope B composition on critical temperature and superconductive properties was evaluated as well as the first successful application of this method for production of hybrid power transmission lines for simultaneous transport of hydrogen and electric energy was demonstrated.

HIGHLY CHARGED BIODEGRADABLE CATIONIC POLYMERS: SYNTHESIS AND ASSESSMENT OF BIOLOGICAL ACTIVITY

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The last decade has witnessed enormous research focused on cationic polymers (CPs). CPs exhibit unique physical-chemical properties that render them appealing for numerous applications.CPs are extensively explored and form electrostatic complexes with anionic biomolecules, nucleic acids and proteins. In addition, their inherent bioactive properties such as stimuli responsiveness, antimicrobial, antioxidant, antitumor and anti-inflammatory make CPs more promising for further enhanced therapeutic potential [1]. Recently, CPs have attracted an increased interest for the application in both gene therapy [1-3] and biotechnology [4-5]. A high challenge is the creation of highly charged CPs capable to be degraded and cleared from the body after fulfilling the functions.

We are reporting on new highly charged biodegradable CPs composed of naturally occurring building blocks such as amino acid arginine and endogeneous multi-amine spermine. Using these compounds we have synthesized various cationic polyamides and polyureas *via* an original synthetic approaches including one-pot synthetic strategy based on the application of epoxy-poly succinamides [6]. The polymers are capable of being biodegraded (hydrolyzed) in a physiological environment with releasing free spermine, utilizable by the organism.

The new CPs were highly water soluble (≤ 200 mg/mL) that is important for their practical applications.The CPs revealed a high *in vitro* cell compatibility within the concentration range 0.04-10.00 mg/mL (evaluated using mammalian cell lines such as 4T1 (murine mammary carcinoma), HeLa (human cervical adenocarcinoma), NIH3T3 cells (mouse fibroblast) & CCL 210 (human fibroblast).The CPs formed a positively charged (zeta potentials ≤ +57.4 mV) stable nanocomplexes with pDNA (38.0 – 312.0 nm) at rather low polymer/pDNA weight ratios (WR=5/1-25/1).The cellular uptake of complexes was evaluated by flow cytometry (FACS) analysis and confocal microscopy study. The new CPs showed selective transfection activity towards certain cell lines that could be promising for practical applications in gene therapy, some of them revealed rather high activity against bacteria (tested with *Bacillus cereus, Staphylococcus aureus*, *E.coli, Salmonella enterica*) and could be of interest also as nontoxic and biodegradable antimicrobial agents.

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SYNTHESIS, CHARACTERIZATION AND APPLICATION FOR SOLID PHASE EXTRACTION OF TRACE METALS COMBINED WITH FAAS OF A NEW SILICA GEL-IMMOBILIZED SCHIFF BASE DERIVATIVE

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A range of analytical techniques including precipitation, adsorption, ion exchange, extraction (solid phase or liquid phase) have been used to determine the content of heavy metal ions especially at low concentration[1]. In recent years, solid-phase extraction (SPE) has attracted great interest to determine the heavy metals from a wide variety of matrices, because it is more environmentally friendly, economical, fast and the experimental processes are simpler. Various adsorbents, such as porous alumina, zeolite, fluorosil, silica functionalized with various Schiff bases are very effective as an adsorbent in SPE methods [2]. In this study, a new alternative sorbent was prepared and the adsorption capacity of this adsorbent for metals was investigated. The novel sorbent was prepared by chemically immobilizing Schiff base derivative benzoin 5-aminoisophthaloylhydrazone (BAH) onto silica gel surface previously modified with silylant agent, 3-chloropropyltrimethoxysilane (Si-CPTS). The immobilization reaction was confirmed through elemental analysis, thermogravimetric analysis (TGA) and fourier transform infrared spectroscopy (FTIR). The adsorbent was used for extraction of metal ions from aqueous solution. Firstly, the effect of important parameters that influence on extraction process such as pH, sorbent amount, the type and volume of eluasyon solution, vortex and ultrasonication time, sample volume and matrix effect were investigated to determine the optimal values. In optimum conditions, solid phase extraction method based on use of silica adsorbent functionalized with Schiff base were successfully applied to the real water samples prior to FAAS analysis.

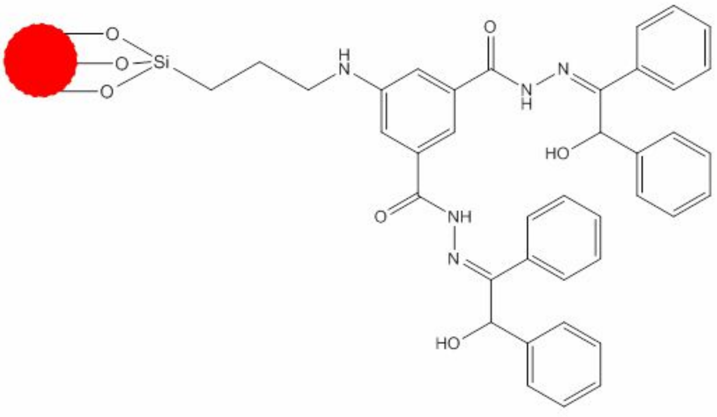

Fig. 1. Molecular structure of novel adsorbent

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CHEMICALLY MODIFIED VISCOUS ADDITIVE POLYALKYLMETHACRYLATE TYPE

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The used lubricating oils must be in high quality in order to ensure the long-time and reliable exploitation of the machine and mechanisms. The quality of the lubricating oils is determined with the quality of the additives used in their content. Among these additives, the viscosity additives are very special. So, they are used in getting the oils having high viscosity-temperature properties that are the high viscosity index. If the base oil used in the preparation of the lubricating compositions doesn't meet the requirement for its index price, then the lubricating composition isn't prepared on the basis of this oil. That's why firstly the viscosity-temperature properties of the oil must be improved. With this purpose, usually the viscosity additives are used. Because using the polymer combinations in little amount (1-2 %) the aim in front of you is achieved, as well as, this way is considered the tested and simple way.

The article was dedicated to the copolymerization reaction of decylmethacrylate with decene-1. The copolymerizaion was realized with the participation of the inisiator the radical mechanism – izooil acid dinitrilyne.

The learning of the polymerizaion reaction of decylmethacrylate with decene-1 shows that, it is possible to analyse the polymer connections having any molecular mass and content with the way of changing the monomers correlation and reaction temperature, that, it is possible to manage it knowing the regularities of the process.

The effect of decylmethacrylate decene-1 copolymers to the viscosity-temperature properties has been learnt. As the result it has been showed that, using the joint polymers of decylmethacrylate – decene-1 in the content of the limpid oils as the thickener additive, it is possible to get the base oils with good viscosity-temperature properties..

ABSORBING RADIO WAVES POLYMER COMPOSITES WITH ELECTRICAL AND MAGNETIC FILLERS

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Effect of different technological factors on the super high frequency (3- 8 GHz) radio wave (RW) absorbing properties of polymer composites based on epoxy resin and electric conducting (carbon black, graphite) and magnetic (nickel, cobalt, ferrite) fine dispersed fillers have been investigated. There are obtained the composites with one and binary fillers, concentration of which changed in the wide range. It is shown that the ability of absorption of these radio- waves essentially depends on the wave length, filler type and its concentration. Relatively high absorption is manifested for composites containing 40 -50 wt% filler. More high results obtained for the layer sandwich type samples. For the composite containing 40wt% in sum of carbon black and graphite at ratio of lasts (50/50) the absorption of RW equals to 70%. The level of absorption essentially expanded at use of these materials contained several absorbing layers with different content and sequence of them. Namely maximal absorbing ability (84%) shows the sandwich, in which the layers are arranged in order of increasing concentration, when the wave falls from the side of the layer with a lower filler content. For the composites with ferrite and graphite so called synergistic effect (non-additive increasing of some parameters at definite proportion of two or more fillers) is manifested. By variation of the profile the absorber with maximal absorption of RW has been selected. Besides of the effect of electric and magnetic fields at hardening of the composites on the wave absorbing ability has been investigated. Essential effect of the absorber surface form reveals rather high absorbing properties, especially the absorber, with conical convexities on the surface of the layer is characterized by 91% of the absorbed intensity.

It is expressed an assumption about essential role of heterogeneity of absorber microstructure in the processes of absorption. Namely, RW absorption ability of investigated materials essentially increases with increasing of the degree of homogeneity of filler particles distribution in the polymer matrix. It is possible that in the RW absorption by polymer composites main role play the different resonance structures localized in the micro-regions of polymer matrix, which actually participates in the diffraction -interference processes of the electromagnetic waves with different length.

THE MECHANISM OF SILVER CORE-OLEIC ACID SHELL INTERACTIONS

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Metal-based core-shell nanoparticles (NPs) have attracted attention owing to their unique properties compared to their bulk counter parts. Recently novel electrochemical method of formation of a sol of silver NPs in a hexane stabilised by an oleic acid (OA) shell was proposed [1-3]. The experimental set-up allows silver ions that formed at the anode to discharge at the cathode surface poisoned by a surfactant (OA), which adsorbs at sites favourable for silver adatoms and inhibits the growth of silver nanoclusters. The latter being weakly adsorbed at the surface and strongly bonded to amphiphile OA molecules easily washed out from the cathode upon rotation, forming the stable sols of Ag-OA core-shell NPs of required dimensions.

In the present study, the intimate mechanism of interaction of metal NPs with OA molecules studded by means of FTIR and UV spectrometry as well as TGA and DLS technique. Semi-empirical method ZINDO1 (packaged in Hyperchem 8.0.9 program [4]) used to evaluate the redistribution of the charge density and electrostatic potential in OA molecule because of interactions with silver core (fig.).

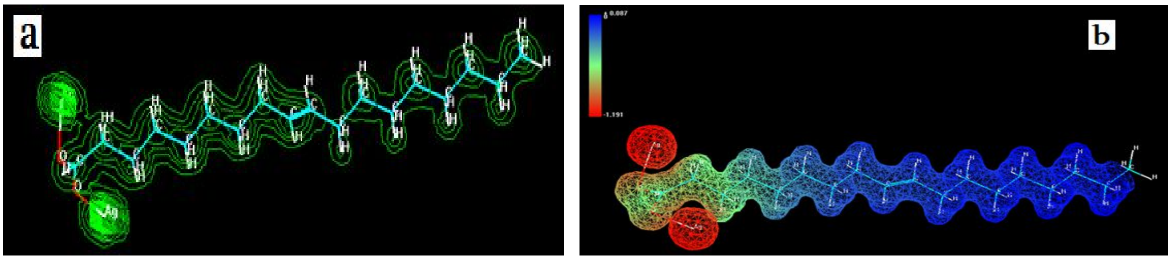

Figure. Total charge density (a) and 3D mapped electrostatic potential (b) distributin in silver core – OA shell NPs.

Nanosilver core -OA shell interactions results in a shift of charge density close to silver core and subsequent weakening of the interatomic double C=C bond (fig, a). These conclusions proved by calculations of variation in electrostatic potential (U) at double bond and charge distribution patterns (fig, b) which displays dramatic decrease in U from -0.467 e/Å to -0,043 e/Å manifesting attenuation of the double bond. Consideration of the proposed mechanism makes it possible to rational explain catalytic action of silver core on oleic acid shell oxidation reaction by strong oxidizers ($KMnO_4$, $K_2Cr_2O_7$, etc.) [2, 3].

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AMBIENT TEMPERATURE TRANSITION-METAL-FREE DISSOCIATIVE ELECTRON TRANSFER REVERSIBLE ADDITION–FRAGMENTATION CHAIN TRANSFER POLYMERIZATION (DET-RAFT) OF METHACRYLATES, ACRYLATES AND STYRENE

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Inorganic sulfites as reducing agents were successfully used in combination with typical reversible addition–fragmentation chain transfer (RAFT) agents for the controlled DET-RAFT (DET: dissociative electron transfer) of methacrylates, methyl acrylate (MA), and styrene (Sty) near room temperature (30 °C). The polymerizations were first-order with respect to monomer conversion and polymers with narrow molecular weight distributions ($Đ < 1.2$), and “living” features were obtained. MALDI-TOF experiments demonstrated the integrity of the chain-ends and clearly showed the absence of SO_2 in the polymer chains. Kinetic studies revealed that an increase of either temperature or concentration of sulfites provided faster reactions, without loss of control. Ab initio quantum chemistry calculations suggested that in the presence of the reducing agent the RAFT agent undergoes one-electron reduction to a stable radical anion that can then undergo fragmentation to yield the initiating carbon-centered radical. The new metal-free DET-RAFT developed proved to be versatile and robust, as it could be also used for the polymerization of different relevant monomers, such as glycidyl methacrylate (GMA), 2-(diisopropylamino)ethyl methacrylate (DPA), and 2-(dimethylamino)ethyl methacrylate (DMAEMA).

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SWELLING PROPERTIES OF POEGMAS BASED HYDROGELS GENERATED BY ELECTRON BEAM IRRADIATION

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Thermo responsive hydrogels based on poly(olygoether methacrylates) (POEGMAs) are attractive materials for storage, transport and controlled release of low molecular mass substances. The most demanding behaviour of thermo sensitive hydrogels is sharp and reversible volume phase transition (VPT) under slight changes in temperature. Thermally induced VPT relates to simultaneous weakening of polymer-water and strengthening of polymer-polymer interactions. In result, VPT leads to sudden collapse of polymer network and to push out the water (1). This mechanism may accelerate process of release of low molecular mass substances (useful in drug delivery systems) or can be used to design hydrogel actuators or microvalves (2). Swelling properties determine amount of transported substance, which is bigger for hydrogels with higher equilibrium swelling degree (SD_{eq}).

Four different monomers from the POEGMAs group (number average molecular mass of side group M_n = 188, 300, 500 and 950 g/mol) were purchased from Sigma-Aldrich. Gels were prepared by electron-beam induced polymerisation and crosslinking. This process was carried out under different conditions: in air or argon atmosphere. Gel density was controlled by irradiation dose applied for sample preparation. After synthesis, samples were immersed in deionized water (Millipore grade purity) at least for 3 weeks to achieve equilibrium. Water was changed every few days to eliminate non-reacted monomers and short polymer chains and clusters (nano and microgels). Then, the gels were freeze-dried. Finally, sol-gel analysis according to Charlesby-Rosiak equation and DS_{eq} measurements were done (3).

Obtained results showed that the gelation threshold (the minimal dose required to produce permanent macrogel) is strongly influenced by side groups length, but only slightly by environment (gelation doses are a little bit smaller for argon). Length of side groups impacts on equilibrium swelling degree, which is higher for longer groups.

Performed investigations showed that the POEGMAs hydrogels synthesised in inert atmosphere have better swelling properties than those polymerised under air conditions. Obtained data suggested that $PMEO_{(7-9)}MA$ have the best swelling properties among examined hydrogels.

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THERMORESPONSIVE TREHALOSE GLYCOHYDROGELS AS SMART BIOMATERIALS

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The presented results concern the research on smart glycohydrogels with covalently incorporated trehalose, which were studied as protein carriers or soft matrices for 3D cell culture. They were fabricated from trehalose monomers by redox-initiated free-radical copolymerization as bulk materials or submicrometer-sized microgels, depending on the used technique. *N*-isopropylacrylamide, whose polymers are thermoresponsive and undergo phase transition around the physiologically relevant temperatures, was used as a main monomer to provide the smart properties to glycohydrogels.

The bulk trehalose glycohydrogels were synthetized with the aim to obtain bioprotective carriers for protein release. Protein and peptide therapeutics have become mass-scale products and have achieved a significant role in almost every field of medicine. However, the fragile three-dimensional structure of proteins makes them very susceptible to proteolytic and chemical degradation, as well as physical unfolding and aggregation in body fluids, which leads to the fast loss of their bioactivity. Therefore, nowadays a lot of effort is put into improving *iv vivo* stability of those biopharmaceuticals. Trehalose is naturally occurring disaccharide mainly known from its ability to protect proteins from inactivation and denaturation under environmental stress conditions. Moreover, recently it has been shown that those unique properties are intensified for trehalose glycopolymers.

The trehalose glycomicrogels were used in form of dispersions as thermogellable matrices for 3D cell culture. Dispersions of microgels based on poly(*N*-isopropylacrylamide) in solutions with physiological ionic strength form colloids, which further gel upon heating to physiological temperature forming macroscopic hydrogel with interconnected porous microstructure. This thermo-driven behaviour were shown to allow for facile, homogeneous and non-invasive cell entrapment and cultivation of 3D multicellular structures. However, synthetic matrices do not contain natural attachment sites which enable cell-matrix interactions, that are of crucial importance for many cellular functions. Therefore, to form attachment points, trehalose as a disaccharide composed of two α,α’-1,1’-linked D-glucose moieties was incorporated within the glycomicrogels polymer network with the intention of providing multivalent interactions between terminal D-glucopyranosyl units and glucose transporters (GLUTs) expressed on the cells surface.

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PREPARATION OF A ZEOLITE MATERIAL WITH A COMBINED MICRO-MESOPOROUS STRUCTURE INVOLVING AN ORGANIC TEMPLATE

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Destructive and constructive approaches can be used to create materials with a combined micro-mesoporous structure. Destructive methods include post-synthetic processing methods leading to partial destruction of the zeolite resulting in the formation of mesopores; in particular, these methods are dealumination and desilylation. Dealumination is achieved by hydrolysis of the Al-O-Si bonds of the zeolite framework by help with high-temperature treatment, steam processing, acid treatment or by other chemical reagents.

In the proposed work dealumination of zeolites of the mordenite and phillipsite type was carried out by treatment with hydrochloric acid under mild conditions and with an organic template - tetramethylammonium, which allowed the formation of final samples without further extraction of aluminum from the zeolite framework. Subsequent processing of the obtained protonic and ammonium forms by water vapor at a temperature above 773 K has made it possible to increase the mobility of aluminum and silicon clusters inside large zeolite crystals, which was reflected in the enhancement of catalytic activity and a decrease in selectivity in the methanol oxidation reaction. The composition, structure, and texture of the intermediates were established by X-ray diffraction and TGA methods, the local structure and the state of individual groups of atoms were studied by the IR-spectroscopy method.

The results of the catalytic experiment showed that in the oxidative dehydrogenation of methanol the activity of modified by this way mordenite increased on 24%, and the selectivity for formaldehyde dropped almost twice (from 68% to 36.5%), carbon dioxide was absent, the content of by-products with a large molecular size increased. It is appeared the drop in selectivity to be due to an increase in the size of the cavities and channels, that decreases of the molecular-sieve effect.

Based on the data obtained, it can be assumed that this method of modifying zeolites into mesostructured materials will enhance the catalytic properties of zeolite catalysts.

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PHYSICAL AND MECHANICAL PROPERTIES OF CMC-MMT-ZnO NANOBIOCOMPOSITE FILMS

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In this research, a novel carboxymethylcellulose (CMC)-based nanocomposite films containing sodium montmorillonite (MMT) (5% wt) and zinc oxide (ZnO) (1, 2, 3 and 4% wt) nanoparticles (NPs) were fabricated via casting method. The results revealed that addition of NPs decreased water vapor permeability, while water solubility and glass transition temperature increased. The nanomaterials enhanced resistance of the nanocomposites against tensile stress, whereas elongation at break was diminished. Moisture uptake of the nanocomposites decreased with MMT, but increased with ZnO. Nano-ZnO was succeeded to block UV-light up to 99%. Formation of hydrogen bonds between the hydroxyl groups of CMC and MMT was evidenced by FTIR spectroscopy. According to the XRD analysis, clay nanolayers formed an intercalated structure in the nanocomposites, whereas ZnO NPs raised crystallinity. SEM micrographs showed well-dispersed MMT and ZnO NPs through the films surface. In conclusion, incorporation of MMT and ZnO nanoparticles improved the characteristics of CMC film.

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DEVELOPMENT OF *IN VITRO* PROSTATE CANCER BIOMARKER ON THE BASIS OF GELATIN MATRIX INCORPORATED GOLD NANOPARTICLE FUNCTIONALIZED WITH FLUORESCENCE DYE AND PROSTATE SPECIFIC MEMBRANE ANTIGEN

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Cancer is a major public health problem in the worldwide. More than 11 million people are diagnosed with cancer every year. It is estimated that there will be 16 million new cases every year by 2020. Lung, colon, prostate, and breast cancers continue to be the most common causes of cancer death, accounting for almost half of the total cancer deaths among men and women. Prostate cancer (CaP) is the second most common cancer diagnosed in men globally. Survival of a cancer patient depends heavily on early detection and thus developing technologies applicable for sensitive and specific methods to detect cancer is an inevitable task for cancer researchers. Biomarkers have an important role in today's diagnostics. A biomarker is a molecule that is up or down regulated depending on the physical state of the body. This make biomarkers interesting as deviations in biomarker levels that can reveal information about a patient's health condition [1,2]. It's known that prostate-specific membrane antigen (PSMA) is one of the most well established and highly specific prostate epithelial cell membrane antigen. PSMA is a type II transmembrane zinc metallopeptidase, belonging to the M28 peptidase family. It possesses hydrolyzing enzyme activities and is also known as FOLH1 (foliate hydrolase 1).

In this investigation as the CaP biomarker we propose gold nanoparticles (GNPs) functionalized with PSMA and fluorescent dye Nile Blue (Nb). In our study, we have shown that the fluorescence enhancement strongly depends on: 1. Size, shape and concentration of GNPs. 2. Distances between GNRs, fluorescent dyes and PSMA. 3. Relative spectral positions between the plasmon absorptions of GNPs and the absorption and emission of the fluorescent dyes.

As the result, we have developed a highly reliable and sensitive screening test diagnostic tools for the detection of prostate cancer in the early stage of its development. Furthermore, while GNPs have the potential to improve contrast with structural imaging modalities, functionalized GNPs could be useful in the field of photothermal therapy that uses light to destroy cancer cells by heat. Besides, a fluorescent dye Nb can be replaced by suitable near infrared dye, because the light irradiation in this region can penetrate deeper inside the tissues, increase the spatial resolution and cause less photodamage than UV/blue pert, as well as to avoid an overlapping of the signal with autofluorescence of biological samples.

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PHYSICOCHEMICAL STAGES OF FORMATION AND STABILIZATION OF LATEX PARTICLES IN STATISTIC MONOMOR-WATER SYSTEM

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The basic synthesis method of aqueous polymer dispersion (APD) is emulsion polymerization. Earlier, positive results on kinetics and topology formation were achieved on the synthesis of emulsifier-free monodisperse latexes initiated by $K_2S_2O_8$ in static heterogeneous systems [1-4]. It was shown that the latex particles in the form of microdroplets of monomer formed at the monomer - water interface and settles during polymerization in the volume of aqueous phase. A hypothesis was proposed, according to which, the source monomer dispersion energy is due to the heat of the polymerization reaction [2,3].

Nevertheless, the reality of such a mechanism of nucleation of latex particles still unclear, as in saturated aqueous monomer phase there is always a probability of accumulation of polymer molecules and the emergence of polymer particles formation to the mechanism of homogeneous nucleation in water [5]. This issue is particularly important in polymerization of polar monomers solubility of which in water allows the formation of large polymer molecules in the aqueous phase, although stability factor here is still unclear.

To clarify these issues physicochemical stages formation and chemistry of the stabilization of the of latex particles in static heterogeneous monomer – water system were investigated. Photo and spectrophotometric observations methods of the aqueous phase, irrespective of the nature of the monomer, show that polymerization reaction at the interface disperse the monomer phase in this static heterogeneous system into water and, as a result, latex is formed. The stabilization chemistry of latex particles during the polymerization of vinyl acetate and styrene in the presence hydroquinone and initiated by AIBN was investigated. Introduced data allow to make an assumption that the stability of latexes is due to hydrophilic-lipophilic balance (HLB) of oligomers which are formed by polymerization reactions that occur in the aqueous phase.

Electron microscopy photos show that the particle diameter varies depending on the duration of the incubation of the static system. Such a fact allows to produce different set of recipes for the synthesis emulsifier free latexes.

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ECOLOGICALLY FRIENDLY POLYMER COMPOSITES WITH ENHANCED PROPERTIES

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To meet the industrial and application needs of polymeric composites with enhanced properties from one side, and to fulfill the contemporary requirements related to the ecological and economical character of construction materials from other side, a great interest is dedicated to research on composites created with commodity polymers as matrix, and with natural fibers and/or powder as fillers and composite reinforcement. The aim of our research was to develop and to characterize new structure materials composed of polyolefin matrix with significantly improved mechanical properties, reinforced with several natural fillers, thus to produce materials with new, desired properties. Thanks to the fiber type reinforcement and to incorporation of fiber-like form of the polymeric matrix, a desired anisotropy and/or isotropy of properties may be achieved. As the composites are principally produced from polyolefin and natural type fillers, a full recycling of these materials after the end-use time is fully assured.

The structure of multilayer arrangement of self-reinforced composites (SRC) with layers composed of polyolefins with fiber and powder type natural fillers/reinforcement has been investigated. A significant part of the experimental work has been devoted to selection of processing parameters, like the temperature processing window, the molding type and the arrangement of layers with various composition. The most significant term by thermal molding was to achieve a compact structure of the composite, with non-melted highly oriented PP fibers.

Two types of the composites will be presented and discussed. The first are the composites with several layers of SRC and WPC (wood polymers composite), where the reciprocal position of both composite layers, and its influence on the mechanical properties was the main goal of this part of the research.

The second type of composite was developed as a multilayer structure of SRC reinforced with natural fibers characterized by various incorporation direction, and its influence on several properties. Beside the morphology studies also the adhesion of the fibers in a form of pull out test has been used to characterize this structure material.

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THEORETICAL INVESTIGATION ON STRUCTURAL AND PHYSICOCHEMICAL PROPERTIES OF SOME IONIC LIQUIDS

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Theoretical studies were carried out using density functional theory (DFT) method, including the explicit dispersion (functional B97D), on a group of five Ionic liquids **(LIs)**, selected on the basis of their hardness. The results of all the theoretical approaches show that there is no covalent bond between anion and cation of the **LIs**. The quantum theory of atoms in molecules (AIM) allowed us to confirm the existence of weak hydrogen bonds. The physicochemical properties were determined using the program cosmotherm. A correlation between viscosity and energy of van der Waals of the **LIs** is obtained. The distribution of the electron density, displayed by MEP cards; shows the effect of introducing the oxygen atom in MoEMIM.

STUDY OF STRUCTURAL CHANGES OF WATER CONFINED IN THE MIXED REVERSE MICELLES

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The microemulsion systems represent a good artificial model of biological membranes due to the likeness of their structure. The analogous picture of normal membrane structure in cell is created by reverse micelles, besides water dissolved in the core of micelle represents the best model of the confined water in biosystems [1]. Introducing of additives of ionic surfactants into nonionic reverse micelles causes an enhancement of resemblance of these systems to natural cell membranes via introducing of polar groups to the water-surface interface [2].

The goal of the proposed work was study of microenvironment of the water nanopools of mixed micelles based on polyoxyethylene (4) lauryl ether (Brij30) and sodium bis(2-ethylhexyl) sulfosuccinate (AOT). The additives of sodium salt of cholic acid (NaCh) was also used as anionic biological surfactant.

The microstructure of mixed reverse microemulsions (AOT+Brij-30), (Brij-30 +AOT) and (Brij-30+sodium cholate) was studied with an infrared spectroscopy method. Deconvolution of the O-H stretching vibrational absorption spectra in the region of 3000-3800 cm^{-1} into three subpeaks (free, bound and trapped water fractions) with a Gauss fitting program and Monte Carlo method was accomplished [3].

The microenvironment of mixed reverse microemulsions (AOT+Brij-30), (Brij-30 +AOT) and (Brij-30+sodium cholate) was investigated with an ultraviolet-visible spectroscopy by using of ortho-nitroaniline as molecular probes [4]. The values of binding constants of ortho-nitroaniline with the abovementioned mixed reverse micelles were determined.

Results may be informative in the application of reverse micelles in the field of drug delivery. Results also may be useful in the study the properties of water aggregates close to the ionic center of the surfactant.

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NEW INORGANIC-BASED NANO MATERIALS: SYNTHESIS, CHARACTERIZATION, BIOLOGICAL AND NANOCARRIERS ACTIVITIES WITH CONTROLLED RELEASE RATE

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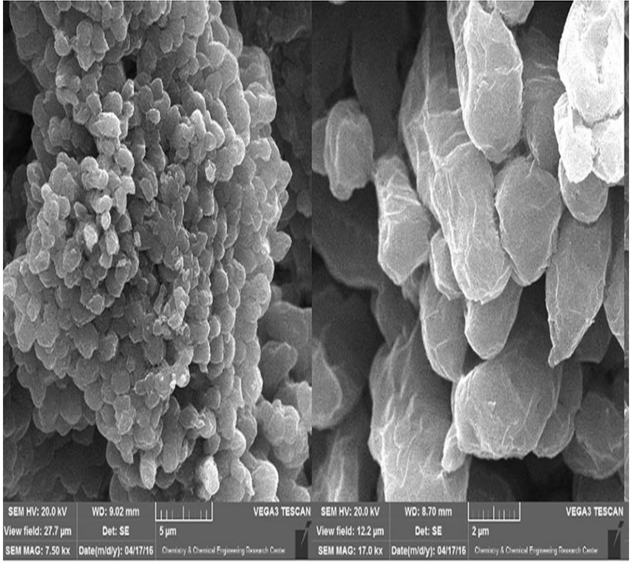
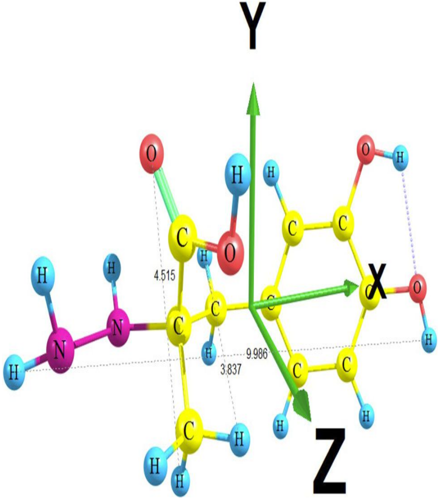
Nanoparticles have the potential to overcome many drugs design and delivery problems. Inorganic nanoparticles have different applications in drug delivery mechanisms and have drawn a lot of attention owing to their various features such as wide accessibility, proper biocompatibility, and excellent surface functionality. Employing nanomaterials as carriers is a heated debate in drug molecule release and delivery. Moreover, the gradual release of drugs as nanoparticle carriers can correspond to the drug delivery systems, having advantages like extended release time and accurate drug delivery to locations. For a practical usage of LDH (layered double hydroxide) as a drug delivery carrier, it is very important to control the release rate of drug molecules, and thereby characterize the maintenance time of drug molecules in vivo [1-2]. In this research, some of the new nano compounds were synthesized. These new compounds were characterized by spectroscopic methods such as FT-IR and UV spectra, X-ray diffraction, SEM techniques and some physical properties. The biological activities such as antitumor activities of these nano compounds against a different kinds of tumor cells such as panel of human tumor cell lines (HT29: Human colon adenocarcinoma cell line T47D:human breast adenocarcinoma cell line) was determined by MTT(3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyl-tetrazolium bromide) assay. The antibacterial of these compounds were studied on a number of bacterial colonies such as Escherichia coli, Klebsiella pneumoniae and two Gram-positive species, Staphylococcus aureus and Bacillus subtilis and, for in vitro antifungal activity against, Candida albicans, Aspergillus flavus, Aspergillus nigar**.**





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PLASMA TREATMENT FOR ENVIRONMENTALLY FRIENDLY SURFACE MODIFICATION OF POLYMERS: EFFECT ON WOOL FIBERS

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This work presents the effects of plasma treatment on several properties of wool fibres. Surface chemistry of wool fibres was studied using ATR-FTIR spectroscopy. FESEM and AFM images were employed to investigate the surface morphology of wool fibres before and after plasma treatment. To examine the effects of these changes on the performance of wool fibres, wettability, tensile properties and dyeability with natural and synthetic dyes were also studied. The surface of fibres was etched after plasma treatment and the roughness was increased as shown in figure 1. The results showed that plasma treatment enhanced the wettability of wool fibres and the dyeability was improved for both natural and synthetic dyes [1-3]. The tensile strength of woollen yarns was also increased after oxygen plasma treatment.

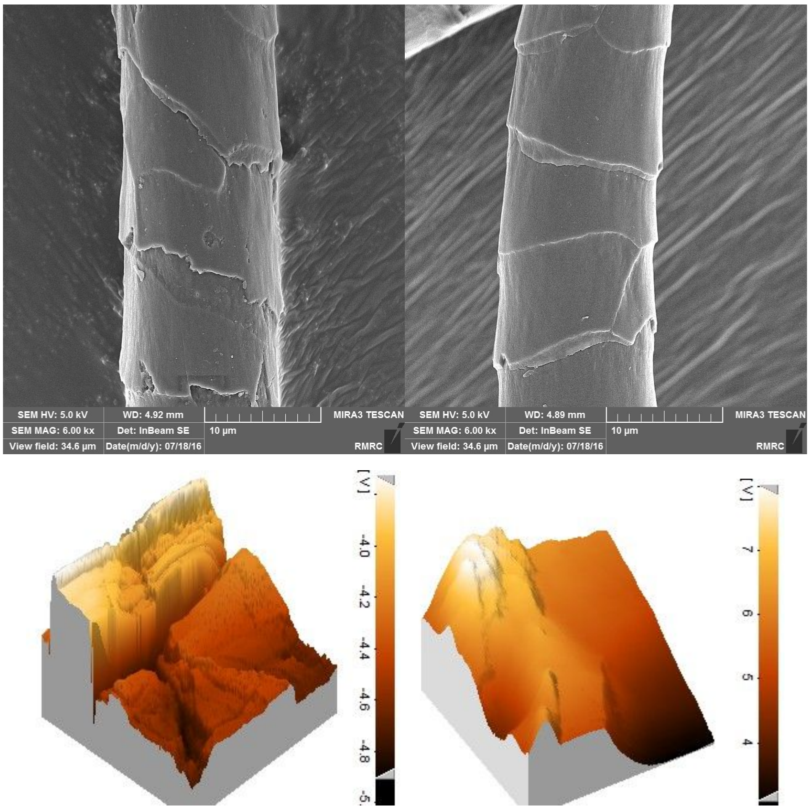

Figure 1. FESEM (top) and AFM (bottom) images of raw (right) and oxygen plasma treated (left) wool fibers

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ENGINEERING POSITIVELY CHARGED BIODEGRADABLE NANOPARTICLES FOR POTENTIAL APPLICATIONS IN NANOTHERAPY

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Nanotherapy is an actual newest mode of treatment numerous diseases using nano-size particles (NPs) loading with different pharmaceuticals. These small drug vehicles can carry therapeutic agents, such as small-molecule drugs, peptides, proteins, and genetic materials. They can improve the solubility, stability, circulation half-life, and biodistribution of a therapeutic agent (TA) encapsulated within them. NPs with targeting capability can deliver a TA to specific tissues or cells and release the cargo in a sustained fashion, thereby reducing the agent's systemic toxicity. NPs can also facilitate the passage of therapeutic agents through biological barriers.

A variety of NPs based drug delivery systems including charged and neutral, degradable and non-degradable polymers of both natural and synthetic origin have been developed. We have found that amino acid-based biodegradable polymers (AABBPs) which can clear from the body after the fulfillment of their function are highly suitable for the design of pharmaceutical NPs [1]. The NPs made of AABBPs are expected to have an improved bioavailability. It is known that bioavailability of the NPs can be improved by imparting them a positive charge that provides their sticking to cell membrane [2,3]. For this one of the most promising look cationic AABBPs also composed of amino acids, e.g. positively charged amino acid L-arginine (**R**). In mind with this we have developed two strategies for fabricating positively charged **R**-based NPs using polymer deposition/solvent displacement method:

(1) by using pure **R**-based amphiphilic cationic AABBPs (poly(ester amide)s, PEAs) since **R**-conjugated polymers and NPs made of them are known for a high transfection efficiency [4].
(2) by blending **R**-based cationic PEAs with neutral AABBPs used for fabricating NPs [1] to impart them positive charge and, hence, increasing their bioavailability.

According to the first method NPs we prepared from pure PEAs **8R3** (composed of **R**, sebacic acid and 1,3-propanediol) and **8R6** (composed of **R**, sebacic acid and 1,6-hexanediol). The NPs prepared from these cationic PEAs were 72 – 101 nm in size with zeta potential within +30 ÷ +35 mV at a concentration 6 mg/mL.

According to the second method the neutral PEA (e.g. **8L6** composed of leucine, sebacic acid and 1,6-haxanediol) and **8R6** were blended during the dissolution in DMSO and the NPs were fabricated using these solutions. The NPs prepared from these cationic PEAs were 133-184 nm in size with zeta potential within +20 ÷ +28 mV depending on **8R6** content (5-50 %, w/w) in the **8L6/8R6** blend.

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ADVANCED NANOSTRUCTURED CATALYST FOR ENHANCED ULTRASONIC DECOMPOSITION OF AN ANTIBIOTIC DRUG IN AQUATIC ENVIRONMENTS

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The application of advanced nanostructured materials named nanotechnology has gained more attention in various fields of our life. The utilization in environmental remediation especially in water purification processes for treating emerging compound of pollutants like pharmaceuticals is one of the most common uses of nanotechnology. The presence of antibiotic pharmaceuticals in aqueous environments can cause danger to aquatic life and human health. This leads to the generation of antibiotic resistant bacteria which is a global health and environmental concern. Therefore, it is essential to purify antibiotic-contaminated water resources by way of an efficient treatment process. There are many treatment technologies for the decomposition of antibiotics in the aqueous phase. However, the application of nanotechnology-based treatment methods as advanced technologies has gained more attention in recent years. Before this, the application of ultrasonic irradiation has been proposed for the treatment of polluted waters. In the present research study, water contaminated with amoxicillin as model antibiotic was treated using ultrasonic irradiation in the presence of magnesium oxide nanoparticles as catalyst. Initial results showed that lonely ultrasonic irradiation is not efficient enough to remove amoxicillin from the aqueous phase. Inversely, ultrasonic irradiation in the presence of nanostructures magnesium oxide resulted in the effective degradation of amoxicillin within a short period of reaction time. According to the results, variations of initial pHs caused no considerable effect on the degradation of amoxicillin by magnesium oxide-catalyzed ultrasonic irradiation. The process followed the pseudo-first order kinetic model. The results exhibited that the presence of magnesium oxide nanoparticles under ultrasonic irradiation can be proposed as an efficient and promising method for the decontamination of antibiotic polluted aqueous environments. It can be concluded that advanced nano-materials like magnesium oxide catalyst can accelerate the degradation rate of emerging pollutant of pharmaceuticals in comparison with the non-catalyzed processes.

ACTIVATED STRUCTURES OF INTERPENETRATING NETWORKS – NEW TYPE OF EFFECTIVE SORBENTS FOR DIFFERENT NATURE IONS

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Previous studies showed that functional polymers of different nature can affect on physical-chemical properties of rarecrosslinked networks. Rarecrosslinked polymer networks which interacts in common solvent are intergel systems. A significant change in electrochemical and conformational properties of polymers interacting on a distance was observed. Study of sorption properties of mutually activated structures point to significant increase of sorption properties and selectivity of mentioned systems. For extension of circle of systems with high sorption ability and selectivity pseudo-interpenetrating networks (PIPN) based on acrylic acid and poly-4-vinylpyridine (P4VP) were synthetized. The object was obtained by polymerization of acrylic acid in an aqueous medium in presence of linear poly-4-vinylpyridine. Content of links of poly-4-vinylpyridine to acrylic acid was varied from 10 to 35 mol. %. Sorption properties of synthetized IPN systems were studied at various initial ratios IPN – gel of poly-4-vinylpyridine relatively to neodymium ions. Obtained experimental results showed that synthetized IPN have higher sorption properties comparatively to initial matrix of activated hydrogel of polyacrylic acid.

At IPN:P4VP ratios 4:2 and 5:1 intergel systems have high sorption properties and selectivity due to pseudo-interpenetration structure. Experimental results show possibility of obtaining of new highly selective structures based on interpenetrating networks and hydrophilic polymers during their remote interaction.

THE SPECIFIC TRANSITION TEMPERATURE OF POLY(VINYL CHLORIDE) MODIFIED BY NANOADDITIVES

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The glass transition temperature (T_g) belongs to the most important factors, restraining the temperature dependent applications of polymers, polymer blends and polymer composites. It is known that the T_g is related to the changes of macromolecular chain mobility, thus below this temperature all polymeric materials became rigid with brittle-like fracture. On the contrary, above the T_g value the polymers reveal highly elastic solid-state properties with low value of E-modulus, but higher elongation at break and improved impact resistance [1-6].

Various measurement techniques are commonly used to determine the value of T_g, the ones applied in this work are: differential scanning calorimetry (DSC), thermomechanical analysis (TMA), dielectric analysis (DEA) and dynamic mechanical analysis (DMA) [1, 5-7].

The poly(vinyl chloride) (PVC) due to its modification ability, substantial environmental resistance and relatively low price, presenting about 12% of total world polymers production, is widely applied nowadays,. Its T_g value is about 80 deg. C, thus for many practical application there is a requirement of modification to lower this value [8].

In our research, we have investigated the possibility to modify the T_g of PVC by means of addition of various nanoadditives. Another task was to determine the role of measurement technique and conditions on its value. As nanofillers the polyhedral oligomeric silsesquioxanes (POSS) in a form of Si-cage-like structure with various functional groups, nanosilica and carbon nanofillers, like CNT nanotubes, were used. The PVC compound, in form of dry blend, containing stabilizer and paraffin wax was applied as matrix of the investigated nanocomposites.

A significant influence of nano modifiers on the T_g of PVC was found. In the case of long chains branched to the Si-cage of POSS a decrease of the glass transition, due to its plastyfing effect was noted. The incorporation of CNT led to an increase of the T_g of the PVC, even in case of very low nanomodifier concentration. A relationship between the measurement charging frequency on the T_g value was observed for all nanoadditives modified PVC matrix.

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PHOTOCHEMICAL CONVERSION OF POLYCYCLOPROPANES

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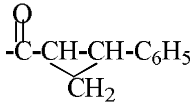
Now the ability of the polymers to lose a solubility after irradiation with ultraviolet light is widely used in the photochemical processes both in polygraphy and for preparation of semiconducting devices, printed circuits.

The mechanism of action of light on photosensitive polymers containing cyclopropane fragments in macromolecule has been still very poorly studied.

In this work, we have studied the action of UV-light on polymers containing cyclopropane fragments in macromolecule. This task included the systematic investigation of influence on light sensitivity of the polymer containing various substituents in cyclopropane ring. With this aim the polyvinylcyclopropane has been synthesized and its light sensitivity has been investigated.

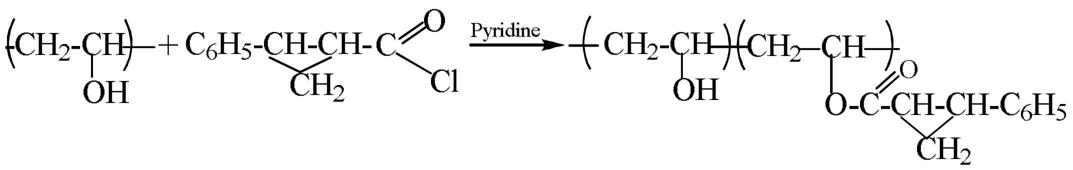
An interaction of polyvinyl alcohol with chloranhydride of phenylcyclopropyl carboxylic acid is accompanied by formation of various link polymer containing in side chains the fragments and vinyl alcohol



In work, it was used the polyvinyl alcohol prepared by alkaline saponification with residual molar content of acetate groups 0.72 % and molecular weight 56000.

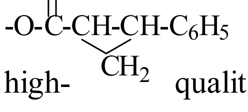
The chloranhydride of phenylcyclopropane acid was prepared by interaction of the corresponding acid with excess of thionyl chloride.

The total scheme of synthesis of the polymer forms can be presented as follows:



It has been revealed that a quantity of substitution depends on reaction conditions. With the aim of establishment of structure and composition of the synthesized polymer prepared by modification of the polyvinyl alcohol the elemental and spectral analyses (İR- and PMR-spectroscopy) have been carried out.

We have investigated the photochemical conversion of the modified polymer under action of UV-irradiation by physical-chemical methods. The availability of two processes at photochemical influence on polymers: formation of cyclic and spatial chain structures has been shown and the scheme of reaction mechanism has been also proposed. An increase of the fragments in the side chain of polymer favors its structuring under action of UV-irradiation. It has been revealed that the modified polymer is the high-qualitative photosensitive material (48-51 cm^2/J).



It has been revealed that the prepared polymer is easily subjected to the photochemical conversions with formation of cross-linked structure and allows to use it in the lithographical processes as the negative photoresist material.

MEDIUM ENERGY ION SCATTERING (MEIS) FOR NANOLAYERS CHARACTERIZATION

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Owing to continuous development in fabrication tools, nanotechnology leads to the production of three-dimensional systems having submicron size. The determination of the shape, size, and atomic composition of multi-component nano-objects with satisfactory accuracy is one of the greatest challenges to the continuing relevance of conventional characterization techniques. Ion beam solid surface scattering method is well suited for a quantitative analysis of the surface and near-surface composition of a sample, because the energy spectrum of scattered particles shows mass dispersion, and the scattering process has a well-defined cross-section at high energies. Three different energy regimes were used for materials investigation and ion scattering: High-energy ion scattering (HEIS); Medium-energy scattering (MEIS) and Low-energy ion scattering (LEIS). HEIS, which also comprises RBS (Rutherford backscattering spectrometry), is normally carried out with H or He ions with energies from about 200 keV to 2 MeV and MEIS is based on scattering of the ions of 50 – 200 keV. LEIS is based on scattering of either inert-gas ions or alkali ions with energies of 1 – 10 keV. The high depth resolution capability, structural and compositional parameters of nanolayers received by method of MEIS is becoming increasingly relevant to the characterization of different nanostructures in devices of microelectronics. Among the techniques that are increasingly proving their capability in this context notably in field of analysis of thin films of nanometer thickness and ultra-shallow implants, is MEIS [1].

In the present paper, MEIS analysis for the determination of composition depth profiles and structural information of nanolayers are described and relevant aspects of the technique are considered. MEIS gives ability to characterize nanolayers from the fact that the energy after backscattering depends (i) on the elastic energy loss suffered in a single collision with a target atom and (ii) on the inelastic energy losses on its incoming and outgoing trajectories [2]. From the former the mass of the atom can be determined and from the latter its depth. Thus MEIS yields depth dependent compositional and structural information, with high depth resolution (sub-nm near the surface) and good sensitivity for all but the lighter masses.

As an example on the high depth resolution application of MEIS to the characterization of a range of layers and multilayers of nanometer thickness for TiN/$SrTiO_3$/TiN and TiO_2/Ru/TiN multilayers metal–insulator–metal structures were investigated. MEIS provides unique information on elemental depth profiles, layer thickness, inter diffusion and segregation at interfaces and other effects due to processing and layer deposition. The unique information provided by the MEIS technique, demonstrated for a number of representative examples, is clear capability to quantify accurately the composition profiles and thickness of nanolayers and complex multilayers as grown, and to identify the nature and extent of atom redistribution during layer deposition, annealing and plasma processing.

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GLOBAL TESTING OF CARBON NANOSTRUCTURES ACTIVITY IN THE OXIDATION ENVIRONMENTS. FULLERENES

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Most cases of the oxidation of organic substances involve a free-radical chain mechanism that make enable the disruptive or creative rate of oxidation to be lowered or accelerated substantially by introducing into a substrate a small quantity of special substances acting as catalysts or antioxidants. The latter often functions either by deactivating the active radicals in the chain process or by decomposing intermediate products that provide a source of active radicals. In view of the continuous growth in the manufacture of various polymeric materials and substances for their stabilization, the testing of chemical compounds as stabilizers has become an urgent problem.

Fullerenes have a high electron affinity and are therefore capable of acting as radical scavengers. This is a well-established fact underlying many applications of the fullerenes with some related records. The electron affinities calculated for C_{60} through C_{84} are:

Fullerenes	**EA (eV)**
C_{60}	2.7
C_{70}	2.8
C_{76} (D_2 isomer)	3.2
C_{78} (C_{2v} isomer)	3.4
C_{82} (C_2 isomer)	3.5
C_{84} (D_2 isomer)	3.5
C_{84} (D_{2d} isomer)	3.3

A quick glance at these values clearly shows that fullerenes should easily accept electrons and free radicals, and thus they were expected to play significant role in radical processes like polymerization, degradation, oxidation, cracking.

This study is devoted to determination the anti-oxidative activity of a range of fullerenes C_{60} - C_{76} generally manufactured in practice in order to rank them according to their comparative efficiency. The model reaction of cumene initiated (2,2'- azo-bis-isobutyronitrile, AIBN) oxidation was employed herein to determine rate constants for addition of radicals to fullerenes. Kinetic measurements of oxidation rates in the presence of different fullerenes showed that the antioxidative activity as well as the mechanism and mode of inhibition were different for pure samples of fullerenes and fullerene soot. All fullerenes - C_{60} - C_{76} operated in the mode of an alkyl radical acceptor, whereas fullerene soot surprisingly retarded the model reaction by a dual mode similar to that for the fullerenes and with an induction period like many of the sterically hindered phenolic and amine antioxidants. For the C_{60}-C_{76} the oxidation rates is supportive for the addition of cumyl alkyl R• radicals to the fullerene core. Rate constants for the addition of cumyl R• radicals to the fullerenes were determined to be $k_{(333K)} = (1.9 \pm 0.2)\times10^8$ (C_{60}); $(2.5 \pm 0.2)\times10^8$, (C_{60} /C_{70}); (); $(3.0 \pm 0.3)\times10^8$ (C_{70}) and $(3.6 \pm 0.3)\times10^8$ (C_{76}), M^{-1} s^{-1}.

The fullerene soot inhibits the model reaction according to the mechanism of trapping of peroxy RO_2• radicals. The rate constant is $k_{C60\ soot.} = (6.5 \pm 1.5) \times10^3\ M^{-1}\ s^{-1}$.

The kinetic data obtained specify the level of antioxidative activity for the commercial fullerenes and may be helpful for designing an optimal profile of composites containing fullerenes.

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MODIFICATION REACTIONS OF POLYMETHYLHYDRO(VINY)SILOXANES

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Macromolecular grafting is a synthetic approach that involves the functionalization of a preformed polymer backbone containing reactive groups with an appropriate reagent. There is an increasing interest in catalytic grafting of polyhydrosiloxane as to an alternative route for the synthesis of organic–inorganic hybrid polymers, owing to the complexities involved in direct generation of well-defined linear hybrid polymers. Besides the process of equilibration, the hydrosilylation process is the most widely used method of preparing organofunctional polymethylsiloxanes starting from poly (methylhydro) siloxanes.

From this point of view the chemical modification reactions of poly(methylhydrosiloxanes as well as polydimethyl (methylvinyl) siloxanes is very interesting.

Presented paper is dedicated to the chemical modification reactions of poly(methylhydro)-siloxanes and polydimethyl (methylvinyl) siloxanes for obtaining of new thermoreactive methylsiloxane oligomers with reactionable side groups, filled composite materials on their basis and investigation of their electro conducting properties.

The financial support of the Georgian National Science Foundation Grant #STCU, 5892 and 6301 is gratefully acknowledged.

A COPPER(II)-BONDED BIOPOLYMER NANOCOMPOSITE: A PROMISING ENVIRONMENTAL ADSORBENT AND ANTIBACTERIAL AGENT FOR WATER DISINFECTION

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Chitosan, a natural biopolymer, is widely used as adsorbent for removal of heavy metals from water. However, a poor adsorption efficiency is seen for anionic species and most of organic compounds due to weak interactions. Chitosan is also well-known for its antibacterial properties. Chitosan exhibits its antibacterial activity in acidic medium where it is soluble and has polycationic structure. This restricts the application of chitosan for water disinfection filters. To overcome these drawbacks, chitosan was modified via the inclusion of inorganic metal oxide nanoparticles followed by impregnation with $CuSO_4$ to form Cu(II)-chitosan nanocomposite. The developed nanocomposite had higher surface area than chitosan as evaluated by BET and SEM. The results of FTIR, XRD and EDX studies indicated the formation of a bond between Cu(II) and amine groups on the chitosan surface. Adsorption ability of Cu(II)-chitosan nanocomposite were examined toward various environmental pollutants such as aromatic amines, phosphate, cephalosporin antibiotics and arsenic. The modified chitosan had much higher capacity for adsorption of these pollutants compared to neat chitosan. Interestingly, the adsorbent shows the best performance at neutral pH values as desirable condition for practical purposes for natural waters. Furthermore, a good selectivity against natural waters common anions was observed. It also exhibited acceptable regeneration ability during several adsorption-desorption repeated cycles. Antibacterial activity of the modified adsorbent was tested using minimum inhibitory concentration (MIC) method. The developed material showed excellent antibacterial activity against both Gram-positive and Gram-negative bacteria as presented in Table 1. Much more increased antibacterial activity was observed under neutral pH conditions where the chitosan is in its undissolved form. This provides the condition for application of the chitosan in bactericidal filters for water disinfection.

Table 1. Bactericidal activity of chitosan and Cu(II)-chitosan/alumina nanocomposite

Microbial strain	**MIC (µg/mL)**	
	neat chitosan	**Cu(II)-chitosan/alumina**
Escheriachia coli	312	15.6
Staphylococcus aureus	625	125
Streptococcus faecalis	625	62.5
Bacillus subtilis	156	62.5

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MICROWAVE IRRADIATION ASSISTED SYNTHESIS OF SMART POLYMERS

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Microwave irradiation assisted the synthesis of a novel class of smart polymer capable of reacting with primary amines. Two kinds of polymers were synthesized from allyl mercaptan, or allyl alcohol, o-phthalic dialdehyde and ethylene glycol dimethacrylate by radical polymerization under both conventional method and microwave irradiation. Microwave irradiation afford higher yield than the conventional method in shorter time. Reactive hemithioacetal and hemiacetal was formed by allyl mercaptan or allyl alcohol and dialdehyde which can bind primary amino groups without additional pre-activation forming the isoindole complex. This method gives a great opportunity to monitor binding and perform loading of the amino compounds onto the reactive surface. The desired polymers were characterized by IR, TGA and SEM.

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PHYSICO-CHEMICAL INVESTIGATIONS OF NATURAL BITUMENS

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All known fields of Kazakhstan having industrial value are in Caspian Depression and Northwest part of the Turansky plate. In the Republic of Kazakhstan high-viscosity oil and natural bitumens are a product of subaeralny aeration metane and naphthenic oil, impregnated mainly friable soil (barkhan sand, sandy loams, loams). In the territory of Kazakhstan considerable reserves of oilbitumene rocks are located. Expected resources of these minerals on the Uralo-Embensky oil-and-gas area approximately make 1 billion t. at an average saturation bitumen of 5-10% From them about 200 million t are located at available depths that does possible their open-pit mining.

In the real work research of OBR of the field Tyub-Karagan and Munayly-Mola is conducted by method of infrared spectroscopy, a gas-liquid chromatography and the EPR method. Spectrums of bitumens, allocated from OBR and modified by polyester pitch are shown. In figure No. 1 the IR spectrum, the natural bitumene emitted from OBR of field Tyub-Karagan is presented. It is visible that at samples of bitumens in the field of 400-2200 cm^{-1} of a strip of absorption (items) are observed at 425 and 426,9, 471,2 and 485,3, 537,5 and 559,5, 618,9 and 646,8, 705 and 726,8, 882, 911,8 and 925,7, 986,1, 1032,3 and 1042,2, 1070,1, 113,5 and 1125,6, 1218,8, 1236, 1282,6 1375 and 1376,3, 1453,9 and 1457,7, 1486,4, 1557,9, 1581,7, 1598,3, 1641,6, 1699,3, 1721,5, 1958,1, 2108,2 and 2149,6 cm^{-1}.

Very intensive items at 1375-1376,3 and 1453,9-1457,7, 1486,4 cm^{-1} in oil fractions belong to valent and deformation fluctuations of CH_2- and CH_3-groups in paraffin and cycloparaffin hydrocarbons. In ranges of all components the absorption strip at 726,8 cm^{-1} which corresponds to deformation fluctuations of CH_2-groups in free paraffin chains is accurately visible.

Products of pyrolysis of OBR which is carried out at 580-600 °C is presented. Products of pyrolysis represent diesel fraction and fuel oil. Diesel fuel 200-370 is present at the number of 65,18%, and fuel oil 370-500 - in number of 34,82%. Content of gasoline is insignificant (1,47%).

Researches of products of pyrolysis of oilbitumene rocks (OBR) are conducted by methods of IK-spectroscopy and a gas-liquid chromatography (the ardent and ionization detector). It is established that products of pyrolysis contain mainly fuel oil 370-500 and diesel fuel 200-370.

PREPARATION OF POLYCONJUGATED COOLIGOMERS OF 2-METHYL-1,4-BENZOQUINONE WITH PHENYL ACETYLENE

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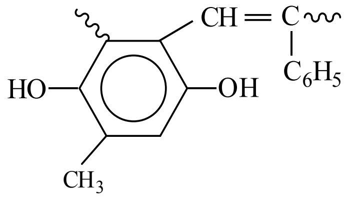
The copolymerization reaction of 2-methyl-1,4-benzoquinone (MBQ) and phenylacetylene (PhA) in solution (benzene, toluene, dioxane) in the presence of catalyst of cation type $BF_3{\cdot}O(C_2H_5)_2$ has been carried out. It has been established on the basis of IR-spectral, elemental and GPA analyses that the prepared products are the cooligomers with molecular weight $\overline{M}_n = 950 \div 1640$ и $\overline{M}_w = 1580 \div 3620$ and consist of 2-methylhydroquinone and phenyl acetylene.



The kinetic regularities of the copolymerization process by dilatometric method in a medium of benzene in the presence of $BF_3{\cdot}O(C_2H_5)_2$ have been investigated. It is seen from kinetic curves that the copolymerization of BQ with PhA proceeds at 313÷333K with high rate. It has been experimentally found that the copolymerization process is subjected to the equation:

$$W = k[BF_3{\cdot}O(C_2H_5)_2]{\cdot}[MBQ{+}PhA]^2$$

On above-mentioned equation the initial rate values ((3.41÷9.17)$\cdot 10^{-4}$ mol/l·s), reaction rate constants (0.93÷4.8)$\cdot 10^{-3}$ l/mol·s) and activation energy (62.5 kJ/mol) have been determined.

On the basis of results of study of the reaction products and kinetic data and also taking into account a nature of the catalyst the cation mechanism of copolymerization of MBQ with PhA has been proposed. An initiation occurs by attack of $C_2H_5^+$ carbocation formed from $BF_3{\cdot}O(C_2H_5)_2$ on MBQ or PhA$^{\cdot}$ $^{\cdot}$PhA. A chain growth is realized by interaction of the intermediate macrocarbocations with MBQ$^{\cdot}$ $^{\cdot}$PhA. A chain break can occur either due to proton emission or due to chain transfer act into monomer, mainly, into 2-methyl-1,4-benzoquinone.

The synthesized cooligomers – powders of brown and dark brown color, possess high reactivity in the electron-change processes and also in interaction with epoxide compounds. In the presence of the catalysts of basic character they are easily react with epichlorohydrin and epoxide resins, as a result of such conversions on their basis there have been synthesized the new polyepoxides and epoxycopolymers. The cooligomers of MBQ with PhA show the paramagnetic, antioxidant, antistatic, antihypoxant and semiconducting properties. It has been established that the prepared cooligomers of MBQ with PhA undergo the oxidation reaction by molecular oxygen in alkaline medium and as a result a content of the paramagnetic centers in their compositions is increased, i.e. the stable macroradicals of semiquinone type are generated. At the same time, it has been shown that an increase of content of paramagnetic centers in the compositions of cooligomers by a factor of 1÷2 is accompanied by growth of their specific electroconductivity by a factor of ~2÷4.

BIOLOGICAL ACTIVITY OF POLY(METHYL METHACRYLATE) FILLED WITH FULLERENE

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Composite polymer materials are promising field of advanced material sciences with scope of using in biology, medicine and pharmacology. Special attention is paid to fullerene-containing polymers which have unique features of both fullerenes and polymers. Modification by carbon nanoparticles results to occurrence of new properties of the polymer, for example, biological activity. Poly(methyl methacrylate) (PMMA) is one of the polymers capable to content nanocarbonic particles. In the present study, we report results of the tests that have been performed to compare antioxidant effect of the PMMA films and PMMA/fullerene composite films. A solvent casting of perspective components (PMMA and fullerenes C_{60}) from solutions was employed for film fabrication.

Influence of PMMA/C_{60} film composites on free-radical oxidation of lipids in biologic fluid (blood serum) was researched in vitro. Subject of research was native blood serum of 10 patients managed in V.N. Gorodkov Research Institute of Maternity and Childhood (Ivanovo, Russia). Specimen of pure PMMA or composite film containing fullerene was put into test tube with blood serum. System was incubated for 1 hour at 4^{o}C. Then, the film specimen was removed from tube.

The parameters of lipid peroxidation in serum after exposure of the film nanomaterials were determined by chemiluminescent analysis. The induced chemiluminescence (ChL) tests were performed by BChL-07 luminometer (Medozons, Russia).

The findings showed ChL parameters in samples after exposure of original PMMA film were approximate to controls. But PMMA/fullerene composites provided greater antioxidant activity. It seems that composites containing fullerenes react with oxygen species easy, preventing lipid peroxidation.

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COPPER COATINGS WITH SUPERFINE PHASE OF CARBON

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Composition coatings, which are deposited from electrolyte-suspension are widely spreading as a result of development of electroplating. Composition coatings are obtained when modifying of surface of metal production, in order to impart it new properties (increase of corrosion stability, decrease of friction and slip coefficient, increase of solidity) [1].

Carbonaceous particles possessing unique properties [2] may become promising particulates. As it is known from literary data [3], owing to these properties carbon is applied in industries (various branches of industry), as well as in an antifriction coatings, such as solid lubricant, which considerably decreases wear and increases reliable performance of subassembly and mechanisms.

The aim of the present work is creation of CEC (composition electric coatings) on the basis of copper, with improved tribological properties and study of kinetics of electrodeposition process in the presence carbonic phase. The investigations were carried out with the use of standard electrolyte for copper coating. Carbon obtained by us from secondary raw material (size of particles ~ 40 nm) was used as dispersed phase for modification of the electrolyte. Carbon particles were processed by ethanol for better wetting and for making of uniform distribution of dispersed phase in the electrolyte. The optimal conditions of obtaining of Cu-C CEC were determined for investigation of the effect of carbonic phase on electrodeposition of copper. The effect of the concentration of dispersed phase on compositions of CEC was studied. The compositions of Cu-C CEC were determined by indirect method. Carbon concentration g/l: 1.0; 2.0; 8.0; 15.0; 25.0. Morphology and friction and slip coefficients of copper coatings and CEC were studied.

It is determined, that introduced carbon of concentration 15 g/l has more effect on tribological properties of composition coatings - copper-carbon.

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MUSHROOM DRY IN COMBINED SOLAR DRYER WITH POLYCARBONATE COVER

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In human ration mushroom that is useful for eating doesn't hold the last place. Safety ensuring and quality of food products must be one of the main course of Georgian public policy, in healthy food branch. Now (in this moment) mushroom that is useful for eating are most commonly used as additional source of vegetable protein. Subsequently mushroom's role as one of the feeding product's will increase with growth of protein lack. Besides mushroom is used for useless food and medicinal product purposes. In pharmacology are well-known preparations which are made on the basis of mushroom, for treatment cancer and other diseases.

Mushroom drying were maicing in combined solar dryer with polykarbonate cover. Polykarbonate is included in the polymers group which belongs to thermoplasts. Polycarbonate is used in the basic of bisponol-A. Bisponol (4,4`-dihydroxyl-2,2- diphenylolpropane, diphenylolpropane technical, dian) this is chemical substance, which we often meet like white color granules (1-2mm).From produced polycarbonate were making tapes, vessels, papers and profiles with exstrusion or casting under pressure method.

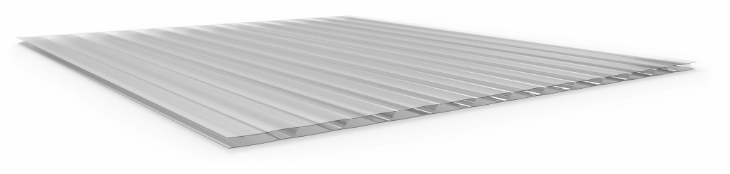

Figure 1. Polycarbonate.

When drying mushroom acquiers new characteristics. It is made by biochemical reactions. In combined dryer mushroom drying restrains more faster about 1,7-3,4 times. Dried mushroom has high consumer properties. In late night time (from 22.00 evening to morning 10.00) speed in this moment on given dryer is high (2-3 times) then in natural drying time when it is on an open space.

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POLY 2-ACRYLAMIDO-2-METHYL-1-PROPANSULFONIC ACID (PAMPS) IMMOBLIZED ON GRAPHENE OXIDE APPLIED AS SUPERIOR CATALYST

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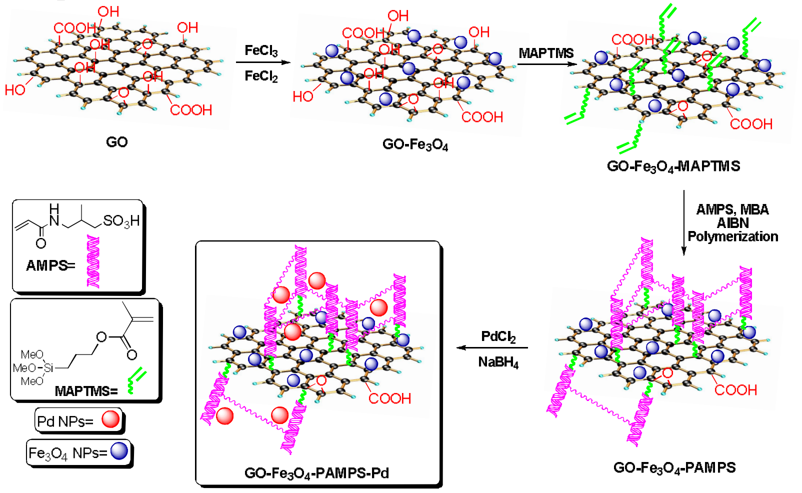
Graphene oxide (GO) modified by poly 2-acrylamido-2-methyl-1-propansulfonic acid (PAMPS) decorated with magnetic Fe_3O_4 and palladium nanoparticles (Pd–NPs) was synthesized (Scheme 1). The PAMPS carrying $CONH_2$ and SO_3H functional groups works as a polymeric ligand which could immobilize Pd–NPs. The synthesized nanocomposite was fully characterized and it was successfully examined as a highly efficient heterogeneous catalyst in the Suzuki–Miyaura cross coupling reaction. The nanocomposite was recycled from the reaction mixture by only an external magnet and reused at least 7 times without appreciable loss in its catalytic activity. Lack of metal leaching is a promising advantage for this novel nanocomposite proved by leaching test.

This study demonstrates the great potential of polymeric-functionalized GO as a support owing to its high loading and suitable dispersing of Pd–NPs, for the development of metal–graphene nanocomposites in industrial scale.



Scheme 1. General route for the synthesis of GO/Fe_3O_4/PAMPS/Pd nanocomposite.

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EPOXY-OLIGOMERIC MIXTURES WITH CARBOXY DERIVATIVE OF EPOXY RESIN

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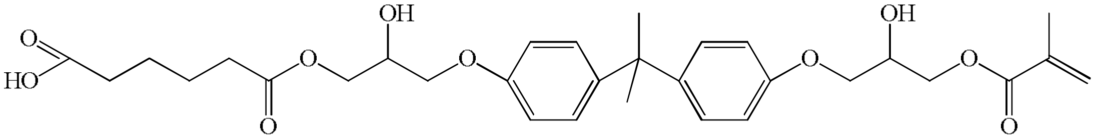
The creation of functional oligomers as active additives for different polymeric materials and composites is an actual problem [1, 2]. The main demand for such products is the presence of reactive groups capable to react with functional groups of the composite at room temperature and at heating [3, 4]. Epoxy compounds are widely used as the initial materials [5].

In this work, we propose to use carboxy derivative of dioxydiphenylpropane diglycidyl ether monomethacrylate (CDE) as an active additive for epoxy-oligomeric mixtures based on ED-20 industrial dianic epoxy resin.

CDE contains free carboxy and methacrylic groups. Its formula is given below:



For CDE was found: M_n 580 g/mol, carboxy groups content 7.2 %, bromine number 25.2 gBr_2/100g product and epoxy groups were absent.

The amount of CDE taken for the investigations was 5, 10, 20 and 30 wt % per 95, 90, 80 and 70 wt % of epoxy resins, respectively. The mixture consists of 10 wt % of TGM-3 oligoesteracrylate and 90 wt % of ED-20 was studied for the comparison.

The mixture crosslinking was studied at room temperature for 10 days and stepwise (first at room temperature for 24 h and then at heating for 15, 30, 45, 60 and 75 min) in the presence of polyethylene polyamine as a hardener.

The epoxy-oligoesteric mixtures with CDE which were crosslinked both at room temperature and heating are characterized by higher gel-fraction content and better physico-mechanical and chemical properties compared with those values for the mixture with TGM-3. The obtained results show the chemical interaction between ED-20 molecules and CDE.

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CONDENSED PHOSPHATES: SOME INNOVATIVES RESULTS-ORIENTED SCIENTIFIC RESEARCHES WHICH LEAD TO THE DEVELOPMENT IN THE FIELD OF INORGANIC POLYMER'S SCIENCE

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It is the historical fact that Jöns Jacob Berzelius was not only one of the founders of modern chemistry, but also the first one who has communicated the discovery of the new compound-Condensed Phosphate [1]. Later on, a great number of scientist's researches in the field of chemistry of condensed compounds was published, that are really valuable and very worthwhile [2-7].

Presented data article contains informations about synthesized by us many crystals and/or powder of Inorganic Polymeric Compounds, concretelly diverse new groups of condensed phosphates, during investigations of the systems M^I_2O-$M^{III}_2\ O_3$-P_2O_5-H_2O at 400K-800K (where M^I are various monovalent, including Ag, metals and M^{III} – some trivalent metals). Numerous -68- a new formerly unknown double condensed phosphates so called inorganic polymers have been obtained [8-10], see table below :

Acid triphosphates $M^IM^{III}HP_3O_{10}$ and $M^{III}H_2P_3O_{10}$	Triphosphates $M^I_2M^{III}P_3O_{10}$	Acid diphosphates, hydrated $M^IM^{III}(H_2P_2O_7)_2\cdot 2H_2O$
complex diphosphates$M^I_2M^{III}H_3(P_2O_7)_2$	Acid diphosphates $M^IM^{III}(H_2P_2O_7)_2$	Diphosphates $M^IM^{III}P_2O_7$
Ultra phosphate $M^I_3M^{III}P_8O_{23}$	Long chain polyphosphates $[M^IM^{III}(PO_3)_4]_x$	$[M^IM^{III}(PO_3)_4]_4$
Cyclooctaphosphates $M^I_2M_2^{III}P_80_{24}$	Cyclododecaphosphates $M^I_3M^{III}_3P_{12}0_{36}$	

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CONDENSED PHOSPHATES AS INORGANIC POLYMERS AND VARIOUS DOMAINS OF THEIR APPLICATIONS

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In XXI century chemistry of Condensed Phosphates or that is to say inorganic polymers developed much rapidly, for the causes of extensive use of phosphates materials in numerous fields of innovative technical domains. Last time importance of the efficient and resource-saving technologies for synthesis and applications of Inorganic Polymers/-Condensed Compounds are out of any doubt which explains the relevance of our works thanks to our technological methods and experience that we have cultivated over many years [1-5]. Multilateral spheres of utilisation of condensed phosphates are very diverse: ion-exchange materials [1,6], nanomaterials, efficient applying fertilizers, detergents, cement substances, catalytic agents, raw materials for phosphates glasses, thermo-resistant substances and also as food additive composites, besides, the phosphate's binding agents, phosphate-binders and laser materials are supplanted/ replaced by biomaterials, on the base of polyphosphates and hydroxyl apatite [7-10]. Thermal properties, the vibrational and perfect luminescent characteristics of condensed phosphates determine their use in quantum electronics [1, 5, 9]. Last years the various new bio-materials appear on the base of condensed phosphates and/or polyphosphates. The investigation of condensed phosphates of alkaline earth metals for use as biomaterials is greatly attractive and interesting [6].

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PREPARATION OF CONJUGATION OF PACLITAXOL TO FULLY GLUTATHIONE DEGRADABLE WATERBORNE POLYURETHANE NANOCARRIERS

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Polyurethanes have been interesting class of polymers that are applicable in many areas including biomaterials synthesis due to their excellent mechanical properties and biocompatibility. Redox-sensitive nanocarriers containing disulfide bonds have received a tremendous amounts of interest due to the presence of redox-potential gradient between the extracellular and intracellular milieu. Reducing agents such as glutathione (GSH) at millimolar concentrations can cleave disulfide bond and can be through thiol–disulfide exchange reactions [1]. Polymer drug conjugates are used as the delivery system for several anti-cancer drugs and have shown very promising results by passing multidrug resistance (MDR) testing [2]. To address the obstacles facing the clinical use of paclitaxel, including poor water solubility, side effects and lack of tumor selectivity, a novel folate-decorated and redox and pH dual-responsive micellar drug delivery system is a promising idea [3]. The waterborne polyurethane was prepared from polyaddition reaction of isophorone diisocyanate (IPDI), 2-hydroxyethyl disulfide and 3,4-epoxy-1-butene as chain extenders, polycaprolactone diol, dimethylolpropionic acid (DMPA) using dibutyltin dilaurate (DBTDL) as a catalyst and neutralized by triethylamine (TEA) to form ionomer. Then it was characterized by FTIR and 1HNMR. The Paclitaxel modified with the thioglycolic acid was chemically conjugated to waterborne polyurethane through SH bond via click reaction. The resulting polyurethane self-assembles into nanocarrier in water and evaluated by DLS and SEM. The in vitro release behavior, cell viability analysis and cell internalization in both HDF noncancer cells and MCF- 7 cancer cells were studied. The waterborne polyurethane synthesis was approved by FTIR and 1HNMR. In vitro release studies demonstrated that the Paclitaxol micelles were relatively stable at normal physiologic conditions but susceptible to tumor-relevant reductive and acidic conditions which would trigger the release of chemically loaded drug. The images of SEM for the nanoparticles reveled that they have spherical shape and the drug release was triggered by endo/lysosomal GSH concentration. MTT assays showed that the therapeutic efficacy of these micelles against MCF-7 cancer cells (IC50 = 0.62 μg mL-1) was enhanced compared with free PTX (IC50 = 0.87 μg mL-1). Compared to the free PTX, PTX conjugated waterborne poyurethane showed low cell cytotoxicity to HDF Cells. In summary, a novel and tumor cleavable waterborne polyurethane was successfully synthesized that could be favorable candidates as a biodegradable carrier for intracellular drug delivery application.

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MODIFICATION OF PHYSICO-CHEMICAL CHARACTERISTICS OF CMC FILM BY INCORPORATION OF MONTMORILLONITE AND TIO_2 NANOPARTICLES

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This study aimed at the preparation of ternary nanocomposite films using carboxymethyl-cellulose as matrix, and sodium montmorillonite (MMT) (1,3 and 5% wt) and titanium dioxide (TiO_2) (1,3 and 5%wt) nanoparticles (NPs). Effects of different concentrations of MMTand TiO_2 on the functional properties of nanocomposite films (water-related properties, mechanical characteristics, and UV transmittance) were examined. SEM, XRD and FTIR assays were used to analyze the morphology, crystallinity and interactions of the films. The results showed that water vapor permeability of the films decreased up to 39% and 50% by adding MMT, and MMT + TiO_2, respectively. Similarly, synergistic effect of NPs on moisture uptake reduction (≈ 40%) of films was observed. Tensile strength of films reached from 5.12 to 7.13 MPa by 5% MMT, and then reduced to 5.9 MPa by 5% TiO2. Both NPs diminished elongation at break of films by about 24%. More than 99.5% of UV-light was absorbed by NPs dispersed into the film matrix, especially TiO2. Formation of hydrogen bonds between the hydroxyl groups of CMC and nanoparticles was evidenced by FTIR spectroscopy. The result of XRD study exhibited that clay nanolayers formed an intercalated structure in the nanocomposites, and a limited agglomeration of TiO_2 nanoparticles led to increment of films crystallinity. SEM revealed homogeneously dispelrsed TiO_2 nanoparticles inside nanocomposite films. In summary, nanoclay and TiO_2 presented good potential to improve physical properties of CMC film.

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CREATION AND RESEARCH OF CELLULOSE ACETATE MEMBRANE

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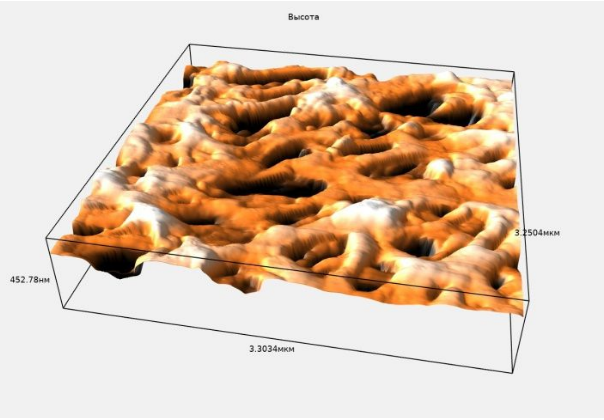
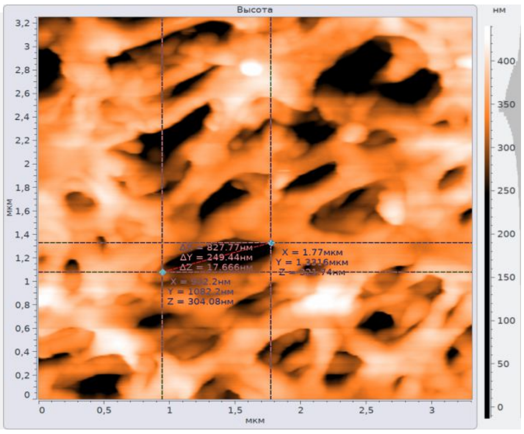
Acetate Cellulose are widely used to produce filtration membranes. To prepare acetate cellulose filtration membranes with desirable properties, the Institute has studied the phase intersection of solutions of various concentrations of acetate cellulose. Dimethylacetamide is used as a solvent for acetate cellulose, however $CaCl_2$ and $MgCl_2$ are used as pore forming agents. During the phase intersection of prepared solutions, water was used as un-solvent.

The study of the obtained membrane structure has shown that the existence of calcium chloride in the acetatecellulose solution causes the increase of the amount and size of viscosity and of supramolecular particles. Also in the calcium chloride solutions the process of forming membrane structure is more mild than in magnesium chloride solutions.As a result, membranes with open-porous selective layer are obtained, specific flux of which may be variable with the change of concentration of pore forming lyotropicalts.

The topography of the surface of the membranes is studied on the scanning probe microscope of the Institute. On picture 1 and 2 is given microphotography of acetate cellulose membrane which is obtained by acetatecellulosa/dimethylacetamide/$CaCl_2$/water 6% solution. The membrane porous size is 0.6 mkm. There are 20 porous on 100 mkm^2. The relief surface does not exceed the diameter of the porous.The area of scanning surface is 13×13 mkm.



Picture 1. Microphotography of membrane obtained from AC 6% solution in 3 dimension (x, y, z)



Picture 2. Microphotography of membrane obtained from AC 6% in 2 dimension (x, y)

POLYANILINE CRYOGELS SUPPORTED WITH POLY(VINYL ALCOHOL)

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Polyaniline, one of the most important conducting polymers, is prepared by the oxidation of aniline with ammonium peroxydisulfate in acidic aqueous medium [1] at room temperature and collected as a precipitate. When the polymerization of monomers is carried out in the presence of a water soluble-polymer, poly(vinyl alcohol)) in frozen reaction mixture, soft conducting hydrogels are obtained after thawing [2]. The cryogel used for illustration contained 2 wt.% of polyaniline, 5 wt.% of poly(vinyl alcohol) and 93 wt.% of aqueous phase (Figure 1). It was macroscopically homogeneous and it had macroporous structure with average pore size of ≈100 µm. The conductivity of cryogel was 0.004 S cm^{-1} in water and 0.105 S cm^{-1} in 0.1 M sulfuric acid. Such materials, three-dimensional conducting polymeric networks swollen with water, can be potentially used in medicine, or in biology or in energy storage devices.

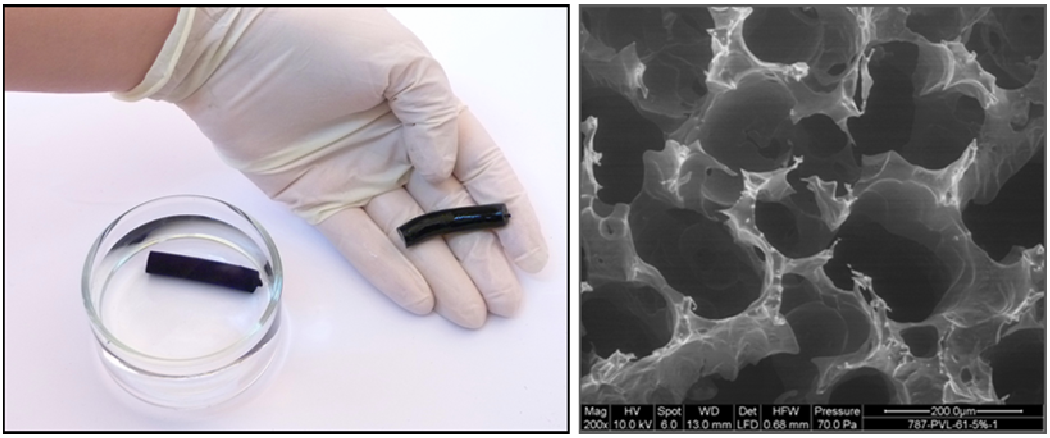

Figure.1. The composite polyaniline/poly(vinyl alcohol) hydrogel and its scanning electron micrograph.

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TREHALOSE DERIVATIVES AS KEY BUILDING BLOCKS OF HYDROGEL NETWORKS

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Trehalose is naturally occurring, non-reducing disaccharide, which is composed of two D-glucopyranosyl units linked by α,α-1,1'-*O*-glycosidic bond. The differential reactivity of the hydroxyl groups at various positions can be a powerful factor for the preparation of its suitable functionalized derivatives. Herein, it was transformed into acetal or ester derivatives containing polymerizable double bonds with the aim to covalently incorporate trehalose molecules within polymer network of hydrogels. These derivatives were used as an element providing hydrogels three various properties: acid-degradability, bioprotective activity towards proteins or possibility to interact with cells.

In the first approach, aromatic diacetals of trehalose were used as the cross-linking agents. Aromatic acetals are well-known protecting groups in sugar chemistry, that are relatively stable at basic and neutral pH, but are susceptible to acid-catalysed hydrolysis. Therefore, use of acetal derivatives as cross-linkers allowed to obtain materials with acid-degradable properties. Such hydrogels are of great interest as drug carriers which trigger the release of drugs once they reach the slightly acidic environment. A large pH shift from 7.2–7.4 in the blood or extracellular spaces to 4.0–6.5 in the various intracellular compartments takes place during cellular uptake. Acidic pH is also characteristic feature of inflammation, ischemia or tumour sites.

In the second approach hydrogels containing trehalose both in cross-links and as pendant moieties were synthetized with the aim to obtain bioprotective carriers for protein release. Protein and peptide therapeutics are very susceptible to proteolytic and chemical degradation, as well as physical unfolding and aggregation in body fluids, which leads to the fast loss of their bioactivity. Therefore, nowadays a lot of effort is put into improving *iv vivo* stability of these pharmaceuticals. Trehalose is a well-known natural bioprotectant with the ability to protect proteins from inactivation and denaturation under environmental stress conditions. Recently, it has been also shown that these unique properties are intensified for trehalose glycopolymers.

In the last approach trehalose derivatives were used in the synthesis of thermoresponsive microgels, which dispersions were developed as thermogellable matrices for 3D cell culture. Monoacrylidene trehalose was incorporated within polymer network to functionalize synthetic, bioinert matrix with terminal D-glucopyranosyl units. The purpose was to provide multivalent interactions with glucose transporters (GLUTs) expressed on the cells surface. Interactions between matrix and growing cells are known to be of crucial importance for many cellular functions. Trehalose monomers turned out to have also anti-syneretic properties.

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NOVEL ALIPHATIC POLYESTER BASED MACROMONOMERS

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Poly(β-propiolactone), also known as poly(3-hydroxypropionate) (P3HP), is a well-known biodegradable[1] thermoplastic polyester with high tensile strength and moisture permeability. Hydrogen transfer polymerization (HTP) is a well-known method for synthesis of poly-β-alanine[2]. The synthesis of P3HP through hydrogen transfer polymerization (HTP) of acrylic acid was first reported by Saegusa et al.[3]. However, this method has not been paid attention possibly due to the low degree of polymerization (DP_n was reported as low as 17.4).

Well-defined oligomers with specific functional groups have many applications in synthetic chemistry and material science such as graft onto approaches[4], surface modification[5], synthesis of block or diblock copolymers via click chemistry[6], making telechelic polymers[7] and bioconjugation[8]. This study describes in detail the structural characterization of oligomeric product obtained from HTP of acrylic acid and its end-group functionalization via monobromination, dibromination and epoxylation.

Oligomer of poly(3-hydroxy propionate) (P3HP) was synthesized via base-catalyzed hydrogen transfer polymerization (HTP) of acrylic acid using sodium tert-butoxide as a strong basic catalyst. Structural analyses based on ^{1}H-NMR and MALDI revealed that the the oligomeric products obtained possess olefinic chain-ends that are open to further end-group functionalization. End-group modifications were performed through mono bromination by HBr in acetic acid, dibromination by bromine and epoxylation by hydrogen peroxide. Extents of conversions of olefinic end-groups to the corresponding functional groups were followed by using ^{1}H-NMR and MALDI mass spectrometry. According to the analyses, the three modificiation approaches resulted with end-group modified oligomers with high yield. The final products may be regarded as novel macromonomers for applications such as synthesis of amphiphilic block copolymers, surface modification and grafting agents.

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ANTIBACTERIAL ACTIVITY OF HYPERBRANCHED POLY(ACRYLIC ACID-CO-3-HYDROXYPROPIONATE) HYDROGELS

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Human health is threatened by many microorganisms, such as bacteria, fungi and parasites that cause numerous infectious diseases resulting in a large number of deaths. Many infectious diseases are easily expanded via contact with infected individuals and environmental sources such as air, drinking water and any infected materials. Sanitation by use of traditional disinfecting agents is mostly inadequate to inhibit the spread of infectious diseases. Moreover, routine cleaning procedures are generally costly and offer short-term protection. Hence, use of antimicrobial materials in daily life is a developing approach to prevent from infectious diseases. Antimicrobial polymers are promising materials in combating with pathogens considering the wide use as commodity materials, relatively low cost, structural diversity and ease of their structural modification. However, the approach has more applications in medical devices, water purification systems, textiles and food packaging industry comparing to commodity materials.

In this research, the antibacterial activity of poly(acrylic acid-co-3-hydroxypropionate) (PAcHP) [1] was studied by disc diffusion [2], broth macrodilution minimum inhibitory concentration (MIC) [3] and minimum bactericidal concentration (MBC) methods. For this purpose, three Gram positive (*B. subtilis* NRRL B-209*, M. luteus* NRRL B-1018 ve *S. aureus* ATCC 6538) and three Gram negative (*E. coli* ATCC 25922*, P. aeroginosa* NRRL B-2679*, P. vulgaris* NRRL B-123) bacteria were selected. Firstly, antibacterial activity study was carried out by disc diffusion method using 100 microgram polymer. No bacterial growth was observed in *B. subtilis* plate, while the 29.63 mm inhibition zone diameter was obtained in the *M. luteus* plate. No inhibition zone diameters were observed in *P. vulgaris, S. aureus, E. coli* and *P. aeruginosa* plates. The minimum inhibitor concentration (MIC) Broth Macrodilution and Minimum Bactericidal Concentration (MBC) method were then applied to three different polymer concentrations (25-50-100 mg/2 mL) in *E. coli, S. aureus* and *M. luteus* bacteria. There was no bacterial growth in *S. aureus* and *M. luteus* plaques which PAcHP polymer at 100 mg/2 mL concentration. For this reason, it was concluded that the PAcHP polymer was bactericidal against three Gram positive bacteria in this study.

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HYDROLİTİC AND ENZYMATIC DEGRADATION OF RASEMIC POLY(α-METHYL-β-PROPIOLACTON) (PMPL)

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Poly(α-methyl-β-propiolacton) (PMPL) might be structurally accepted between and. It resembles to poly(lactic acid) (PLA) since the methyl group at the alpha position in the repeating unit. It is a poly(β-ester) like poly(hydroxy butyrate) (PHB). Moreover, it is structural isomer of PHB. PHB and PLA are the most common biopolymer due to their biodegradable[1], biocompatible[2], and bioresorbable[3] properties. By this way, PMPL has drawn attantion as potential biomaterial. Although the similarity was mentioned in literature [4] biomadical application of PMPL has not been studied yet.

Rasemic PMPL was prepared chemically via ring opening polymerization of rasemic α-methyl-β-propiolacton according to recent studies [4,5]. Structural characterization of the polymer were done by FTIR, ^{1}H-NMR and MALD-MS spectroscopy techniques. Film samples of the polymer were prepared through solution casting technique. Biodegradability of the film samples in phosphate buffer saline (PBS), trypsin and porcine pancrease lipase were investigated over the 5 weeks. Mass loss of the film samples were recorded to get information about degradation kinetics. In addition, solution phase of the degradation medium was analyzed by LC-MS to reveal the chemical structure of the polymeric fragments.

The rates of mass loss in each medium were observed to be very high in the first stage of degradation process possibly due to the semi-crystalline structure of the polymer. This behavior was attributed to the faster diffusion of ions and enzym molecules to the amorphous regions [5]. Mass loss in the samples were determined to be 70% at the end of 5 weeks. Definitely, this abrupt decrease in the mass of the films are due to the relatively low molar mass of the pristine polymer. LC-MS studies revealed that soluble products were monomeric and dimeric hydroxy acids [6] which are indications of ester hydrolysis mechanism [7] during biodegradation process.

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OBTAINING OF NANOSTRUCTURAL CERAMIC POWDER COMPOSITES USING ORGANIC PRECURSORS OF B_4C-TiB_2

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A suspension consisting of amorphous boron, titanium (IV) oxide and organic precursors has been used to obtain B_4C-TiB_2 ceramic composites. Even distribution of the amorphous boron and titanium (IV) dioxide in the mixture was possible by long-term mixing of the powder in attritors. Maximum homogeneity could be achieved by subsequent adding of the water solution of organic precursor to the powder mixture. Carbohydrates, polyols, polyvinyl alcohol and others were used as carbon-containing components. Simultaneous dehydration of suspension were made in a special thermostat-type mixer at 110-120°C.
Thermal treatment of the obtained viscous mass was realized in two stages in the atmosphere of argon at 230-1250°C. X-Ray spectral analysis showed that the product synthesized in the atmosphere of argon at 1250°C was a two-phase system consisting of B_4C and TiB_2 (Figure 1). Electron-microscopic studies showed that the grain size of the powder composite was less than 100 nm (Figure 2).

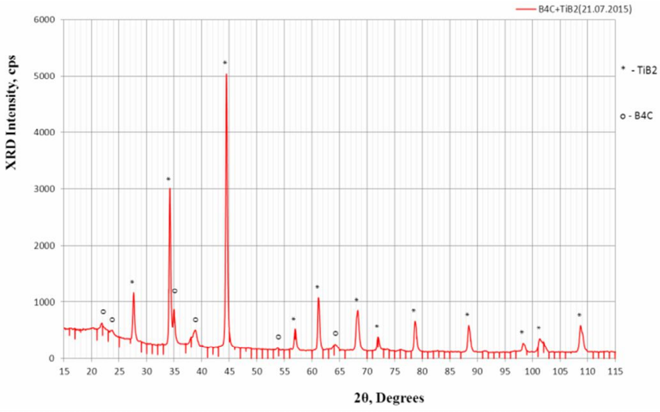

Figure 1. X-Ray spectral analysis

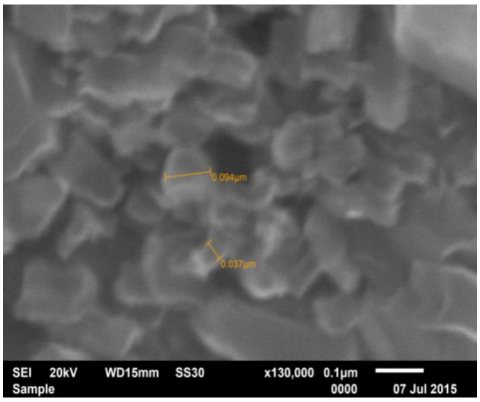

Figure 2. Electron-microscopic studies of the composite

NANOSTRUCTURAL IRON AND MAGNETITE POWDERS OBTAINED FROM IMPREGNANTED IRON(0) PENTACARBONYL

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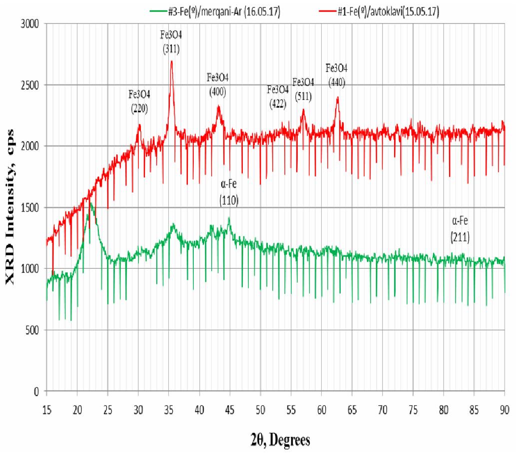
Iron(0) pentacarbonyl is widely used to obtain different functional appointment magnetic materials containing ultra-disperse iron. By its impregnation and subsequent transformation became possible to get zero nanovalent iron and oxides of iron supported in various nature matrixes (organic and inorganic). Chemical transformation of $Fe(CO)_5$ impregnated in porous sorbents and biopolymers have been carry out in the autoclave in an argon area at 200^0 C (Figure 1). In an argon flow Fe^O, sizes of which varied from 50 nm to 300 nm, spreads in matrixes. Composite Fe^0 /wood particles are paramagnetic and are easily moved into the water by the effect of magnetic field. By the X-ray analyses was determined that in the presence of wood in the autoclave iron pentacarbonyl undergoes oxidation by organic compounds and water released from wood. Organic components of the wood undergo partial pyrolysis, so magnetite powder contains carbon (Figure 2). Iron magnetite is black and constitutes a powder with a density of 0.22-0.26 mg/ml. The scanning electron microscope has determined that the particle size of the powder is 50-100 nm.



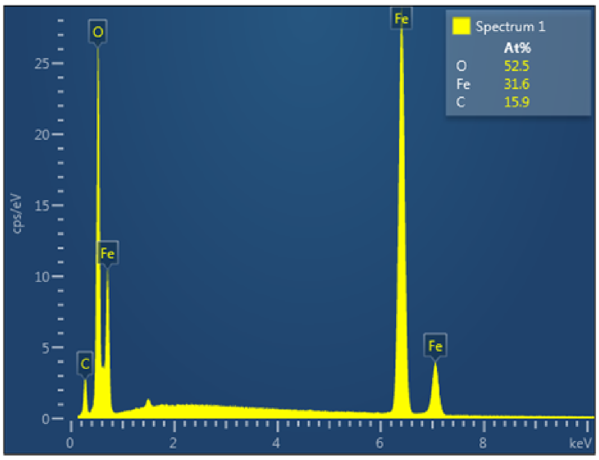


Figure 1. X-ray diffraction patterns of Fe^O/wood composite andFe_3O_4
Figure 2. EDS analysis of magnetite.

UNSATURATED BOND-CONTAINING HETEROCHAIN POLYMERS FOR BIOMEDICAL USE

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Biomedicine is one of the most interesting spheres for use of different classes of polymers containing unsaturated bonds. Further extension of applicaiton area for AABB polymers is possible through their functionalization, via insertion of chemically active groups [1], as well as hydrophobic so-called adhesive groups [2] into basic and lateral chains of polymers. Insertion of unsaturated bonds both into basic and lateral chains of macromolecules is one of the most prospective ways of polymers functionalization [3-4]. Series of new biodegradable unsaturated polyesteramides (UPEAs) and co-polyesteramides (coUPEAs) were obtained by us in the Research Center of biomedical polymers and biomaterials at Georgian Technical University in collaboration with research group of Cornell University (USA) [5-7] on the basis of unsaturated fumaric acid, saturated aliphatic dicarbonic acids and α-aminoacids – derivatives of L-leucine and L-phenylalanine. For synthesis of targeted polymers we have used the activated polycondensation method [8-9].
Fumaric acid – unsaturated dicarbonic acid was a key monomer of our work, by means of which we inserted unsaturated bonds into basic chain. The syntheses of three types of new unsaturated PEA polymers were explored – (I) Leu- and Phe-based unsaturated PEA homopolymers (UPEAs) composed of 100% of fumaric acid, (II) Leu-based unsaturated-saturated copolymers (USPEAs) composed of fumaric acid and saturated fatty diacids, and (III) Leu- and Phe-based UPEA copolymers composed of 100% fumaric acid (co-UPEAs). We have conducted reactions of chemical transformation of polymers, cross-linking reactions with UV radiation. Biodegradation of synthesized polyesteramides (enzymatic hydrolysis) was studied by gravimetric method *in vitro* tests under close-to-real conditions (pH 7,4; 37°C). Representatives of hydrolases class – α-chymotrypsin and lipase were used as enzymes.
Thus, as a result of carried out research on the basis of natural aminoacids L-phenylalanine and L-leucine is synthesized a new family of biodegradable, unsaturated homo-polyesteramides, unsaturated/saturated polyesteramides, co-polyesteramides, with good material properties, which are prospective for getting of biodegradable materials with high mechanical strength meant for implantable artificial organs, biodegradable hydrogels, drug-delivery systems, micro- and nanocapsulation etc.

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ELECTRODEPOSITION OF Zn-Mn ALLOYS FROM SULFATE SOLUTION CONTAINING COMPLEXING ADDITIVES

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Zn-Mn Alloys obtained by electrodeposition are characterized with high corrosion protective properties compare to pure zinc galvanic coatings widely used for corrosion protection of steel surface [1-3]. The incorporation of inexpensive metallic manganese into alloy shifts corrosion potential towards to the more negative one and makes more effective protection of steel surfaces. Corrosion resistive Zn-Mn alloys are obtained from less aggressive sulfate solutions containing complexing agents - citrate and EDTA [4-7].
However, these solutions are characterized with instability (manganese citrate precipitates from solution) and process proceeds with low current efficiency.
In our research, electrodeposition of Zn-Mn alloys was carried out in solutions which contained manganese, ammonium and zinc sulfates, and additives: sodium nitrilotriacetic acid, sodium citrate, sodium gluconate, EDTA or their mix.
It is found that chemical composition of high quality galvanic coatings and current efficiency strongly depends on the ratio of manganese and zinc ions concentration in solution, nature of complexing additive, pH, cathodic current density and temperature. X-ray diffraction revealed that obtained alloys are mixture of phases of Zn and ε-ZnMn. No precipitation manganese citrate was observed when sulfate solutions contained citrate and additive of 0.001 M $K_4P_2O_7$.
It is determined that electrodeposition of Zn-Mn alloys is possible in a diaphragm free electrolyzer using insoluble anodes (graphite, titanium modified by ruthenium oxide DSA) and solutions containing sodium nitrilotriacetic acid. Whereas in the case of using solutions containing EDTA and citrate, their oxidation happens on anodes.
This work was supported by Shota Rustaveli National Science Foundation (SRNSF)(grant number YS-2016-18 “Electrochemical Synthesis of Corrosion Resistant Manganese Alloys Coatings”).

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COMB-TYPE METHYLSILOXANE POLYMERS WITH FLUORINE CONTAINING SIDE GROUPS

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The wide application of organosilicon polymers in many fields of techniques pushed the development of organosilicon chemistry and increased application-oriented researches in above mentioned field. Polysiloxanes are characterized by a number of interesting properties, e.g. excellent heat resistance, low toxicity, biocompatibility, high oxygen permeability, poor wet ability, extremely low surface tension, low melting point and glass transition temperature, resistance to radiation, special rheological properties, outstanding electrical isolating properties and others.

In this presented work we report the synthesis of new comb-type polysiloxane via direct way hydrosilylation reaction of tetrahydrotetramethylcycloterasiloxane with 2.2.3.3.-tetrafluoropropyl acrylate as well with vinyltriethoxysilane at 1:4.2 and 1:3:2 ratio of initial compounds at various temperature and catalysts in result D_4^R and $D_4^{R,R'}$ type organocyclotetrasiloxane have been obtained. The structure and composition of obtained compounds have been determined via FTIR, NMR ^{29}Si, ^{1}H, ^{13}C spectra data.

The polymerization reaction of D_4^R and $D_4^{R,R'}$ type organocyclotetrasiloxanes have been carried out in the presence of nucleophilic catalysts and dihydroxy terminated comb-type polymers with fluorine containing side groups have obtained. The structure and composition of obtained polymers ha ve been determined been via FTIR, NMR ^{29}Si, ^{1}H, ^{13}C spectra data. For polymers DSC and GPC investigation have been carried out.

This work has been fulfilled by financial support of Science & Technology center in Ukraine (Grant #6301).

REWRITABLE IMAGE RECORDING ON THE SPIROPYRAN DOPED NEMATIC AND CHOLESTERIC LIQUID CRYSTAL POLYMER FILMS

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The last decade has seen an intensive research effort focusing on the novel photochromic materials suitable for optical data storage. Azobenzene, spiropyran (SP), phenoxyquinone, and bisthienylethene derivatives are representative of the most common types of photochromic compounds explored to date. One of the most unique examples of molecular switches are SPs [1,2], whose closed-ring, hydrophobic isomer transforms into a highly polar, open-ring merocyanine (MC) form upon exposure to UV light, whereas the reverse reaction can be induced by visible light or by heat. In this work, we demonstrate the photochromic composites, based on the SP doped polymer dispersed Nematic and Cholesteric liquid crystal (CLC) films. The films are obtained by encapsulating an SP and liquid crystal mixture in a polymer matrix and they exhibit a light controllable spatial-temporal optical image modulation with the improved photosensitivity and high resolution. Proposed photochromic medium has a great potential for the development of high-performing optically gated photonic devices such as rewritable paper, real-time holograms, light-controlled molecular and fluorescent switches, real-time UV irradiation dosimeters, smart credit cards and labels. Further, the presented materials are promising for the production of mechanically flexible, environment-friendly, lightweight, large-area optical devices that can be fabricated by room-temperature solution processing.

Acknowledgement. This work was supported by the Shota Rustaveli National Science Foundation (SRNSF), project number № 217330

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THE WOOD COMPOSITIONS, HAVING DIFFERENT TECHNICAL FEATURES AND THEIR INFLUENCE ON THE BIOLOGICAL SYSTEMS

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Nowadays, wooden sawdust tile (particleboard) is used for making furniture as well other building elements, in which urea or phenol-formaldehyde resins are used as binding-adhesive substance. Therefore, it is considered that the particleboard is not ecologically safe and for what it's use is forbidden in dwelling [1, 2].

New renewable compositions were received on the basis of waste received from distilation of cellulose, corn straw, leaf, sunflower, nut shell, and other powder at the department of macromolecular chemistry, faculty of Exact and Natural Sciences, Iv. Javakhishvili Tbilisi University, where organic and silicon organic polymers were used for the first time. [3].

Goal of work: Comparative study of influence of wooden compositions with different technical features, on common quantity of leukocytes in the peripheral blood of adult white mice.

Material and Method: Experimental objects were adult white mice. Gorayev's chamber was used for evaluation of leukocytes quantity.

Results: It was determined that using of wooden sawdust tile as a construction material in animal cages reduces the number of leukocytes by 50% of the peripheral blood in adult white mice. Amount of leukocytes is not changed in case of using new composition materials, which are formaldehyde free.

Conclusion: Cellulose based new renewable compositions don't have negative influence on live system functionality.

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AN ANALYTICAL METHOD FOR DETERMINATION OF ISOSORBIDE DINITRATE BY USING GRAPHENE QUANTUM DOTS

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Isosorbide dinitrate (ISDN) is used to prevent and relief of acute attacks of angina, in long-term prophylaxis of classic angina. It is also used in congestive heart failure, in shock, and in achalasia esophageal spasm. Some analytical methodologies for trace determination of ISDN have been established. Some of them may suffer limitations on economic and sensitivity. An ISDN economic and sensitive method is favored. Only few methods have sufficient sensitivity to be applied for ISDN analysis in pharmaceutical formulations.

In this study, a simple and sensitive automated flow injection based spectrophotometric method is used to determine the ISDN in the related pharmaceuticals. In this method, ISDN was hydrolyzed at 80 °C for 100 min in 0.05 mol L^{-1} sodium hydroxide. During the process, ISDN is degraded to nitrite and the other constituents. Then the produced nitrite reacts with metoclopramide hydrochloride in acidic solutions to produce a diazonium cation which is subsequently coupled with graphene quantum dots, GQDs, which finally forms a yellow colored azo product having the absorption peak at 423 nm (λ_{max}). It should be noticed that GQDs (only in this work) has been introduced as a new coupling reagent. The reagent has behaved sensitively and selectively. Under optimum conditions of hydrolysis, azo dye formation, the calibration curve was obtained which was linear in the range of 0.3 to 50 µg mL^{-1} of ISDN.

The method used was found to be sensitive and accurate in the determination and quality control of pharmaceuticals containing ISDN. In this work tablets containing ISDN from different companies were tested as the real samples. Two different pharmaceutical tablets (from two different companies) were analyzed. One of them, with nominal ISDN value of 10 mg per tablet, showed 10.14±0.25 and 9.95± 0.14 by using the presented method and a standard spectrophotometric method, respectively. Another tablet with a nominal value of 10 mg per tablet also showed 9.46±0.06 and 9.79±0.11 by using the presented method and a standard spectrophotometric method, respectively. The ± amounts are standard deviation of measured ISDN contents. The t-student statistical test was followed for the two ISDN samples for comparison of the results obtained by the presented method and the standard method. The t-test results showed no statistical differences in P=95.

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NITRATE AND AMMONIUM DETERMINATION: GRAPHENE QUANTUM DOTS FOR QUALITY CONTROL OF CHEESE, MINERAL WATER AND FERTILIZERS

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Nitrogenous inorganics such as ammonium and nitrate are thought to play a major role in ecosystems. The compounds are present in various systems and samples at micro-molar and mili-molar levels. Various sensitive analytical methods have been established which determine the inorganics in samples such as cheese, mineral water and fertilizers. Reduction of nitrate to nitrite and then diazotization-coupling reaction produces an azo dye. Reduction of nitrate has been generally carried out by passing sample solutions through a copperized cadmium (Cd-Cu) column. Also, to form the azo dye, modified Griess-Ilosvay procedure is preferred. The formed azo dye often is detected spectrophotometrically. But for the determination of ammonium by spectrophotometry, often a preliminary reaction named "Berthelot reaction" is neccessary. Only few spectrophotometric procedures have been described based on oxidation of ammonium to nitrite and subsequent diazotization-coupling reaction.

The present research introduces grapheme quantum dots (GQDs) as a novel coupling reagent for azo dye formation in a flow based analytical method. GQDs are coupled to diazotized metoclopramide in acidic media to determine the resulting nitrite after reducing nitrate to nitrite (using a Cd-Cu column). Also, oxidation of ammonium to nitrite (using a bromate–bromide reaction) was used prior to formation of the metoclopramide based azo dye, to measure ammonium, selectively. Using a straightforward 3-line flow injection manifold, determination of the formed intermediate, nitrite, was carried out.

Two linear spectrophotometric calibration curves were obtained at 423 nm in the ranges of 0.05-9.0 and 0.2-4.0 $\mu g\ mL^{-1}$ for nitrate and ammonium, respectively. The method was satisfactorily applied to the determination of nitrate and ammonium in some real samples.

A cheese and two mineral water samples were analyzed and their containing nitrate were determined. The cheese sample showed nitrate as 0.639±0.005 and 0.614±0.008 $\mu g\ g^{-1}$ by using the presented method and a standard spectrophotometric method, respectively. One of the mineral samples showed 1.04±0.01 and 1.09±0.02 $\mu g\ mL^{-1}$ and another also showed 1.59±0.01 and 1.63±0.01 $\mu g\ mL^{-1}$ by using the presented method and a standard spectrophotometric method, respectively. To investigate the efficiency of the presented method for the determination of ammoniuml two chemical fertilizer (ammonium sulfate and diammonium phosphate) was tested. Two fertilizer samples from two different companies were also subjected to be analyzed by the presented method and a standard method. One of the fertilizers, ammonium sulfate, showed nitrogen percent as 20.7±0.2 and 20.8±0.3, when analyzed by using the presented method and the standard method, respectively. The other fertilizer, diammonium phosphate, was also showed nitrogen percent as 11.60±0.13 and 11.70±0.25, when analyzed by the presented method and the standard spectrophotometric method, respectively. (The ± amounts are standard deviation of nitrate or ammonium concentrations).

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POLYMER COMPOSITION MATERIALS ON THE BASIS OF POLYETHYLENE AND MODIFYING ADDITIONS

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In technologies connected with development of the filled polymer composition materials of various purpose a special attention is paid to scientifically substantiated selection of modifying additives to the polymer matrix, in which the phenomenon of antagonism between them is excluded and sufficiently high operational properties are provided [1].

In recent years with development of nanotechnologies there were opened the wide possibilities of variation of the physical-chemical and operational indices of the composition materials by impregnation of various metals, their oxides, sulfides, montmorillonite, graphite and other modifying substances in the structure of the polymer matrices [2-4].

The processes running in impregnation have been in detail studied on action of nano-dimensional particles (NDP) or their cluster particles on properties of traditional polymers (PE, PVC, etc). This is explained by ability of the particles to form the ionic and coordination cross-links limiting a mobility of the molecular chains or their segments by cohesion and adhesion interactions and other reasons, [3]. Often in the structures of the compositions on the basis of PE, PTFE, etc along with inert fillers there are used the reactive oligomers and cooligomers participating in the cross-linking process of the polymer chains with formation of the material with high strength and antifriction properties.

MAGNETIC NANOPARTICLE IMMOBILIZED N-PROPYLSULFAMIC ACID: THE EFFICIENT, GREEN AND REUSABLE NANOCATALYST FOR THE SYNTHESIS OF COUMARIN DERIVATIVES UNDER SOLVENT FREE CONDITIONS

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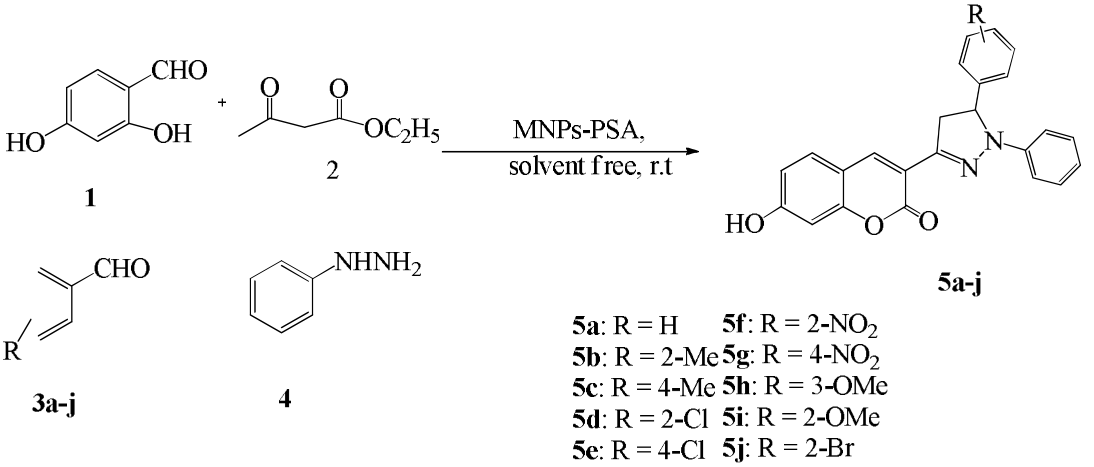
The catalytic activity of Magnetic nanoparticle immobilized *N*-propylsulfamic acid (MNPs-PSA) was investigated as a recoverable catalyst for the one-pot synthesis of novel substituted pyrano [2,3-*h*] coumarins linked to pyrazoline derivatives in high to excellent yield at room temperature under solvent free conditions. This method has the advantages of low cost, short reaction time, high atom economy, convenience and efficiency. It also the characteristic aspects of this catalyst are rapid, simple and efficient separation by using an appropriate external magnet, which minimizes the loss of catalyst during separation and reusable for several times with little loss of activity.



5a: R = H **5f**: R = 2-NO$_2$
5b: R = 2-Me **5g**: R = 4-NO$_2$
5c: R = 4-Me **5h**: R = 3-OMe
5d: R = 2-Cl **5i**: R = 2-OMe
5e: R = 4-Cl **5j**: R = 2-Br

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SYNTHESIS AND STUDY OF MIXED-LIGAND HIGH-MOLECULAR CHELATES

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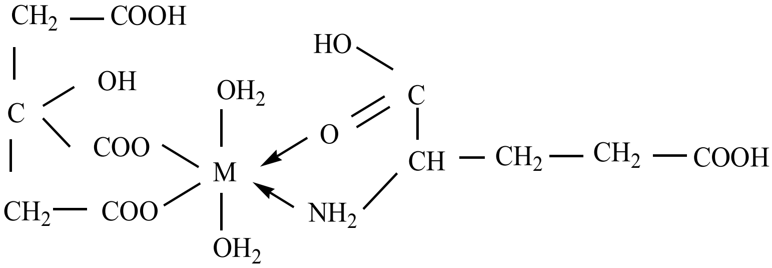
Chelates of microelements play significant role in physiological and biological processes proceeding in living organisms. Rapid growth of biological activity of animals and birds occurs when filling the deficit of microelements by chelates [1,2]. Mixed-ligand chelate compounds with general formula $M\cdot gl\cdot L\cdot nH_2O$ (where M=Mn,Zn,Fe,Co,Cu; gl–the molecule of glutaminic acid, L^{-2}–citrate-ion) are synthesized. Their composition, individuality, crystallity are determined, and X-ray-amorphous and isostructural series are revealed. Through study of IR absorption spectra of compounds is determined that neutral molecules of glutaminic acid coordinate with complexing metals by means of oxygen atoms of carbonyl group and nitrogen atoms of aminogroup and with formation of five-membered metallacycles; while two of three carboxyl groups experience deprotonation in citric acid molecule. This deprotonized carboxyl group by means of oxygen atoms forms a bond with metal atoms. Thus, we can assume that neutral molecule of glutaminic acid and citrate-ion form octahedral configuration around metal atoms. Two water molecules also participate in coordination for filling up the octahedral configuration. Possible octahedral coordination of $M\cdot gl\cdot L\cdot nH_2O$-type compounds may be represented in such form:



Thermal stability and character of thermal decomposition are determined through thermographic study of synthesized compounds. In particular, there is established that chelates are thermally stable and their decomposition proceeds stage-by-stage. Premixes prepared on the basis of synthesized chelate compounds are tested in mixed rabbit feed. Based on experiment is established the optimum quantity of chelate-form microelements entering into premix. The conclusion is made that synthesis and study of chelate compounds is interesting both from scientific and practical viewpoint. Premixes prepared on their basis may be successfully used in mixed feed as industrial-purposed additives for feeding animals and birds.

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CLARIFICATION AND STERILIZATION OF PHARMACOLOGICAL SOLUTIONS WITH USE OF FLUOROPLASTIC MEMBRANE

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The fluoroplastic membrane modified by us (pores sizes 0.11 mcm) is used for filtration of various medicinal plants extracts and pharmacological solutions.

Fluoroplastic membrane is produced by sintering of polytetrafluoroethylene polymer powder. Further formation of the film is provided by extrusion and calendaring.

As compared with the other materials, fluoroplastic has many advantages, the main of which includes resistance to multiple wetting and drying, washing up and regeneration, treatment with aggressive solutions. Fluoroplastic is biologically safe and fit for food-stuffs and medicines.

The works was performed using out pilot system . The solution was delivered from the feed tank with help of compressor under pressure of 1 – 1.2 atmosphere. In result of microfiltration we produce retentate and permeate in membrane cell, which are collected separately.

We have researched filtration/regeneration processes of water extracts of aloe, quince leaves, chamomile, eucalyptus, St. John's wort, blueberry, blackberry leaves, also alcohol extracts of hawthorn, mint, St. John's wort, aloe. The results of analyses prove that filtrate are clarified and sterile (turbidity was measured with turbidimeter Lovibond).

After cycle of filtration we provided restoration of microfiltration membranes with the various regenerants. Experimentally we selected the regenerants and determined their optimal concentrations and regeneration time. We established that regeneration of the membranes fouled in filtration of alcohol extracts is much harder than in water extract filtration. In spite of some difficulties we have developed the technological mode of membrane restoration.

The experiments results prove that before microfiltration all kinds of extracts should be necessary exposed to mechanic filtration to avoid sedimentation of coarse fractions at the membrane surface and rapid drop of its permeability.

We have established that filtrate received with microfiltration is free of undissolved particles and that we produced really clear filtrate. Also, we have shown that 0.11 mcm pores fluoroplastic membrane is able to detain microorganisms. So, the filtrates produced by us in resulted passing of alcohol and water extracts through the microfiltration membrane made from fluoroplastic are clear and microbiologically sterile.

It is also important that fluoroplastic polymer is notable for high thermo- and chemical stability, at the same time it is ecologically pure, permissible in food and medicine and above all, this polymer is stable to all regenerants used by us. Permeability of membranes completely restores and, therefore, allows their multiple using. We hope that our results will be of interest to pharmacological companies.

MECHANICAL PROPERTIES OF 3D BIOPOLYMER MATERIALS WITH ADDITION OF MAGNETIC NANOPARTICLES

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Chitosan, hyaluronic acid and collagen are compounds, which belongs to the group of biopolymers. These polymers occur naturally in living organisms or are produced by living organisms. Biopolymers are widely used in biomedical field because they are fiber-forming and film-forming. Two or three biopolymers can be mixed together and such the blends can lead to new materials. The mechanical properties of polymer materials are important from both scientific and practical point of view. Biopolymeric mixtures can be bioactive, biodegradable and biocompatible [1,2].

Materials containing metals, are currently the subject of research in many fields of science around the world. Of particular interest are materials containing iron oxide. Iron oxides exist in many forms in nature, with magnetite (Fe_3O_4), maghemite (γ-Fe_2O_3), and hematite (α-Fe_2O_3). The most common and frequently used in biomedical applications is magnetite. Magnetite is a mineral and one of the main iron ores. It is the most magnetic of all the naturally-occurring minerals on Earth [3,4].

In this study matrices based on the collagen, chitosan and hyaluronic acid were prepared and modified with magnetic particles. Magnetic particles were obtained by chemical precipitation method. 3D matrices were obtained by lyophilization process of solution made of the blend of collagen, chitosan and hyaluronic acid with addition of magnetic particles. Mechanical properties of 3D materials were tested. Magnetic properties of the material were studied using electromagnetic field.

The results showed, that the addition of magnetic particles to polymeric matrices based on biopolymeric mixtures led to modification of their properties. Moreover, the materials obtained exhibit magnetic activity.

Acknowledgments. Financial support from the National Science Centre (NCN, Poland) Grant No UMO 2013/11/B/ST8/04444 is gratefully acknowledged.

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OBTAINING LINEAR BIO-DEGRADABLE POLYMERS OF ON THE BAZE OF AMIDO-ALDEHYDE CO-POLYMERS

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Linear co-polymer that is obtained by polycondensation of carbamide and thiocarbamide with formaldehyde can be used as a nitrogenous fertilizer acting by prolonged mechanism. Co-polymer undergoes biodegradation at the impact of microorganisms and it passes into the form digestible by a plant and this process is kept for the whole period of vegetation.

For the purposes of getting complex fertilizers, we obtained polymer composites, which alongside with prolonged action nitrogenous fertilizer contain natural phosphorites, potassium salts and microelements. Mixing of the components is performed at room temperature in rotor pellet making unit and the microbial preparation designed for degradation of fertilizer is added in the very unit. Then the mix is granulated. The obtained composite is an ion-exchange system, where ammonium ions created as a result of degradation of nitrogenous fertilizer interact with natural phosphate and substitute calcium atoms in it; as a result of it phosphate, in the form of ammonium salts passes into soluble state and at the action of bacteria is gradually consumed by a plant.

Ion exchange fertilizers consist of hardly soluble ingredients, which as a result of buffer effect of chemical reactions going on in soil are released and are assimilated by plants according to their demands,

Thus, all main nutrients of the composite are released and plants can assimilate them. Alongside with it, other nutrients are released too at the dissolution of P-rock, which, as usual, is very rich in various microelements.

Chemical and field experiments proved that ion-exchange fertilizers are highly efficient and they, helping a plant to assimilate nutrients more effectively, reduce nutrients washing off and contamination of environment. Besides, crop productivity is increased compared with that obtained at the application of common soluble fertilizers (www.zeoponic.com).

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SYNTHESIS OF CARD TYPE POLYARILATES

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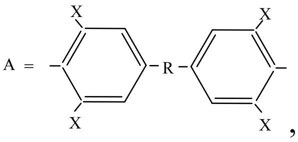
Dependence a some of properties of polymers on their structure was established on the example of various class polymers, which enables us to obtain polymers of preliminarily focused properties. Softening temperature of rigid structure polymers is higher than their destruction temperature. This makes impossible to process the polymers from their melt, while poor solubility complicates their treatment from polymer solutions. Such situation restricts the area of practical application of many very interesting polymers. We have synthesized polyarylates on the base of cyclic bisphenols, which at the central carbon atom possess norbornane type non-coplanar substituents. This enables to obtain polymers which simultaneously will be characterized by good solubility in organic solvents as well as by high heatand thermoresistance. $4,4^1$ -diphenyloxidedicarbonic acid dichloranehydride was used as an acid component. Synthesis was realized by high temperature polycondensation method in ditolylmethane. Schematically reaction of homogeneous polyarylate can be expressed as follows:

$$nHOAOH + nClOCBCOCl = 2nHCl + [-OAOOCBCO-]_n$$

where A –is a trace of bisphenol molecule, B – is a trace of dicarbonic acid molecule.



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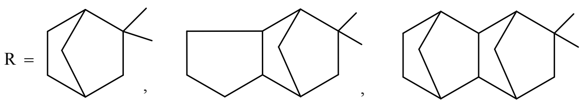

X = H, CH_3- , Cl

The obtained polyarylates are characterized by high softening temperature.
Presence of oxygen atom in phenyl nuclei of diphenyloxidedicarbonicacid conditions decrease of polymer softening temperature and increase of flexibility. Results of thermogravimetric analyses show that thermal resistance of polymers somewhat decreases.
From the solutions of organic solvents polymers form transparent, stable films, which possess good mechanical and dielectric properties. Thus, e.g. tangency of angle of dielectric losses equals to 6.10^{-3} and 5.10^{-3}, correspondingly. Tensile strength equals to approximately 400 kg /cm^2. Polymers retain high mechanical and dielectric indices at high temperature too. Specific volumetric resistance of polymers is within 10^{17} ohm. cm.

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THE TRIBOLOGICAL PROPERTIES OF POLYTETRAFLUORETHYLENE MODIFIED WITH Fe-DOPED CARBON NANOPARTICLES

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The effect of improvement of physical-mechanical and tribological properties of polymer materials by introduction of small amounts of various oxide and metallic nanoparticles into the composition is well known. Amongst polymers the polytetrafluorethylen (PTFE) is the most promising one for development of new compositional tribological materials aimed for the production of wearing units in the technical means exploited in the conditions of cold climates, high vacuum and in the highly aggressive environments [1]. From this view point application of doped nano-particles of carbon nano-forms (CNT, CNP) as fillers for PTFE has considerable attention. In present work has been studied the compositional material, which was obtained in the PTFE base with 2.5-10 wt% iron-doped carbon nano-tubes and core-shell type carbon nano-particles as fillers. The samples without PTFE fillers have been prepared as well. The test has been performed in the friction machine under 0.7 MPa load where as a counterpart cast iron was used. From the beginning the weight wear was measured after passing some velocity steps and afterward the linear wear calculated. Determination of the friction coefficient the investigated compositional materials have been done in the device ИМ-58, which at the same time is a small inertia stand. Obtained results have shown that introduction of the about 5 wt% of Fe-doped CNTs into PTFE drastically improves the tribological properties (parameters) comparatively to the unfilled PTFE. Namely, the wear resistance of this composition has been increased by the factor of 150-200 in the 0.12-1.25m/sec friction velocity range.

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OLIGOMERS ON THE BASIS OF DGEBA WITH EPOXY AND HYDROXY GROUPS

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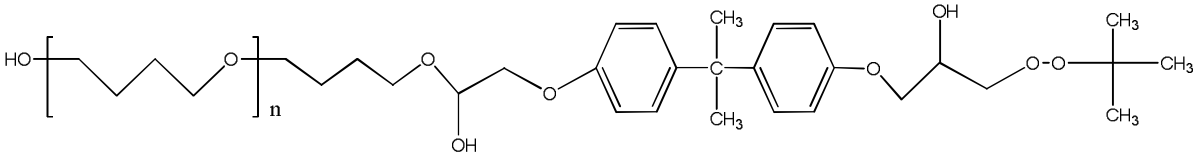
Oligomers with different functional groups are often used as active additives for polymeric mixtures. The compounds which are able to react via both radical and condensation mechanisms are of special interest.

We developed the synthesis method and synthesized oligomers with peroxy, primary and secondary hydroxy groups on the basis of peroxy derivative of bisphenol A diglicydyl ether (DGEBA). The structure of DGEBA with free peroxy group (we denoted the synthesized compound as HPO) is represented by the formula:



where n = 0–28

The structure and composition of the synthesized oligomers were confirmed by chemical, spectroscopic and chromatographic methods. The resulting products have M_n 490–2370 g/mol, active oxygen content 1.03–1.9 %, hydroxyl number 82–189 mgKOH/g.

We investigated the synthesized product as an active additive during polymer films formation. The chemistry of films formation was shown by IR-spectroscopy. The presence of –O–O– bond in the structure allows to form polymeric mixtures containing compounds with double bonds. On the other hand, the presence of primary and secondary hydroxy groups allows to introduce diisocyanates into the mixture structure.

The application of the synthesized HPO as an additive for epoxy-oligomeric mixtures based on ED-20 industrial epoxy resin improves some physico-mechanical properties of the products and chemical stability of the films compared with the compounds without additives.

EPOXY RESINS MODIFIED BY DIOLS

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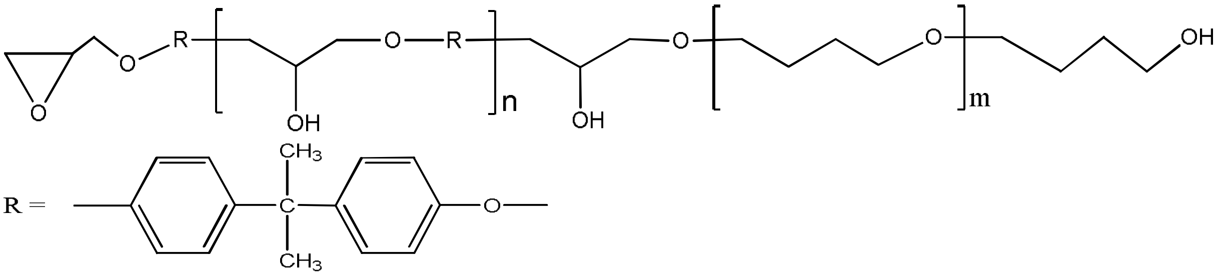
Epoxy oligomer-based materials are widely used in many branches of industry due to their unique complex of technological and operational properties.

To improve the properties of products on their basis and to combine them with other polymers the mentioned oligomers are modified by different low- and high-molecular compounds. These compounds contain functional groups of different nature which are capable to interact via radical or condensation mechanisms and form unified network. For this purpose on the basis of dianic epoxy resins we synthesized oligomers with epoxy, primary and secondary hydroxy groups. The structure of hydroxy derivatives of epoxy resins is given below:



where n = 0–2; m = 0–28.

Free primary and secondary hydroxy groups in the oligomer molecules allow to use oligomers for the production of polyurethane of new type, composites in the presence of diisocyanates, epoxides, amonicompounds, etc.

The structure and composition of the synthesized oligomers were confirmed by chemical methods, spectroscopy and chromatography. The resulting products have M_n 420–2330 g/mol, epoxy groups content 1.9–11.2 %, hydroxyl number 53–365 mgKOH/g. They are soluble in acetone, chloroform, dioxane. The synthesized oligomer may be used as an active additive during polymer films formation. The chemistry of films formation was shown by IR-spectroscopy. The oligomers with free epoxy, primary and secondary hydroxy groups may be used for the production of polymers with specified properties. Their peculiarity is the simultaneous presence of high-reactive ternary cycle capable of homopolymerization and primary hydroxy group which reacts with isocyanates and forms urethanes.

The application of the synthesized compounds as an additive for epoxy-oligomeric mixtures based on ED-20 industrial epoxy resin improves some physico-mechanical properties of the products and chemical stability of the films compared with the compounds without additives.

SOLID POLYMER ELECTROLYTES ON THE BASIS OF SILOXANES

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The wide application of organosilicon polymers in many fields of techniques pushed the development of organosilicon chemistry and increased application-oriented researches in above mentioned field. Interests in polymer electrolytes from the standpoints of application and fundamentals has led to search for synthesis of new methylorganocyclosiloxanes and polymers on their basis with short side chain ethers groups attached to polysiloxane exhibit high segmental mobility, and they do not display a significant increase in T_g as salt content is increased in polyelectrolyte.

As it is known from above mentioned literature data polymer electrolytes are obtained via hydrosilylation reaction of methylhydrosiloxane with allyl or vinyl containing organic compounds in the presence of catalyst. It must be denoted that the reaction at this time proceeds with obtaining of various linking systems and often cross linking, and branching processes take place, which is undesirable technologically.

In this presented work, we report the synthesis of new polysiloxane having propyl cyanide as an electro donor side group and ethyltriethoxysilane group as cross-linkers via hydrosilylation reaction of D_4^H with propyl acetoacetate in the presence of platinum catalysts: Karstedt's catalyst ($Pt_2[(VinSiMe_2)_2O]_3$), platinum hydrochloric acid (0.1 M solution in THF) and platinum on the carbon.

In ring-opening copolymerization reaction as an initial compound D_4^R and $D_4^{RR'}$ with hexamethyldisiloxane has been used. Copolymerization reactions in the presence of catalysts (0.01 - 0.005% of total mass) alkali fluorides (KF, LiF and CaF_2) and tetramethyl ammonium hydroxide have been carried out in inert atmosphere, in melt condition in temperature range 50-120^{0}C and in toluene solution at 50-110^{0}C. By gas-liquid chromatography (GLC) it was established that alkali fluorides in this condition does not promote obtaining of polymers and only 25-30% of initial compounds take place in ring-opening polymerization in case of KF. So the yield of oligomers is very low.

Studying of catalytic activity of various ionic fluorides in relation of polymerization of organocyclotetrasiloxanes has shown that activity, decreases in a line: $CaF_2 < LiF < KF$. So this type of catalysts is not convenient for polymerization of these types of organocyclotetrasiloxanes. Copolymerization reaction of $D_4^{RR'}$ and hexamethyldisiloxane have been studied in inert atmosphere in toluene solution at temperatures 40-60^{0}C with presence of powder-like anhydrous potassium hydroxide (0.05 - 0.01% of total mass). The kinetic parameters: reaction order, rate constants and activation energy of copolymerization reaction has been determined. The synthesized oligomers are vitreous viscous products, which are well soluble in organic solvents with the specific viscosity $\eta_{sp} \approx 0.035 - 0.2$. Structures and compositions of oligomers were determined by FTIR, ^{1}H, ^{13}C and ^{29}Si NMR spectral data. GPC, WAX and DSC analyses of oligomers have been studied.

Via sol-gel processes with lithium triflate and bis(trifluoromethylsulfonyl)imide (5-20%) solid polymer electrolyte membranes has been obtained. The dependence of ionic conductivity as a function of temperature and salt concentration has been studied.

This work has been fulfilled by financial support of Science & Technology center in Ukraine, grant #5055.

FABRICATION OF SCAFFOLDS FROM UNCATALIZED POLYURETHANES BY SC/PL

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Tissue engineering (TE) is an interdisciplinary field, which combines materials engineering, biology and medicine knowledge. One of the developed branches in the TE is the design and the fabrication of the tissue scaffolds. These are highly porous templates, which support and promote tissue regeneration. The tissue scaffold should be highly biocompatible and degradable at the controlled rate and time frame. One of the methods to prepare such scaffold is solvent casting combined with particle leaching (SC/PL). This technique allows to obtain highly porous three-dimensional (3D) structure of the scaffold with the pore sizes in the range of 100-400 μm.

The polyurethanes (PUR) belong to the wide family of engineering materials. By proper design PURs can be applied in the biomedical field, due to their biocompatibility with relatively low thrombogenicity, suitable mechanical properties and susceptibility to degradation. One of concerns, described in the literature, is the fact that catalysts, used in the synthesis of PURs, can lead to a significant decrease biocompatibility of these materials. Furthermore, degradation products of aromatic PURs, may be toxic for the human body. To overcome this limitation, we performed the synthesis of PUR systems, based on the aliphatic 1,6-hexamethylene diisocyanate (HDI), without the use of a catalyst. These uncatalyzed PURs were further fabricated into the porous scaffolds with the use of SC/PL technique. Uncatalyzed PUR scaffolds were prepared from a 20% solution of dimethyl sulfoxide (DMSO). As a leachable particle the sodium chloride, with crystals size in the range of 250-450 μm, were used. Initial optical microscopy analysis allowed to determine the porous structure of obtained PUR scaffolds (size, location of the pores, porosity). Total porosity of the obtained scaffolds reached about 90%. The compressive strength of the obtained PUR scaffolds was around 200 kPa. What has to be pointed out is that the permanent deformation of the samples did not exceed 6%. The results indicated a satisfactory porous structure and mechanical properties of uncatalyzed PUR scaffolds, which may suggest their potential use in tissue engineering.

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MATERIAL MODEL OF POLYESTER COMPOSITES WITH GLASS-REINFORCED POLYESTER RECYCLATE AND NANOFILLER

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Our earlier studies showed that glass reinforced polyester recyclate may be used as filler in new polyester composites [1-2], but mechanical properties of the composites was decreased. In this case the glass reinforced polyester waste was ground and added to new composites with the dolomite dust. In new composites the dolomite dust was partially replaced by glass reinforced polyester recyclate. However, in these composite materials the empty spaces have been observed, and they have an influence on weakening and increasing of composite absorption. But Szustakiewicz [3] reported that the addition of the modified montmorillonite to composites has caused a significant improvement in their mechanical properties. In order to improve properties of our new composites with recyclate the nanofiller (modified montmorillonite) was added. The influence of the amount of nanofiller on compressive and flexural strengths of composites containing glass reinforced polyester recyclate have been tested, according of content of recycled material and polyester resin.

The subject of this paper is the statistical analysis of the synergic effects and estimation of the relative importance of the components of polyester composite with glass reinforced polyester recyclate. For this aim, the material model of polyester composite has been developed on the basis of experimental results, and then the statistical significances of the elements of the model have been estimated.

In this study, the sought relationships have been determined in the form of 2nd degree polynomials (quadratic functions). Conformity of the model to experimental data was evaluated using determination coefficient R^2. Multi-criteria optimisation, based on the statistical experimental material model of the composite, has been carried out and composition of polyester composites with glass reinforced polyester recyclate of high strength has been formulated. The measure of the coefficient's significance is the absolute value of t-Student parameter. For the given significance level α (i.e. the accepted risk of mistake; in the technical problems α is usually equal to 0.05) there is a critical value of parameter t, above which the regression coefficient is considered as statistically significant. The higher value is an absolute value of t, the larger is a significance of the estimated effect. The evaluation of significance of the regression coefficients of the determined model is presented in the form of Pareto charts.

Results have confirmed that the addition of 2 wt.% nanofiller to the polyester composite with 20 wt.% polyester resin and no more than 12 wt.% recyclate significantly improves the mechanical properties in comparison to the properties of the composite without the nanofiller.

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PROMISING CATHODE MATERIALS FOR LITHIUM ION BATTERIES

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Lithium power sources (LPS) occupy one of the leading places among chemical current sources in the world. Intensive works on their further improvement are underway worldwide. Lithium-ion batteries (LIB) have undeniable advantages due to the high activity of lithium, the lowest value of self-discharge and high enough safety. Properties of cathode materials have the greatest impact on the LIA operation [1.2]. The purpose of the presented work was to create a relatively cheap and environmentally friendly nano-structured, high-voltage cation-substituted spinel type compounds - $LiNi_{0.5}Mn_{1.5}O_4$, and its derivatives - $LiMe_xNi_{0.5-x}Mn_{1.5}O_4$ (Me = Co, Cr, etc., $0 \leq h \leq 0.4$) as LIA cathode materials. As a result of performed research conditions for structuring spinels with given composition were optimized. Samples were synthesized through a method based on thermal decomposition of the eutectic mixture of the appropriate acetates. Substitution in the samples of nickel with Co/Cr may lead to increased stability during cycling and significant electrochemical changes. Cathode materials, based on nanoscale spinel, characterized by a large specific surface, a good crystallization, etc., due to the high kinetic characteristics of the nanostructure may initiate high power and find application as promising cathode materials for next generation lithium batteries, used in EV, HEV and other devices. [3].

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THE CHARACTERIZATION OF CHITOSAN/GELATIN SCAFFOLDS CROSS-LINKED BY STRACH DIALDEHYDE ADDITION

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Gelatin and chitosan can be used as biomaterials in regenerative medicine [1]. Isolation of collagen in native state as triple helical molecule has to be carried out precisely to avoid destruction of the protein structure. However, gelatin is a product of collagen hydrolysis and the production costs are lower than for native collagen, thus making gelatin leads to a cheaper substitute to obtain materials for regeneration processes [2]. Gelatin as well as chitosan possess many significant properties as biocompatibility, biodegradability, biological activity and non-toxicity [3].

Proteins and polysaccharides may be modified by physical and chemical methods. Physical cross-linking methods include UV-light [4] and gamma radiation as well as dehydrothermal treatment [5]. Chemical cross-linking methods include the use of naturals or synthetic compounds that interact with natural polymers [6]. As an example, starch dialdehyde is a promising compound as it is biodegradable and toxically acceptable [7]. It had been already reported to be used for several polymers modification (collagen, elastin, chitosan and gelatine).

The aim of the study was to obtain scaffolds based on gelatin and chitosan by freeze-drying method. Moreover such scaffolds were cross-linked by the dialdehyde starch addition. The use of such cross-linking agent in the mixture of natural polymers (gelatin and chitosan) in scaffolds form is a novelty in such materials modification. Obtained scaffolds were characterized by the mechanical testing, zeta potential analysis and scanning electron microscope images.

The addition of dialdehyde starch caused the formation of bonds between the cross-linker and the natural polymers, where the amine groups react with aldehyde groups. These modifications led to increased mechanical strength and zeta potential values. Pores had different sizes and shapes, with smooth edges. Thus, dialdehyde starch proofs to be safe and effective cross-linker for materials based on the blend of gelatin and chitosan.

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STRUCTURE AND PROPERTIES OF POLYMER COMPOSITES BASED ON RANDOM POLYPROPYLENE AND MINERAL FILLERS

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In recent years, scientists worldwide have all increasingly been attracted to researches aimed at studying the influence of the structure and composition of mineral fillers on the process of formation of crystalline permolecular organization in polymer materials. Unique ability of finely divided particles of minerals to affect the mechanism of occurence and growth of heterogeneous crystal nucleus in the polymer matrix has been detected in the process of mixing the polymers with the minerals. The latter fact has an essential impact on improving the properties of polymer composites filled with minerals. Therewith the efficiency of simultaneous use of number of additives has the combined action on the properties of the polymer composite. The mechanism of the existence of the components in the boundary areas of interphase area is predetermined by the physical and physico-chemical forms of interaction existing in the additive-macrochain-filler system.

There are almost no systematic studies aimed at establishing the effect of multifunctional organic structurants on the structural characteristics and properties of filled polymer composites. The urgency of this problem is that the introduction of the minimum concentrations of organic structurants contributes not only to improving the deformation-strength characteristics of polymer composites, but also significantly facilitates the miscibility of the blend components and, as a consequence, their processability.

It is repeatedly confirmed that the use of organic structurants significantly affects the formation of finely-divided spherulitic structures that contribute to the improvement of the technological compatibility of limited-compatible polymers, increasing the strength properties, melt flow index and processability of composite materials.

Investigations on the effects of finely-divided particles of the organic structurants on mechanism of formation of permolecular structures in polymer composites and processes occurring in the interphase area and boundary areas of polymer-filler system still remain open. The occurrence of certain structures in the filled polymers and the consequential impact of filler on the regularity of the changing of their properties are one of the most important criteria predetermining the degree of "strengthening" of the polymer base. The increase in the elasticity coefficient and strength of the samples by dispersing the filler is considered as a form of "strengthening" of polymer composites.

Taking into account the complexity and the insufficient illumination of this problem in the literature, the purpose of this paper is to show how essential the role of multi-functional structurants in the regularities of changes of main physico-mechanical and rheological properties of filled polymer composites is.

Thus, on the basis of the conducted researches, it can be concluded that the use of structurants with various mineral fillers has a positive impact on the improvement of physico-mechanical, thermal and rheological properties of filled polymer composites. It becomes obvious that the use of mineral fillers and structurants allows solving a number of problems related to improving the technological capabilities of processing of filled polymer composites. As a matter of fact, new polymer composites with improved operating and processing characteristics were generated in the process of modification of REP.

HETEROCHIAIN POLYMERS *via* TRICOMPONENT CLICK STEP-GROWTH POLYMERIZATION: OPTIMIZATION OF THE REACTION

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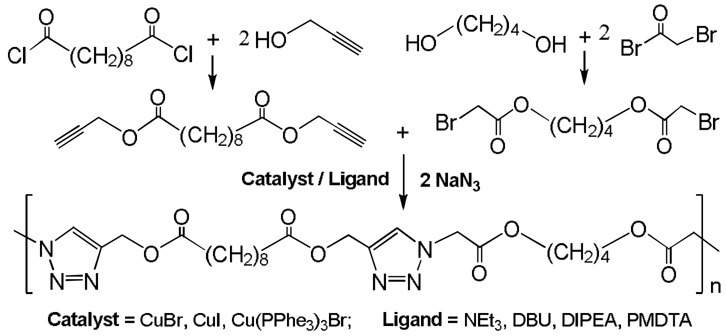
Since its introduction in polymer science in 2004, the copper(I) catalyzed azide–alkyne 1,3-dipolar cycloaddition (CuAAC) click reaction has already been exploited for the synthesis of a variety of polymer constructs including end-functionalized polymers, block copolymers, cyclic polymers, graft copolymers, star-shaped copolymers, dendrimers, and cross-linked materials [1]. Surprisingly, there are only few papers [2-5] on the application of CuAAC click reaction in step-growth polymerization (SGP) as a chain propagation reaction, and, to our best knowledge, there are no examples of the synthesis of heterochain fully aliphatic polymers such as polyesters, polyamides and poly(ester amide)s *via* CuAAC click chemistry. Recently we have reported on the first successful synthesis of 1,2,3-triazole-containing clicking poly(ester amide)s *via* one pot tricomponent CuAAC click SGP reacion [6].

The present work deals with a systematic study for optimizing the click SGP reacion in terms of solvent, catalyst, catalyst's activator (ligand), monomers concentration, duration and temperature of various steps of one pot reaction. The study was performed for the synthesis of clicking polyester which was being synthesized according to Scheme 1. The established optimal conditions of CuAAC tricomponent click SGP reaction will be applied to the synthesis of other classes of clicking polymers such as regular aliphatic poly(ester amide)s and amino acid based poly(ester amide)s promising for biomedical applications as biodegradable biomaterials.



Scheme 1. Synthesis of clicking polyester

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HYDRO INSULATION MATERIALS WITH ORGANIC AND INORGANIC ADDITIVES AND RESIDUES

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Hydro insulation materials protect constructions like bridges, buildings, highways, tunnels, various devices from damage such as aggressive impact of water and other liquids. According to the purpose of use, these materials divide as anti-filtration, anticorrosive and hermetic .As for the type of materials, they divide as asphalten, mineral, plastic, metal materials, etc.

Waterproofing tape, bitumen insulating fabric, metal insulation,Birulen are distinguished by their high waterproofness and plasticity. In more simple cases for hydroinsulation are used rubberoid, pergamumand and tar paper.

The hydro insulation material should have strong adhesiveness, adhesion to surfaces and metals, and it should be whole and of equal thickness. Should be mentioned negative aspects of using asbestos due to its high carcinogenicity.

Presented research aims at using advantageous materials for hydroisolation, which will be innovative, cheaper and safe and can be found in existing conditions.

Various types of residues are used as a raw material. As a result of special recycling of oil and organic polymer residues, mixing them with other components (silicates and other inorganic material), and further homogenization, we receive universal and cheaper compositions. By changing the ingredient ratio, variation and improvement of specific features in these compositions is considered.

It should be emphasized, that using above mentioned residues is crucial from the ecological perspective as well, in order to avoid nature pollution.

The report describes the processing specifics of some residues, which are used in accordance with the project goals.

ZEOLITES AS MICRO-PORE SYSTEM AND THEIR USAGE PROSPECTS

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Zeolites belong to the natural rock the constant usage of which in science and practice has the following basis: its high ion-exchanging capacity, prolonged activity of water and salt changing mode in soil (Aftereffect); selectivity towards NH_4^+ and K^+- which causes increasing the coefficient of their usage by plants and enhancing efficacy of mineral fertilizers.

Taking growing dosages (3-6-9-12 T/Hectares) of zeolites in red soils of west Georgia at the background of mineral fertilizers (NPK) caused increasing of P, K, Ca, Mg in tea leaves. Nitrogen decreasing tendency must be caused by selective absorption of NH_4^+ by zeolites, which increases nitrogen usage coefficient by tea plant. Taking zeolites in the red soils with mineral fertilizers improves tea leave quality. Compared to the background option usage of zeolites by 12 tones/hectare dosage, caused increasing tannin and extractive substances by 3,8-3,3%. Zeolites improve physical-chemical properties of the soil, in particular: strong acid reaction of red soils was decreased up to pH 4,5-5,8, it was caused by increasing Calcium and Magnesium easily soluble in water, which caused increasing pH of soil. By taking 12 tones/hectare zeolites in soils P_2O_5 and K_2O concentration increase is indicated (P_2O_5-78,5 mg/100g; K_2O-14,6 mg/100g) as well as humus (4,22%) and total nitrogen consistency(0,29%) was increased in soils.

Usage of zeolites as mineral fertilizers improves productivity qualities of the tea plant. Compared to NPK background taking zeolites by 12 tones/hectare in soils caused increaseing normal shoots by 34,2 %- and decreasing of stupid shoots by 51,3%.

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GLYCEROL ETHOXYLATE BASED CROSSLINKED POLYMERS AND THEIR USE AS OIL SORBENTS

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A gel can be defined as a three-dimensional network that store large amounts of liquids [1]. Polymer gels are attractive for many applications including tissue engineering, sensor, food industry, medical, agriculture, electronics and sorbent owing to their soft nature, durability, good mechanical properties and so on [2-4].

Amphiphilic polymeric networks (APCN)s are three dimensional polymeric network that have hydrophilic and hydrophobic components which capable of absorbing both water and organic solvents but not dissolve in them [5]. (APCN)s can extensively be employed in analytical and industrial applications due to their due to their sophisticated features in variety of fields such as tissue engineering, protein binding, contact lens, drug delivery, bioseparation and absorbent [6-10].

In this work, this work mainly aims to prepare and characterize a series of amphiphilic sorbents which comprise hydrophobic segments and hydrophilic segments, and to explore the absorbing ability of water and organic liquids. To do this, water and a variety of organic liquids including; dichloromethane, tetrahydrofuran, benzene, toluene, ethyl benzene, xylene, hexane, and cyclohexane were used for swelling experiments. The absorption and desorption speed of amphiphilic sorbents were also explored using dichloromethane as model absorbate. The characterization of polymers was examined using FTIR and thermal gravimetric analysis.

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PREPARATION OF NEW MATERIALS BASED ON THE INCORPORATION OF MICROPARTICLES INTO COLLAGEN MATRICES

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Collagen is the most abundant biopolymer in animals and it possesses many interesting properties, e.g. biocompatibility, non-antigenecity, non-toxicity. For this reason, collagen is regarded as one of the most useful natural biomaterials. This protein is also a common constituent of many cosmetic products. At present, the main sources of type I collagen are bovine or porcine dermis. However, due to outbreak of Bovine Spongiform Encephalopathy (BSE) and Transmissible Spongiform Encephalopathy (TSE) in pigs, cattle, use of collagen and collagen derived products from these sources have been limited. Type I collagen has also been extracted from skin, bone, fins, and scales of fresh water and marine fishes. In the present study, collagen was isolated from scales of *Esox lucius*.

Present study focuses on preparation and characterization of new collagen-based materials through incorporation of microparticles into the collagen matrices without modifying significantly their microstructure. ***Microparticles*** are small beads (1-500 μm) with the potentially very broad application in medicine, pharmacy and cosmetology. Microparticles can be the base for working out a system for active substance controlled release.

In this work microparticles made of gelatin and poly(vinyl alcohol) were prepared. The obtained microparticles were loaded with the *Calendula Officinalis* flower extract or retinol and they were incorporated into the collagen matrices. The prepared materials were characterized using ***scanning electron microscopy***, ATR-IR and UV-Vis ***spectroscopy***. The properties of matrices, such as porosity, mechanical and swelling properties were studied.

The results obtained suggest that incorporation of microparticles into collagen matrices can be used as modifying agent for preparation of new collagen-based materials for cosmetic and dermatological applications.

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HETEROCYCLIC AZO-CONTAINING MATERIAL SYSTEMS

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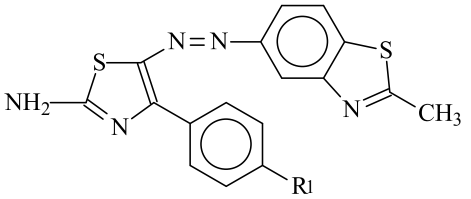
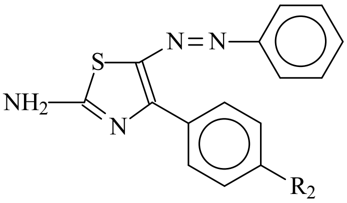
We present the optical properties of the heterocyclic azo dyes, which were dispersed in poly(methyl methacrylate) PMMA.



R_1= H, OCH_3



R_2= Br, H, CH_3, OCH_3

Azobenzene is an aromatic molecule where two phenyl rings are bridged by an azo (–N=N–) linkage. The extended conjugation gives rise to strong absorption in the ultraviolet and visible wavelengths. Azobenzenes are interesting because they combine the properties of anisotropy with photoresponsive behavior and can give rise to application in such areas as LC displays, NLO materials, information storage devices, etc [1, 2]. The desirable properties of these materials are attributed to the high efficient photo-revisable *trans-cis* isomerization of azobenzene fragment. The isomerization process of azobenzene containing compounds plays significant role in the unique optical properties of materials.

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PITCH-THERMOPLASTIC AS A COMPATIBILIZER FOR POLYMER-POLYMERIC COMPOSITIONS

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The using of polymer-polymeric compositions (PPC) greatly allows to satisfy the growing need of industry in new materials. The study of the relationship between compatibility of components, structure and properties of such PPC has a great theoretical and practical significance. The obtaining of such PPC opens the possibility of reuse of waste polymer materials for production of relatively cheap construction products.

Improved compatibility of polymers can be achieved by introducing into the system the compatibilizers - high-molecular compounds that enhance specific intermolecular interaction at the phase boundary. The most of modern compatibilizers relate to the relatively expensive materials. Therefore, the selection of inexpensive and highly efficient compatibilizers for incompatible polymer mixtures is one of the topical areas of research to improve the technology of obtaining high-quality composite materials based on them.

For the first time, based on experimental data, it has been shown that the compatibility of a pair of individual thermodynamically incompatible polymers: acrylonitrile-butadiene-styrene plastic (ABS) - polypropylene (PP) is achieved when using a pitch-thermoplastic as a compatibilizer.

Pitch-thermoplastic is a new polymeric material obtained by modification of coal tar pitch by polymers with active functional groups [1-2].

Based on the studies carried out, it was established that pitch-thermoplastic technologically compatible with ABS and PP. Preliminary introduction of a pitch-thermoplsatic into each polymer promotes their uniform mutual dispersion during mixing and compatibility. An essential advantage of the use of a pitch-thermoplsatic as a compatibilizer for the preparation of PPC is its low cost and high efficiency.

In the process of carrying out a complex of studies to improve the compatibility of different pairs of individual polymers, a new type of compatibilizer, the pitch-thermoplsatic, was proposed. It allowed obtaining of technologically compatible polymer compositions based on incompatible polymers such as ABC and PP.

PREPARATION OF COPPER-CONTAINING NANOPARTICLES IN POLYETHYLENE MATRIX WITHOUT USE OF SOLVENTS

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One of the perspective directions in a science of the polymers and material science of last years is the development of principles of preparation of the polymer nanocomposites, which are the newest type of functional materials and can be used in very various spheres of application.

The known thermal method of preparation of the nanoparticles based on decomposition of salts of the organic acids or metal-organic compounds (method “klaspol”) in a medium of polymer – simple, it can be done in usual thermostable glass flask at t=300-350°C, however, it is used a large quantity of solvent, a yield of nanocomposite is low. Vacuum oil (VM-1) is used as a solvent. The prepared samples are separated from oil with multiple washing by benzene [1,2].

This work has been devoted to the preparation of copper-containing nanoparticles in polyethylene matrix without use of solvents by decomposition of salts of the organic acids in a medium of polymer in the conditions of high shear deformations and investigation of properties of the prepared nanocomposite.

By a method of high-speed thermal decomposition of the metal-organic compounds in the conditions of shear deformations there have been prepared the copper nanoparticles in matrix of polyethylene of high pressure in two stages. At the first stage at temperature 130-140°C on laboratory rolls it was made the binary mixture of polymer and precursor. At the second stage the mixture was heated in microextruder “Brabender” in a medium of nitrogen at temperature 170-190°C for 10-12 min. The copper formate dehydrate $Cu(HCOO)_2 \cdot 2H_2O$ was used as a precursor

The phase composition of the prepared nanocomposite was used by X-ray structure analysis on diffractometer of wide purpose “PANlytical Empyrean”. The phase identification was carried out on data of interplanar spaces with use of card file ASTM. It has been shown that in the investigated nanocomposites the reflections form planes of metal crystal lattice corresponding on card file ASTM in a series of d_{hkl} of copper oxide I (Cu_2O) were observed.

Microphotographies of the prepared nanocomposite evidence about formation of layer structures, which possess high viscosity destruction [3].

The prepared composites containing nanoparticles of copper oxide can be used as the catalysts of organic and petrochemical synthesis, adsorbents for water purification and also modifying agents of the industrial polymers with the aim of improvement of their operational properties.

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STAR-LIKE POLY(N-ISOPROPYLACRYLAMIDE): SYNTHESIS, CHARACTERIZATION AND PROSPECT FOR BIOMEDICAL APPLICATION

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In the recent years stimuli responsible polymers base on poly(N-isopropylacrylamide) (PNIPAM) with lower critical solution temperature (LCST) become a subject of study as a promising polymer for fabrication of the nanocomposites for biomedical application. PNIPAM has a lower critical solution temperature (LCST) around 32°C, it is close to the body temperature. Stimuli responsible polymers based on poly(N-isopropylacrylamide) is discussed as promising approach to novel drug delivery nanosystems fabrication.

Two star-like copolymers with dextran core and grafted poly(N-isopropylacrylamide) arms were synthesized and characterized by size exclusion chromatography equipped with light scattering, refractometry and viscometry detectors. The copolymers differed in the distance between grafts, that caused various conformation of poly(N-isopropylacrylamide in star-like macromolecule. The influence of the polymer internal structure on the conformational transition temperature range has been studied by Quasi Elastic Light Scattering. It was shown that the thermally induced collapse of end-grafted poly(N-isopropylacrylamide) chains above the Lower Critical Solution Temperature was depended on the grafting density.

Star-like copolymer with dextran core and grafted poly(N-isopropylacrylamide) arms (D-g-PNIPAM) was used as matrix for silver sols preparation. The comparative study of behaviour of individual D-g-PNIPAM and system D-g-PNIPAM/embedded silver nanoparticles in the temperature range near lower critical solution temperature (LCST) has been done by UV-vis, DLS, TEM. It was shown that the thermally induced collapse of end-grafted poly(N-isopropylacrylamide) chains above the LCST doesn't affect the size characteristics of silver nanoparticles in the sols.

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ANTIBIOCORROSIVE COVERS BASED ON MODIFIED INDUSTRIAL ORGANIC POLYMERS AND VARIOUS BIOACTIVE COMPOUNDS

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The aggressive microorganisms have adverse effects on the environment and human. Many man-made materials, polymers and cultural heritage are susceptible to attack of microorganisms in the environment leading to product failure. Hence, the development of advanced inorganicorganic antimicrobial hybrid materials and protective covers is a highly-desired objective.

For obtaining of inorganic-organic hybrid antimicrobial composition and antibiocorrosive covers with specific properties as bioactive components we chose macro dispersed bioactive inorganic compounds (possibly bioactive metal micro dispersed particles, such as Ag and ZnO), also non-volatile stable compounds, containing ferrocene, carbocyclic fragments and some of biogenic d-metals simultaneously.

As polymer matrices, we used industrial polymers (polyepoxides, polyurethanes) modified by functional silicon-organic oligomers and functionalized fluorine-containing polymers.

Thermo-physical properties of the obtained matrices and covers we studied by TGA, DTA and DSC methods. It was established that by modification of polymeric matrices their elasticity, tribological properties and hydrophobicity, photo- and isothermal aging resistance was improved.

It was established that the obtained composites and covers:

- are characterized by a good fixation on various synthetic and natural materials, as well as on museum exhibits;
- do not violate wholeness of samples during hardening and exploiting of the covers;
- in thin films are transparent and almost do not change the color during their aging;
- have enough strength and stable mechanical characteristics (they do not scratched easily and do not change relief of the surface) and are characterized with high hydrophobicity (<0.3%), typical for such materials;
- are not dangerous for human; during the exploitation they do not produce harmful gases; they are relatively cheap and available.
- are visual-ultraviolet radiation, thermal aging and moisture resistant.

Acknowledgements. Authors would like to thank the Shota Rustaveli National Science Foundation of Georgia and international “Fulbright” foundation for financial support one of authors (Dr. Kh. Barbakadze).

TECHNOLOGICAL PECULIARITIES OF THE OBTAINING THE EPOXY-AMINE COMPOSITES WITH SUPPRESSED COMBUSTIBILITY

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At the present time, the polymer composite materials on the basis of epoxy resins hold much promise and competitiveness. Wide application of the epoxy polymer materials in different areas of industry is specified by a whole spectrum of enhanced properties. Nevertheless, the high growth rates of industrial production are constantly putting forward new claims to the quality to the composite materials to provide the high operating characteristics of goods on their base. The using the already known and prevalent epoxy composites are not able to provide the polymer materials by indispensable properties to the full. In many cases the limited utilizing the polymer matrix on the basis of epoxy composites is specified by insufficient thermal stability, flame resistance and augmented fire risk.

That is why, the making the scientifically well-grounded approaches for the elaborating the new modified epoxy-composites and the efficient technology of the preparing the fire-safe materials on their basis is the vitally important necessity. It foresee the searching the new chemical agents which would be able not only to efficiently suppress the combustibility of the epoxy-amine composites, to well combine with polymer, not to worsen the physical-mechanical properties of materials, but also to be nontoxic, accessible and relatively cheap. Whereupon, the fire-retardant influence onto the technological peculiarities of the obtaining the composite material and its remaking into goods must be taken into consideration.

The elaborated available synthesis method of the epoxy-amine composites with suppressed combustibility provides for the using the copper(II) chelate complexes as a fire retardant-hardener for the epoxy *diane* oligomers. The copper(II) chelate complexes have been obtained by means of crystallizing the mixture of amine curing agent of epoxy resins – *polyethylene-polyamine* and of inorganic cupric salt. The synthesized fire retardant-hardeners do not need an after-treatment, purification or dehydration and practically not influence onto composites shelf life. The obtained composites survive fluidity over a period of 3 h.

The final curing the epoxy-amine composites in chelate complexes presence has been happened during 24 h. at room temperature. It is necessary to note that after adding the crystalline complexes the epoxy-amine composites acquire dark-blue or green-blue color.

The introduced method provides for the obtaining the structurally homogeneous, surface-glace and aesthetically attractive materials.

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THE INFLUENCE OF THE CONCENTRATION OF MOLIBDATE IONS DURING THEIR ELECTROREDUCTION FROM THE TARTARIC ACID ELECTROLYTES

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The actual problems of the modern material science are to work out methods to obtain thin-layered films of alloys of bicomponent chemical compounds. So, the aim of our research is to obtain thin semiconductive films of MoS_2 with photoelectrochemical properties using their electrochemical deposition from electrolyte of tartaric acid.

There are a great number of works on the electrochemical deposition of thin films of these chemical compounds. For obtaining of thin semiconductive films it is necessary, at first, to learn the mechanism of electrochemical deposition of components separately. Based on this, we learned electrochemical reduction of tartaric acid in presence of Pt electrode.

According to polarization curves, we can say that electrochemical reduction of molibdate ions is two stage reduction within 0,35 – (-0,2) V potentials.

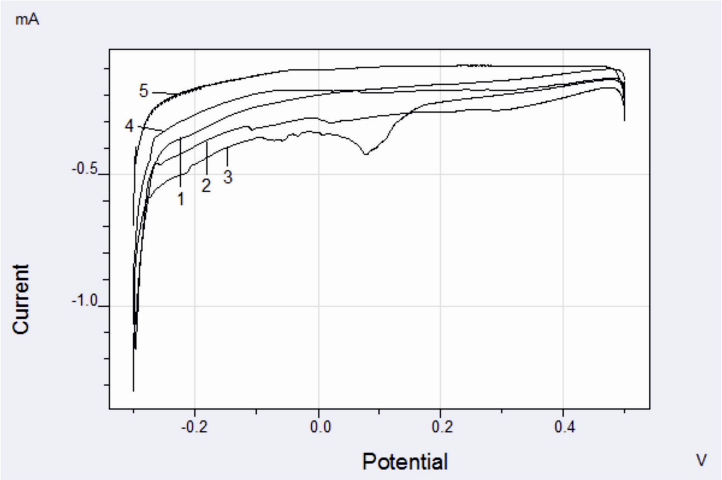

Figure 1. The influence of the concentration of molibdate ions to electroreduction process. Electrolyte (mol/L): Na_2MoO_4 + 0,007 $C_4H_6O_6$. 1-0,1; 2- 0,2; 3- 0,3; 4- 0,4; 5- 0,5.

The effect of the different factors to electroreduction process has been also investigated. The influence of the concentration of molibdate ions to process has been learned within 0,1-0,5mol/L concentration, and takes place in a different way. In the first step the influence of concentration was regular, more precisely, with increasing of concentration of ions electrochemical reduction occurs in more positive potentials that we cannot say the same about higher concentrations. Within these intervals, the rebound of potential to negative site is observed.

We think, it is connected with the fact that, in high concentrations the molibdate ions form more stable complex with tartaric acid. Thus, their further dissociation becomes harder. Therefore, we chose 0,2 mol/L concentrations of molibdate ions for optimal option.

INVESTIGATION OF COMPLEX FORMATION PROCESS OF CADMIUM WITH MACROMOLECULAR SUBSTANCES, ISOLATED FROM NATURAL WATERS

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Natural macromolecular substances: humin and fulvic acids have functional groups and that's why they take an active part in complex formation and sorption processes and stipulate migration forms of toxic metals.

Objective of the work was to obtain pure samples of fulvic acids, to study complex formation process between cadmium and fulvic acids at various pH by the gel chromatographic method and to calculate conditional stability constants of fulvate complexes. Taking into consideration an average molecular weight of fulvic acids, for the optimal determination was used sephadex G-25 (the limits of Fractionating100–5000).

The main solution of fulvic complexes were obtained by the solubility method. $Cd(OH)_2$–FA-H_2O, pH=8, μ = 0.01(KNO_3). Obtained main solutions of fulvic complexes were devided into 4 parts, which differs from each other, only with the value of pH (9,02; 8,00; 6,03; 5,01). Complex formation process of fulvic complexes with cadmium was studied at various pH by the gel filtration method. 2-2ml aliquots of solutions with various pH were taken and put one the top of the gelchromotographic column. Eluation process was done with the bidistilled water, which had the same pH as the solution.

Take into consideration data of gelfiltration, was determined the quantity of metals connected with the fulvic acids, in such fractions which releasing volumes fits the substances with molecular weight 300≤ Mw>5000.

On the basis of experimental data was calculated the stability constants of fulvic complexes by the (1) equation

$$\beta = [\sum_{Me} - C'_{Me}]/\{[C'_{Me}][FA]\} = [C''_{Me}]/\{[C'_{Me}][FA^{2-}]\} \qquad (1)$$

$C'_{Me} = \sum_{Me} - C''_{Me}$ (2) და $[FA] = C_{FA} - C''_{Me}$ (3).

where C'_{Me}- the quantity of metal which was not involved in the complex mole/L $\sum_{Me}$ – the total quantity of metal in main solution.mole/LC''_{Me} – the quantity of metal,connected with fulvic acids (determined fractions 300≤ Mw>500 mol/L [FA]–free ligand mole/L; C_{FA} –the total quantity in the system mole/L. Number values of Conditional stability constants of cadmium fulvate complexes at various pH are: pH=9 β =1,5x10^4; pH=8 β= 8,8x10^3; pH 6 β= 4,5x10^3; pH 5 β= 1,1x10^3.

Obtained data could be successfully used for evaluation the role of geopolymers in complex formation processess proceeding in all types, groups and class of natural waters.

The work was done by supporting the World Federation of Scientists and the World Laboratory.

MAGNETIC POLYETHERIMIDE NANOCOMPOSITES FOR CO(II) REMOVAL

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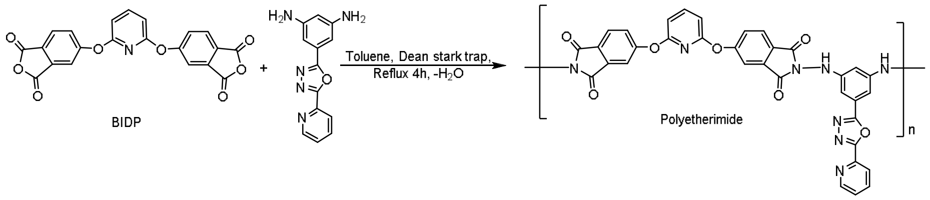
In this work, we wish to report the synthesis and characterization of an aromatic dianhydride monomer, 2,6-bis-(isobenzofuran-1,3-dione-5-yl)pyridine (BIDP), containing two pyridine moieties and ether linkages. The polyetherimide obtained from the reaction of BIDP and 2-(5-(3,5-diaminophenyl)-1,3,4-oxadiazole-2-yl)pyridine (POBD) was used for removal of Co(II) cations from aqueous solutions. The metal coordination ability of the 2-pyridyl group adjacent to the 1,3,4-oxadiazole ring was noted in designing POBD [1-2], Scheme 1.



Scheme 1. Synthesis of the polyether imide using BIDP and POBD.

Among different nanoparticles MNPs are widely studied and have found their way into various domains [3-4]. On the other hand, removing harmful heavy metal ions from industrial effluent is one of the most important challenges focused on by many researchers [5]. Spherical or ellipsoidal magnetic nanoparticles (MNP) of about 15 nm diameters were prepared through coprecipitation method and then coated with γ-glycidoxypropyl triethoxysilane (GPTES). Magnetic polyetherimide nanocomposites (MCN) were prepared from solution blending process of the polyetherimide obtained from BIDP/POBD and different amount of GPTES-modified MNPs. Structure and morphology of the nanocomposites were investigated by FT-IR, X-ray diffraction (XRD). Various factors influencing adsorption capacity such as pH, contact time, absorbent dosage and initial Co(II) concentration were investigated. Results obtained from optimization of pH showed that the nanocomposite containing 25 wt.% of GPTES-modified MNPs (MCN 25 wt.%) has the maximum adsorption capacity (Q_t= 0.4 mg/g). It was observed that the adsorption kinetics of Co(II) followed a pseudo–second-order kinetics with correlation coefficient of R^2 = 0.995. The adsorption equilibrium data obeyed Langmuir isotherm than by Freundlich with correlation coefficient of R^2 =0.963. The thermodynamic parameters were also obtained (ΔG = -2.96 kj/mol; ΔH = 19.63 kj/mol; ΔS = 75.80 j/mol). The average extraction efficiency (*E%*) of the four consecutive runs is 85.2%, meaning that the sorbent was recovered by 92.6% after four cycles.

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POLYMER COMPOSITES ON THE BASIS OF EPOXY RESIN AND MODIFIED MINERALS

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The composites on the basis of Diane epoxy resin and fine dispersive modified with liquid glass (LG) andesite, diatomite and bentonite have been obtained. High temperature (up to 160°C) condensation reaction between mineral fillers and LG was carried out in toluene solution. The concentration of powder fillers with average diameter up to 50 micron was changed in the range 10-60 mass %.

The dependence of ultimate strength on the content of filler (both for modified and unmodified) has an extreme character with maximums depending on the filler type. However, these maximums for the composites with modified fillers are higher in comparison with ones containing unmodified fillers; e.g. the ultimate strength for composite with about 35wt% diatomite modified with 5wt% LG is 70 MPa, while for analog composite with unmodified same filler at same concentration is near 50MPa. The modified composites show also higher thermal stability than their unmodified analogues (this parameter for composite with 30wt% andesite of modified by 5wt% of LG is 4-times better than unmodified analog). Effect of modifier on the investigated polymer composites reveals in the water absorption too - hydrophobicity of the composites containing the modified filler is better than for the same material with unmodified filler (this parameter for the composite with 50wt % diatomite nearly 2-times better in comparison with it analog containing unmodified analog).

Improvements in properties is observed in case of composites with binary fillers. For example, the ultimate strength of composite containing modified by 5wt% fillers diatomite and andesite at ratio 20/30(full concentration of fillers 50wt%) is about100 MPa, while unmodified analog -80Mpa. In this case so called synergistic effect (non-additive change of some properties of composites at definite ratio of two or more filler concentrations) arises.

The obtained experimental results are explained in terms of composite structure peculiarities. LG molecules displaced on the surface of the filler particles participate in chemical reactions between active groups (hydroxyl) on the surface of LG and polymer (epoxy group). It molecules create the “buffer” zones between filler and the polymer. This phenomenon may be one of the reasons of increasing of strengthening and other physical properties of composites in comparison with analogues containing the same but unmodified fillers. The composites with modified filler display more high compatibility of the components than in case of analogues with unmodified filler. So, modify agent stipulates the formation of heterogeneous structures with higher compatibility of ingredients and consequently enhances the noted above technical characteristics.

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THE SELF CONDENSATION REACTION OF N,N' –BIS(4'-AMINOPHENYL)-1,4-BENZOQUINONE DIIMINE AND INVESTIGATION OF STRUCTURE AND ELECTRIC PROPERTIES OF SYNTHESIZED AND DOPED WITH IODINE COMPOUND

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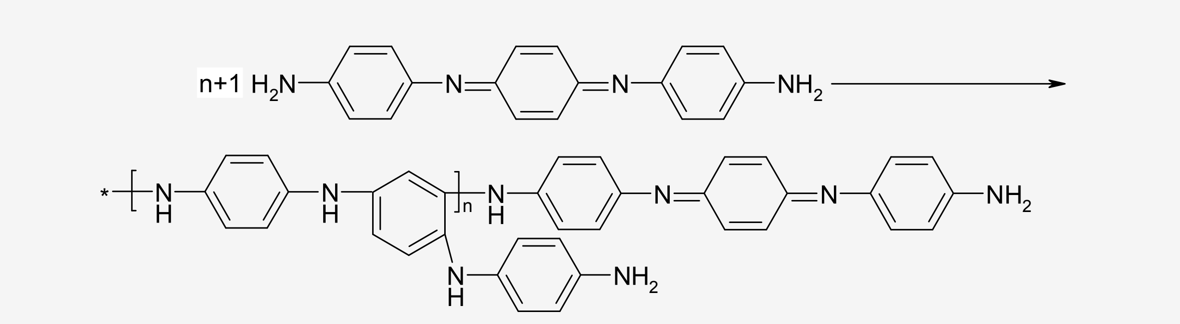
Polyaniline and polymers obtained from aromatic amines have a special place among electroactive polymers due to their environmental stability and unique properties [1,2]. We have worked out a new and useful method of synthesizing N,N′-disubstituted quinonediimines using oxidative condensation of p-phenylenediamine(PPDA) in organic medium and particularly, N,N' –bis(4'-aminophenyl)-1,4-benzoquinone diimine was the main product of the condensation of PPDA using molar ratio PPDA/potassium peroxydisulphate 4:1. It was found that with heating the terminal amino and quinine diimine groups of different N,N' –bis(4'-aminophenyl)-1,4-benzoquinone diimine molecules reacted. This is self condensation reaction, which proceeds according to scheme which leads to the formation of oligomers and polymers depending on the heating time.



Obtained compound was oxidized by potassium persulphate. UV, PMR and IR spectral methods we used to prove the structure of obtained compounds. Electric conductivities and conductivity activation energies of both as synthesized and doped with iodine compounds were determined.

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ORGANOSILICONE BLOCK-COPOLYMERS WITH RIGID AND FLEXIBLE FRAGMENTS

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Organosilicon block copolymers (BCs) have recently received widespread attention [1]. There is information about organosilicon BCs with a cyclolinear structure of the macromolecules [2]. From A*mBn* type cyclolinear organosilicon BCs there are systems containing rigid silarylene-cyclosiloxane, ladder fragments and BCs with rigid bead-like fragments containing polymers in the main dimethylsiloxane chain.

From literature it's known, that introduction of cyclic fragments in dimethylsiloxane chain is resulted in variation of the spiral-shaped structure of dimethylsiloxane polymers, which causes variation of their physical and chemical properties [3].

The aim of our work is synthesis and investigation of properties of block-copolymers containing silarylene-cyclosiloxane-dimethylsiloxane fragments in the main chain. The BCs have been synthesized via heteofunctional condensation reactions of pleminiraly synthesized dihydroxy group containing rigid silarylene-cyclosiloxane blocks with α,ω-dichloro-[bis(dimethylamino)dimethylsiloxane oligomers.

Synthesized BCs have been investigated via FTIR spectroscopy, diferential scanning calorimetry, gel-permeation chromatography and wide angle X-ray reontgenographic analyzes.

Via diferential scanning calorimetry and wide angle X-ray reontgenographic analyzes it was shown that the phase incopatibility in BCs is connected with the lengths of the rigid and flexible blocks. By DSC method it was shown that at a small values of flexible dimethylsiloxane chain the copolymers are one phase systems with the only one transition temperature $T_{melt}=90\div100\ ^{o}C$. With an increase of the length of dimethylsiloxane chain on the DSC thermograms additionaly appears two glass transition temperature for rigid and flexible blocks and two melting temperature for flexible and rigid blocks.

The phase incompitibility of BCs one can see during wide angle X-ray reontgenographic investigations. Here also phase incompatibility takes place at high values of flexible dimethylsiloxane chains.

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SOL-GEL PROCESSING OF PRECURSOR FOR SYNTHESIS OF MERCURY-BASED SUPERCONDUCTORS

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Formation of the Hg-based superconducting materials critically depends on the used precursor and synthesis conditions. Using the wet chemistry offers some advantages in comparison with the classical solid-state ceramics processing, especially, better chemical homogeneity and higher reactivity of the precursor powder. On this basis the influence of $Ba_2Ca_2Cu_3O_x$ precursor on the synthesis and properties of Hg-based superconductors has been examined. $HgBa_2Ca_2Cu_3O_y$ superconducting samples were prepared by a two-step method. In the first step, was prepared Ba:Ca:Cu=2:2:3 multiphase ceramic precursors, for comparisons two methods we synthesized precursors by sol-gel method (SG) using ε-Caprolactam and as well as ordinary solid-state reaction method (SSR). In second step on both samples HgO was added and finale synthesis of $HgBa_2Ca_2Cu_3O_y$ was carried out in a sealed quartz tube.

We note that for both methods, starting materials was used powders materials (Sigma-Aldrich) of BaO (99.98%), $CaCO_3$ (99.0%) and CuO (99.999%). The synthesis of a precursor by the sol-gel method was used ε-Caprolactam (99%) as a complexing agent.

The prepared patterns were characterized by X-ray diffraction (XRD, Dron-3M) with CuKa radiation. Ac susceptibility and high harmonic response of samples are measured in weak *ac* and *dc* magnetic fields. As a result, we could conclude that, in comparison with SSR in SG sample we found highest value of the transport critical current densities J_c.

Acknowledgment**s.** This work was supported by Shota Rustaveli National Science Foundation (SRNSF), grant number: 217524, Project title: Influence of the polymerization and various dopants on the Hg-1223 superconductive properties.

INVESTIGATION OF THE REACTION OF POLY(1.4-BENZOQUINONEDIIMINE-*N,N´*-DIYL-1,4-PHENYLENE) WITH HYDRAZINE

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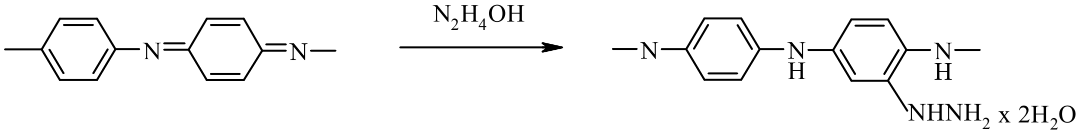
Poly(1.4-benzoquinonediimine-N,N’-diyl-1,4-phenylene) (PBQIP) was synthesized by new one-step method based on the oxidative condensation of p-phenylenediamine with potassium persulphate in organic medium [1].

It is known, that pernigraniline type polymers could be reduced to other forms of polyaniline - leucoemeraldine and emeraldine. We carry out the reduction of PBQIP by hydrazine hydrate being the commonly used reducing agent for the reduction of emeraldine [2]. According to UV spectroscopic data all quinonediimine groups were converted to aminophenyleneaniline groups under the action of hydrazine hydrate.

Obtained polymer was oxidized aiming to obtain polymer with analogous to emeraldine structure. However, the conductivity of obtained polymer after doping with 3 N hydrochloric acid was only 1.3×10^{-7} S/cm. Therefore leucoemeraldine was not formed as a result of reduction of PBQIP. To elucidate the causes of obtained data the reaction of model compound N,N'–bis(4'-aminophenyl)-1,4-benzoquinonediimine with hydrazine hydrate was investigated as well. According to 1H NMR data 1,4- addition of hydrazine to quinonediimine groups occurs rather than reduction.



Obtained polymer (compound 1) has been doped with different molar ratio of 0.23 N J_2 solution. We studied the dependence of electrical conductivities of PBQIP and compound 1 upon doping level with iodine. On both cases, as doping level was increased, the increase in conductivities was observed. According to obtained data doping level in all cases is higher for compound 1. It can be deduced, that the treatment of compound 1 powder with iodine involves its oxidation according to the following scheme. Conductivities of doped compound 1 samples measured at room temperature on the next day after heating to 358 K increases.When doping the PBQIP and compound 1 with iodine, the electrical conductivity of the polymer increases from $<10^{-10}$ to 5×10^{-5} S/cm and from $<10^{-10}$ to 5.7×10^{-4} S/cm, correspondingly.

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Abstract

NEW TECHNICAL ACCESS FOR CREATION OF GRADUALLY ORIENTED POLYMERS

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One of the actual directions of modern polymer science is creation and research of graded materials with different (mechanical, optical, electrical, magnetic, etc.) properties. There are different methods of receiving such materials. We have developed and patented the original technical solution for obtaining graded polymer and composite materials, according to which the creation of gradient of properties is conditioned by graded orientation of isotropic materials. Graded orientation is created using specific devices. The improvement of the technical characteristics of these devices significantly contributes to the development of graded material science.

The constriction of the add-on device is proposed that allows to carry out of graded orientation in combination of add-on device with any standard stretching machine.

A mathematical model of graded orientation of polymer materials is developed, which enables to work out polymer materials with preset dimensions and distribution of relative elongation.

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CHITOSAN-COATED TiO_2 LAYERS FOR BIOMEDICAL APPLICATIONS

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Due to their good biocompatibility and corrosion resistance, titanium and its alloys have drawn scientists' attention as potential implantable materials. In order to reduce the time of the process of chemical bonding between the implant and bone, it is possible to create the TiO_2 layers prior to implantation surgeries. One of the commonly used methods to coat the titanium with the oxide layer is anodization. The formed nanoporous anodic titanium oxide (ATO) layer not only improves the osteoblast cell adhesion, but also can be used as a drug delivery system for nonsteroidal anti-inflammatory drugs (e.g., ibuprofen) [1]. Moreover, ATOs possess apatite-forming abilities which cause them to be attractive materials in biomedicine. The nanoporous TiO_2 can be coated with biocompatible polymers, such as chitosan. Chitosan has antibacterial and osteointegration properties. In addition, the polymeric coating reduces the burst release of drugs and extends overall release [2].

Nanoporous TiO_2 layers were prepared via a three-step anodization process in an ethylene glycol electrolyte containing 0.38 wt.% NH_4F and 1.79 wt.% H_2O at the constant temperature of 20 ºC. In order to change the crystallographic structure of the as-anodized amorphous samples, the layers were annealed in air at 400 and 600 ºC. Consequently, the anatase and a mixture of anatase and rutile phases were obtained, respectively.

The samples were coated with chitosan applying the dip-coating process. Polymer solution of chitosan (1% (w/v), chitosan + 0.8% (v/v) acetic acid + distilled water) was prepared. 100 μl of the polymer solution was pipetted onto the anodic TiO_2 layers. Then, the samples were dried in an oven at 70 °C. The procedure was repeated five times. The modified TiO_2 layers were studied as potential drug delivery systems. Ibuprofen, a nonsteroidal anti-inflammatory drug, was loaded inside nanopores before the formation of chitosan coatings. 1 ml of ibuprofen solution was pipetted onto the ATO surface and the samples were dried in the air at room temperature. The loading procedure was repeated five times. The release studies were carried out in a 0.01 M phosphate buffer solution (PBS, pH = 7.4) at 37 °C. The drug concentration was determined using UV-Vis spectrophotometry. A desorption-desorption-diffusion model of the drug release was fitted to the resulting profiles. The apatite-forming ability of chitosan-coated nanoporous anodic titanium dioxide layers were examined in simulated body fluid (SBF). In order to form hydroxyapatite on ATO surfaces, the samples were soaked in SBF for 1, 3, 5, 7, 14 and 21 days. Afterwards, ATO layers were washed gently with distilled water. The growth of calcium phosphate crystals on anodic TiO_2 was characterized by Scanning Electron Microscopy (SEM) and EDX spectrometry.

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NEW FUNCTIONALIZED POLYESTERS FOR COATING MAGNETIC NANOPARTICLES

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Biodegradable and biocompatible polyesters derived from lactide, glycolide, and ε-caprolactone are known as key materials for biomedical applications [1]. However, the parent homopolymers have limitations. For example, they are often too hydrophobic for applications in aqueous environments, and more importantly, they lack chemical functionality that enables modification of the polymer backbone. Known strategies to polyesters involve multistep monomer syntheses, provide a narrow range of functional groups, and offer limited flexibility in changing the polymer composition. It is highly required to have monomers that allow after polymerization facile placement of a broad spectrum of pendant functional groups onto polyester without unwanted backbone degradation. Furthermore, such polyesters should be compatible with a wide range of functional groups, solvents, and conditions [2-4].

In our work, we were interested in developing new polyesters, which have already attached reactive function, offering later on the possibility of further functionalization of the polymer chain. We report the synthesis and characterization of two new different polymers which are containing in the side chain the allyl group which is used for achieving new functionalized polymers. The prepared polymers were used further in achieving functionalized polymers and in surface modification of magnetic nanoparticles. The functionalization of the magnetic nanostructures was completed using the thiol-ene reaction. The polymers were structurally investigated by NMR, FTIR, TGA and mass spectrometry. The properties of the resulting magnetic nanostructures were investigated by TEM, FTIR-spectroscopy, TGA and magnetization measurements.

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THE POLYMERS CREEPING DEPENDENCE FROM THE ENVIRONMENT

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It's known that the polymers change more in the liquid environment than in air in the same tensity. This fact is mentioned in some works [1-3]. But data which explains the creeping raise in polymers, which are under the constant tensity, they are very few with temperature's and concentration wide range in the aggressive environment.

It's also known that environment acts unimportant to the delay time, but acts more to the high elastic deformation maximum meaning.

So, to explain the creeping it's enough to find the quantity connection with the maximum high elastic deformation and between system polymer-environment parameter.

Table 1
The delay time, in the polymer water during creeping in the different temperature and tensity condition

Polymer	ℓ, mcm	T, °C	σ, MPA	Q, min
Polyethylene terephthalate	20	25	100 200	2,8 2,8
		40	100 200	2,2 1,4
		60	100 200	1,7 1,7
Polycaproamide	45	25	80 38 15	1,8 1,9 2,8
		80	80 38 15	1,7 2,2 2,8
Polyacrylate F-2	20	20 40 60 80	80	4,8 3,6 3,3 2,6

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THE POLYMERS CREEPING INTO THEM DURING THE WATER DIFFUSION

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Water diffusion in the polymers is the wide spread research subject. For example, in the polyethylene terephthalate, polyethylene and polycaproamides water diffusion data are given in the works [1. p. 259]. If water diffusion speed is more than polymers air creeping speed – in the polymer, in this case liquid 'll fill accessible districts in the polymers matrix and there will be liquid saturated polymers creeping. Such condition happens the polymers majority thin films in the water. We'll discuss the water diffusion regularity in the researched polymers. In the table is given the water diffusion ratio meanings in the polymers.

Table 1

Water diffusion ratio meanings in the polymers 25 °C.

Polymer	$Dc=10^9\ cm^2/sec$	E, KCal/mole
Polyethylene terephthalate	3,9	10,4
high pressure		
Polyethylene (d=0,922)	230	14,2
Polycaproamide	1	6,5

For the polycaproamides with experiments defined D_{H2O} meaning is depending on the water concentration in the polymer [2] and marginal sorption equal water concentration $D_{H2O}=3\cdot10^{-8}$ cm^2/sec. The polyethylene terephthalate and the polyethylene D_{H2O} meanings are not connected to the water concentration in the polymers. The polyarylate F-2 water diffusion ratio meaning is not known in the literature and is determined by us. The done experiments show that the polymers thin films creeping whole speed in the liquid area is limited in the polymer by water diffusion caused processes.

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OBTAINING AND INVESTIGATION OF COMPOSITES BASED ON SOME ORGANIC/ INORGANIC BINDERS AND SAWDUST

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Primary goal of the presented work is obtaining of new wood polymeric composites (WPC) on the basis of high dispersive sawdust powders and ecologically friendly organic binders. Phenylethoxysiloxane of two types (PhES-50 and PhES-80), polyethylene and liquid glass were used as binders, concentrations of which varied in region 3-15 wt%. Composites were prepared with use of standard hot pressing method at definite temperatures and pressures during 10 min. Analysis of Fourier transform infrared (FTIR) spectroscopy data of the composites allows express an opinion about formation of the some chemical bonds in result of reaction between active groups on the sawdust surface and different binders. The mechanical properties (bending strength, impact viscosity) of the composites essentially depend both on filler concentration and technological regime (temperature, pressure) of obtaining of these materials. Experimentally it is shown that under conditions of temperature 170-180°C and pressure 15 MPa during 10 min there are formatted the composites with relatively best mechanical properties. The data of dependence of the softening on the temperature are in accordance with mechanical properties (the higher strength the higher is thermal stability of the composites). It is shown that mechanical and thermal properties of the composites containing more dispersive fillers have higher technical characteristics in comparison with analogues with less dispersed fillers. The value of the water absorption for the most composites has negative sign, which is probably due to elution of some low molecular products formed after chemical reactions between phases in the composites.

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SILICA - POLYMER SORBENTS FOR HPLC

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The development of new methods for the synthesis of packing materials for chromatogramphy with the goal of improving its structure and its chromatographic parameters always was and remains significant to the present day. Most often, researchers turn to the different means of modification of the surface of already existing chromatographic systems.

Problems of the modification of the surface of silica gel with layers of polymer and the influence of the quantity of the coated polymer on the chromatographic properties of the resulting sorbents have been considered. Problems of the modification of the surface of silica gel with layers of polymer and the influence of the quantity of the coated polymer on the chromatographic properties of the resulting sorbents have been considered. The polymer modification of the surface of wide-pore silica gel obtained by means of hydrothermal treatment of the meso-porous silica gel under autoclave conditions is descrybed. The polymer layer itself is formed by an octadecylmethacrylate-methylmethacrylate copolymer. As a result, packings for reversed-phase high-performance liquid chromatography (RP-HPLC) were obtained. Polymers can be designed in a wide variety of properties and therefore deliver solutions to specific chromatographic problems. Thus, tailor-made polymer coatings are an alternative to the classical bonded stationary phases. Polymer modification is one of the methods for the elimination of the disadvantages of silica packings (narrow working pH range and “silanol” interactions).

The possibility of varying the pore characteristics of packing materials by means of polymer coatings can be regarded as an important peculiarity of this technique. It is impossible to change the pore characteristics of the initial porous material by classical modification methods (C_8, C_{18}, bonding etc.) since the quantity of the grafted phase is dictated by the properties of the sorbent itself (first of all by its specific surface area). The influence of the modification on the pore structure and the chromatographic properties of the obtained systems is very important in the modification of porous systems with various modifiers, particularly with polymers. The knowledge of the character of these changes will help to select a suitable initial porous material.

THE CHARACTER OF THE ANTIBACTERIAL SPECTRUM OF TRICYALIC, NON-SELECTIVE AND SELECTIVE, ANTIDEPRESSANTS OF DIFFERENT CHEMICAL COMPOSITION

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The aim of the present investigation was to study the antibacterial spectrum of different generation tricyclic, non-selective and selective, antidepressants. The problem is actual because unlimited receive of common antimicrobial agents, which people frequently apply arbitrarily, contributed to the development of "antibiotic resistance" and new infectious diseases. Because of this, the effectiveness of a wide range of antibiotics, anti-microbial infection protective agents, gradually decreases, while their toxic side effects rise up. That is why the search for the antimicrobial activity of various pharmacologically active drugs has been initiated and research of their effects on clinical isolation of many drug-resistance bacteria and resistance to many antibiotics was started more than two decades ago (Cederlund, Mårdh 1993; Hendricks et. al. 2005; Jeyaseeli et. al. 2006). Antibacterial influence of antidepressants of different chemical composition on the growth and development of *Escherichia coli, Bacillus subtilis, Staphylococcus aureus* and *Mycobacterium phlei* is not studied carefully and therefore needs new research.

Following Microorganisms were used as test cultures: *Escherichia coli, Bacillus subtilis, Staphylococcus aureus and Mycobacterium phlei.* A third generation tricyclic antidepressant, non-selective inhibitor of mononamines' re-uptake, Melipramine, (0.1; 0.01 and 1 g/L) and recent generation tricyclic antidepressant, selective inhibitor of serotonin re-uptake, Fluoxetine (0.01; 0.1 and 1 g/L) were used for the studdying of antibacterial spectrum.

It turned out that only Fluoxetine exerts the suppressive action on the growth and development of test-objects (the size of the suppression area is 3.0-5.5 mm). In addition, the quality of antimicrobial activity is different for the studied test-objects. In particular, Fluoxetine exerts relatively high activity on the *B.subtilis* and *M.phlei* (5.5 mm and 5.0 mm in the suppression area), and relatively low activity on the *E.coli* and *St. Aureus* (the suppression zone is 3.0 mm). The antibacterial effect of Fluoxetine reveals dose-dependent character. In particular, 0.01 and 0.1 g/l concentrations of Fluoxetine do not show antibacterial action, the effect reveals only at 1 g/l concentration of antidepressant. It is noteworthy that Melipramine does not show the suppressive action on the growth and development of test-objects at all, despite the concentration used.

Thus, the study of antibacterial spectrum of tricyclic, non-selective and selective, antidepressants of different chemical composition showed that only the last generation tricyclic drug, selective inhibitor of serotonin re-uptake, fluoxetine reveals antibacterial action on the growth-development of *Escherichia coli, Bacillus subtilis, Staphylococcus aureus* and *Mycobacterium phlei*.

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BRANCHED POLYURETHANES BASED ON SYNTHETIC POLYHYDROXYBUTYRATE

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Polyurethanes are very interesting class of polymers. Because of their wide application in different fields of human life (both in medicine and in the building, furniture, textile, automobile and packaging industry) they are produced in huge amounts (about 3.7 Mtonne [1]), and in consequence the very large amounts of used products, containing polyurethanes, can be found at the garbage dumps. One of the ideas to solve this problem is the introduction into market materials with the controlled degradation profile. Dependently on type of application the rate of polymer degradation can be very fast (e.g. as the absorbable drug carriers [2]) or very slow, when degradation should occurs only after a finite period of use of the product. Increasing of polyurethane materials degradability can be achieved by introducing of hydrolysable moieties (such as ester moieties) into their structure or blending with degradable particles, such as chitosan. Interaction between the polyurethane matrix and chitosan can be modified with the addition of montmorillonite.

Polyurethane with soft segments built with polycaprolactone diol, synthetic poly([R,S]-3-hydroxybutyrate) and polycaprolactone triol (as a branching agent) was synthetized (according to procedure described in [3]) and next modified with chitosan and additionally with montmorillonite.

This branched polyurethane appeared as easy soluble in organic solvents (dimethylformamide, toluene, acetone, ethanol and chloroform). Blending the polyurethane with chitosan and montmorillonite increased the sorption of water and decreased oil sorption. The obtained samples had a low permeability to water vapor.

Microbiological studies, designed to determination of biostatic properties of polyurethane and its composites, showed that none of these materials were biostatic against *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans* - there was no zone of inhibition of microorganisms' growth around the samples on agar plate.

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REMOVAL OF A TEXTILE DYE FROM AQUATIC ENVIRONMENT USING CHITOSAN/FE$_3$O$_4$/BONE CHAR NANOCOMPOSITE AS NATURAL POLYMERIC ADSORBENT

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In present study, the potential of chitosan/Fe$_3$O$_4$/bone char nanocomposite as natural polymeric adsorbent for removal of Direct Blue15 dye (DB15) from aqueous solution was investigated. The influence of operational parameters including initial pH of solution, contact time, initial dye concentration, adsorbent dosage and organic compounds together with the reusability potential were studied on DB15 removal efficiency. Characterization of nanocomposite was carried out using scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transform infra-red (FT-IR) analysis. The experimental results indicated that natural pH was favored for adsorption of DB15. At a pH value of 7.0, increasing adsorbent dosage from 0.5 to 4 g/L resulted in increasing the removal efficiency of DB15 from 36.32 to 99.52%, respectively. At the initial dye concentrations of 15 and 30 mg/L, the complete removal of DB15 was attained within the reaction time of 60 min. Overall, chitosan/Fe$_3$O$_4$/bone char nanocomposite can be applied as an efficient reusable adsorbent for removal of textile dye from aqueous solutions.

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Abstract

ETHYLENE VINYL ACETATE COPOLYMER / GRAPHENE OXIDE NANOCOMPOSITE PREPARED VIA SOLUTION CASTING METHOD AND DETERMINATION OF THE MECHANICAL PROPERTIES

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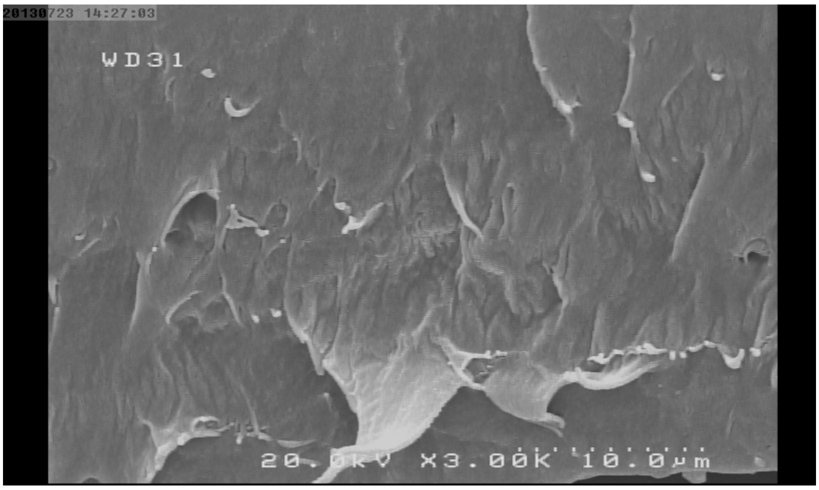
Graphene, a single layer of carbon atoms in a hexagonal lattice, has recently attracted much attention due to its novel electronic and mechanical properties. In this project ethylene vinyle acetate/graphene oxide (EVA/GO) nanocomposite films were prepared via solution method for packaging industries. Mechanical measurements showed that Young modulus and tensile strength of EVA have improved with introducing small amount of graphene oxide. The morphological studies of prepared nanocomposites were investigated using scanning electron microscope (SEM) and X-Ray Diffraction (XRD) methods and the results of the permeability measurements showed that prepared films have good resistance against oxygen. The properties of prepared film were investigated. The permeability test revealed that the permeability of EVA against gases such as CO_2 and O2 is relatively high especially when vinyl acetate is high. While introducing small amount of GO into polymeric matrix dramatically reduced its permeability against O2 and CO_2. Furthermore, the mechanical strength of prepared films which prepared from pure EVA is not enough for packaging therefore, it is necessary to improve EVA mechanical and barrier properties.



SEM image of EVA18/GO (3 wt.%) nanocomposite film with 3000 magnification

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SUSTAINED RELEASE OF CURCUMIN FROM THERMO-RESPONSIVE MOLECULARLY IMPRINTED POLYMER

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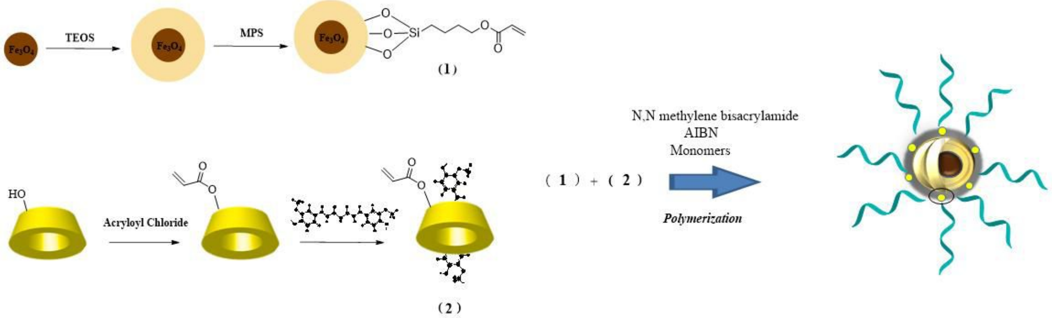
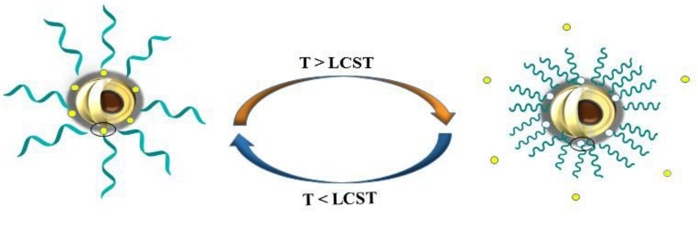
In this work we prepared a new thermo-responsive magnetic molecularly imprinted polymer (TMMIP) by copolymerization of NIPAM, acrylated β-CD, AIBN and MBAm for selective adsorption and controlled release of CUR. The adsorption experiment results were indicated that the TMMIP with imprinted cavities for template molecules has selectivity, high affinity and adsorption capacity toward CUR. Also the adsorption of CUR was promoted in the presence of β-CD due to host-guest interactions of them. Other benefits of this system was its magnetic properties which was facilated the separation process with the help of an external magnet. According to DLS and SEM analysis the hydrodynamic diameter of TMMIPs ranged from 149 to 115 nm (LCST= 38 °C). The release experiments shown an increase in drug release with increasing temperature beyond LCST. These result proved the phase change behavior of NIPAM monomer which resulted in more release in higher temperatures. Overall, the synthesized TMMIP was shown an enormous potential application win biomedical and biochemical fields such as separation and drug release.





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PREPARATION OF NEW COAXIAL BIOCOMPATIBLE NANOFIBERS FOR BONE TISSUE ENGINEERING

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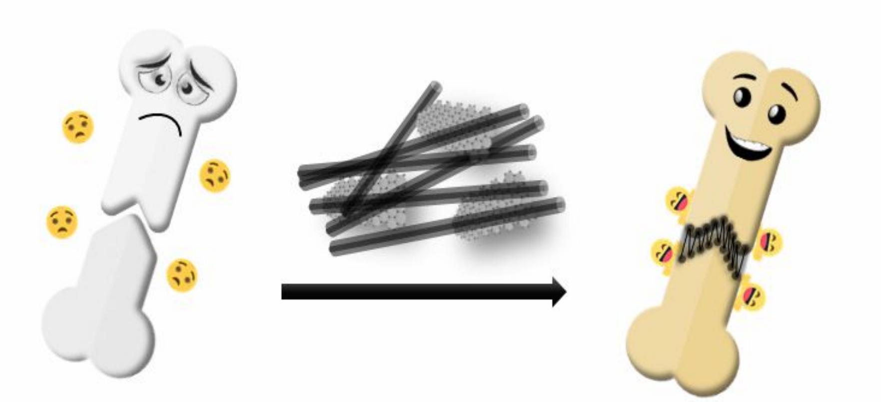
The Zn-CUR incorporated electrospun scaffolds as a new polymer system have been successfully prepared using coaxial electrospinning. In the present study, graphene oxide (GO) and Zn-Curcumin complex (Zn-CUR) as a bioactive biomolecule were loaded into coaxial electrospun nanofibers, and the capacity of the Zn-CUR scaffolds for bone regeneration was investigated. The electrospun nanofiber scaffolds were characterized by SEM, TEM, and FT-IR spectroscopy analysis. The SEM and TEM observation showed defect-free uniform coaxial nanofibers with X nm diameter. The potential of the composite nanofibers as bone tissue scaffolds in terms of their biocompatibility and bioactivity were evaluated by MTT assay, alkaline phosphatase (ALP) activity, and alizarin red-S (ARS) staining. Cellular morphology and MTT assay demonstrated that Zn-CUR nanofibers supplied better support cellular adhesion, spreading, and proliferation in comparison with Zn-CUR free nanofibers. Moreover, the addition of Zn-CUR complex to scaffolds increased ALP activity and production of matrix mineralization. The Zn-CUR complex not only enhanced osteogenic performance but also has an excellent antibacterial activity and therefore reduced postoperative infection. Overall, our study showed that the novel Zn-CUR composite nanofibers with enhanced osteogenic capacity and cytocompatibility offer a promising approach for bone tissue engineering.



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CORROSION PROTECTION OF AM60B MAGNESIUM ALLOY BY SOL-GEL NANOCOMPOSITE

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Magnesium alloys have high strength to weight ratio and therefore are excellent choice for aerospace and automobile industries where weight is a critical design parameter. Unfortunately, the poor corrosion resistance of the magnesium alloys has been hindered their widespread applications in the outdoor application [1]. The aim of this study is to investigate the effective corrosion protection of AM60B magnesium alloy by application of a sol-gel drived inorganic polymer coating containing approprite concentrations of functionalized graphen oxide (GO) nanoplates. First, GO nanoplates were functionalized using 3-aminopropyltriethoxysilane in order to better dispersion behavior in the hybrid organosilane mixture (tetraethyl orthosilicate + 3-glycidoxypropylmethyldiethoxysilane). The functionalized GO nanoplates (fGO) were characterized by FTIR and SEM methods. Afterward, the fGO nanoplates were ultrasonically dispersed in the hybrid organosilane mixture. Then the fGO containing silane mixture was hydrolyzed by adding acidic water ($pH\approx1$) under vigorous stirring for about 2h. Different sol solutions containing different concentration of the fGO were prepared. Next, the prepared sol solutions were applied on AM60B magnesium alloy substrates by dip-coater instrument. Transparent, uniform and dense sol-gel nanocomposites were obtained after curing at 130 °C for about 2 h. The corrosion protection performance of the sol-gel nanocomposites was evaluated in Harrison's solution (0.35% Ammonium sulphate, 0.05% sodium chloride) by performing Electrochemical Impedance Spectroscopy (EIS) tests at different immersion times. The impedance response of the coated samples showed two different capacitive time constants at high and low frequencies followed by an inductive tail at the lowest frequencies [2-3]. An equivalent circuit having two time constants was used for EIS data fitting and the inductive loop data were not participated in the fitting process due to data scattering. The quantitative results of the EIS measurements showed that the fGO containing sol-gel coatings have much better corrosion protection performance than the pure one. The rGO@APTES nanoplates may increases the corrosion resistance of the sol-gel coating via decreasing the micro-pores and increasing the diffusion path length of the aggressive electrolyte. Moreover, the better corrosion protection performance of the nanocomposite films may be related to the formation of cross-linked and dense sol-gel film [4]. The best corrosion protection performance was observed for the coating containing 100 ppm fGO content. However, the beneficial effects of the fGO nanoplates were decreased when the concentration increased.

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PHOTOSENSITIVE COPOLYMERS ON THE BASIS OF GEM-DISUBSTITUTED VINYLOXYCYCLOPROPANES

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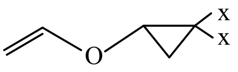
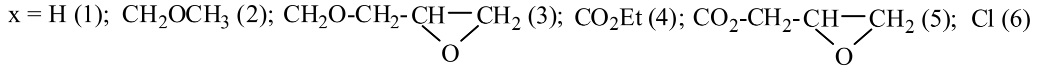
The radical copolymerization of vinylcyclopropyl ether (1) and its derivatives (2-6) containing substituents, having the electron-donor and electron-acceptor properties has been investigated:





$x = H\ (1);\ CH_2OCH_3\ (2);\ CH_2O\text{-}CH_2\text{-}\underset{\diagdown O \diagup}{CH\text{—}CH_2}\ (3);\ CO_2Et\ (4);\ CO_2\text{-}CH_2\text{-}\underset{\diagdown O \diagup}{CH\text{—}CH_2}\ (5);\ Cl\ (6)$

The compounds (1-6), synthesized by us [1], have been included in radical copolymerization with maleic anhydride. The interrelation between copolymerization process and formation of complexes of the donor-acceptor type between comonomers in the system has been investigated. These systems are convenient for study of mechanism of the alternative copolymerization, as in these conditions the copolymerization each of the comonomers is not able to homopolymerization: chain growth in these cases is possible only due to act of cross growth, in which it can be participated both free monomers and ones connected in complex.

The copolymerization carried out in $CHCl_3$ solution at 60°C in the presence of AIBN showed that the compositions of the prepared copolymers almost don't depend on composition of the initial mixture of monomers and always corresponds to equimolar one.

It has been established that in the conditions of copolymerization there are used the donor-acceptor complexes between comonomers, the availability of which has been revealed by methods UV- and PMR-spectroscopy. The composition of complexes has been established by a method of isomole series and equal to 1:1. The equilibrium constant values of the complex-formation and extinction coefficient of complex were obtained by Benesi-Hildebrandt equation. It has been considered the copolymerization scheme due to addition stage to growing chain end both separate comonomers and complexes of monomers as whole. In this case the prepared equation of the process rate contains both complex concentration and free monomers, and parameters reflecting relative reactivity of monomers in the cross growth reaction, and also the relative reactivity of complex in comparison with free monomers in the same reaction.

It has been investigated the photosensitivity of films of the synthesized copolymers prepared from solutions, after drying at 60°C for 30 min by irradiation by xenon lamp with capacity 2 kWt. It has been shown that the photosensitivity of the investigated copolymers depends on MW, polymer solubility, nature of functional substituent and quite a number of other factors. The dependence of quantity of gel-fraction on irradiation dose has been determined.

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SYNERGISTIC EFFECTS IN THE SILICON RUBBER ELECTRICAL CONDUCTING AND MECHANICAL PROPETIES

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The dependence of conducting and mechanical properties of the silicon composites on the content of the fillers has been investigated. There were obtained the composites on the basis of polydimethylvinylsiloxane and two types of electric conducting fillers (carbon black and graphite). Diethylaminomethyltriethoxysilane was used as vulcanization agent. The filler particles are displaced chaotically in the polymer matrix. When the concentration of filler particles reach to so called percolation limit and the continuous clusters form the composite becomes conductive.

For the composites containing binary electrical conducting fillers so called synergistic effect (non additive change of some physical-chemical properties at definite ratio of the fillers in the blend) have been discovered. By help of the mathematical method of planning of the experiment the composites with best electrical conducting and mechanical properties higher than for analogues containing only one filler have been obtained. For example, the minimal specific volumetric electrical resistance for the composites containing carbon black and graphite receives the significances: 550 (for sum of the filler concentration 30wt%, at ratio: carbon black/graphite 50/50), 105 (40wt%, at 45/50) and 30 (50wt% at 40/60) Ohm.cm, respectively. These signifycances of ρ_v are much less than that for the composites containing any one filler, concentration of which in composite is equal to the sum of both fillers. Synergistic effect was shown also in case of value of mechanical strengthening for the same composites with binary fillers. This parameter changes in the row presented above with following significances: 4.2, 2.5 and 1.8 respectively. However comparison of the numbers corresponding to the ρ_v and σ obtained for respective composites leads to conclusion that at the change of concentration in the selection interval the significances of first parameter exponentially decreases, while for second one – decreases. The structural model of composites with binary fillers has been proposed.

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OLIGOMERIC AND POLYMERIC INORGANIC MATERIALS FOR APPLICATION IN VARIOUS TECHNOLOGICAL DOMAINS AND EVERYDAY LIFE

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Silicon dioxide is one of the main components of such materials as geopolymers, micro-silica, modified cement clinker etc. used in modern branches of the technology [1-3]. Silicon-phosphoric acid cements represent the silicate cements modified zinc - phosphatic cements. They surpass silicate cements in the chemical and physical and chemical properties. The chemistry of inorganic compounds of Silicium and Phosphorus has advanced intensively at the end of the 20th and the beginning of the 21st centuries as well as that condensed compounds of these elements are greatest applicable, useful and convenient for promote development of the chemistry of inorganic polymers, and last but not least - they are reasonably presumed as best fertilizers, detergents and as materials used in engineering, construction and other areas, such as raw materials for creation of phosphates glasses, thermo-resistant constituents, effective applying nourishments, cleaners, cement substances, ion-exchange ingredients and also catalytic agents [4-6].

The intensification of scientific researches in domain of condensed compounds chemistry was due also to the very active and prompt development of progressive methods of analysis, as well as to the evolution and achievements in this field of chemistry and of the important application of silicates and phosphates materials in the several technical domains, including nanotechnologies. The development of chemistry of silicates and high-melting nonmetallic materials technology are predetermined by physical-chemical properties of the condensed states of the phases and substances in a colloid dispersed state and to the great possibility of using silicates in various fields of new technical domains.

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HYDROSILYLATION REACTION OF ALLYL-2,3;5,6-DI-O-ISOPROPYLIDENE-D-MANNOFURANOSE WITH METHYL- AND PHENYLCYCLODISILAZANES

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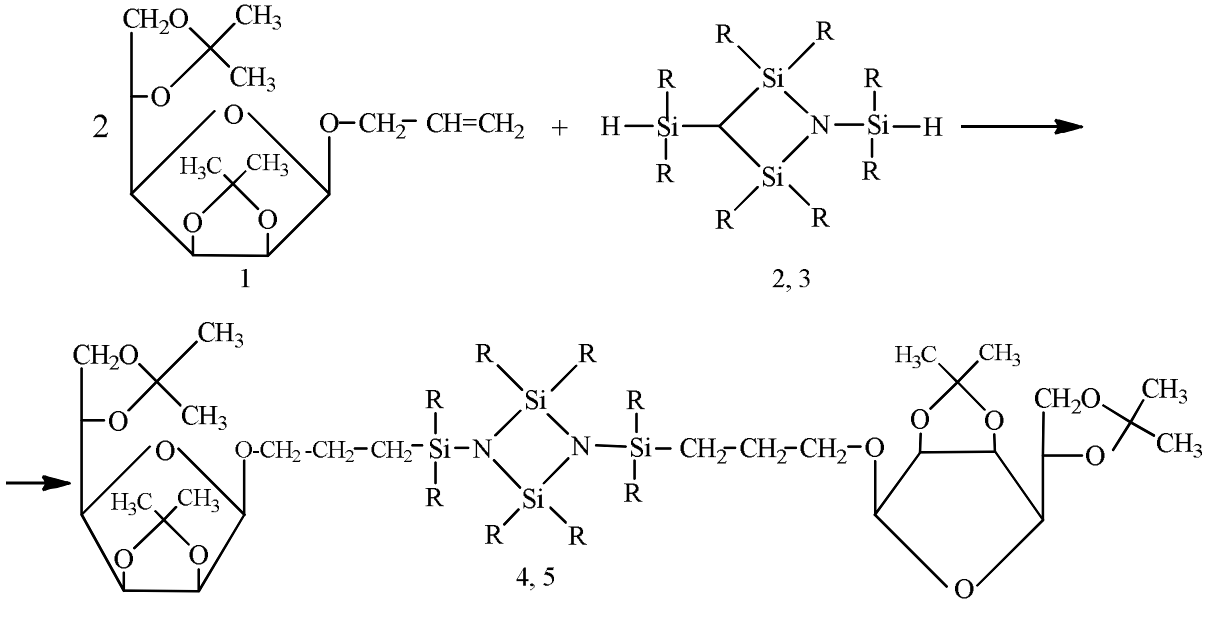
In order to obtain biologically active compounds, we have devised a new method for synthesizing glycosides containing silicon and sulfur. Insertion of silicon and sulfur atoms in known medicinal preparations can result in essential change of character of action of a preparation, and sometimes can give them a number of new properties.

By hydrosilylation 1-0-allyl-2,3;5,6-di-0-isopropylidene-D-mannofuranose (1) with 1,3-bis(dimethylsilyl)-2,2,4,4-tetramethylcyclodisilazane (2) and 1,3-bis(diphenylsilyl)-2,2,4-4-tetraphenylcyclodisilazane (3) in the presence of catalyst – $Co_2(CO)_8$. The reactions mainly occur according to Farmer′s rule, although a small amount of the Markovnikov addition product is also formed.



R =CH_3 (1, 2, 4); R = C_6H_5 (1, 3, 5).

The structures of obtained compounds were established by physical-chemical methods of analysis.

GLYCEROL ETHOXYLATE BASED CROSSLINKED POLYMERS AND THEIR SWELLING PROPERTIES

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A gel can be defined as a three-dimensional network that store large amounts of liquids [1]. Polymer gels are attractive for many applications including tissue engineering, sensor, food industry, medical, agriculture, electronics and sorbent owing to their soft nature, durability, and good mechanical properties [2-4].

Amphiphilic polymeric networks (APCN)s are three-dimensional polymeric network that have hydrophilic and hydrophobic units. These materials can absorb both hydrophilic and hydrophobic solvents [5]. (APCN)s can extensively be employed in analytical and industrial applications due to their sophisticated features in variety of fields such as tissue engineering, protein binding, contact lens, drug delivery, bioseparation and absorbent [6-10].

This work mainly aims to prepare a series of new amphiphilic sorbents which comprise hydrophobic and hydrophilic segments. To explore the absorption ability of the synthesized sorbents, water and a variety of organic liquids including; dichloromethane, tetrahydrofuran, benzene, toluene, ethyl benzene, xylene, hexane, and cyclohexane were used for swelling experiments. The absorption and desorption speed of amphiphilic sorbents were also explored using dichloromethane as model absorbate.

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THE NEED TO USE POLYMERIC MATERIALS IN THE DESIGN OF OZOGENERATORS

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The paper notes the use of ozone in the food industry, in medicine and in the chemical industry as a means of disinfection and sterilization. Ozone is a very active chemical element with a high penetrating ability and strong oxidizing properties, which makes it an excellent tool for combating fungal formations - disinfection of mold. Ozone enters all hard-to-reach places, filling itself with the entire volume of the room. Unlike pesticides, which act only on the shell of insects. Ozone penetrates into the plasma of insects and destroys its structure.

The Scientific Group of the Georgian Technical University, TSU and Velimisioni specially developed the Samani-2 ozogenerator for this purpose, which was used in libraries for the disinfection of books and as a protective agent for controlling microbiological contamination.

Polymeric compounds viniplast and phenoplast are widely used in the technical complex of the mentioned ozogenerator. Polymeric compounds are economically and technically cost-effective for the construction of this type of technical device due to the distinctive technical-economic characteristics. Their use is due to the need for sustainability of vacuum variation and also for the freezing of prepolluting compounds from the surface of the processing. This device increased the productivity of other previous analogues, which is reflected in the reduction in the cost of surface treatment.

The structural device consists of 2 blocks:
1. Ozonogenerator;
2. Different sizes of the material development unit, the unit can be designed directly from polymer compounds, or cover the surface of the block within a thin layer of polymer compounds.

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ORGANOSILICON POLYMERS WITH PHOTO SWITCHABLE FRAGMENT IN THE SIDE CHAIN

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Polysiloxanes are characterized by a number of interesting properties, e.g. excellent heat resistance, low melting point and glass transition temperature, resistance to radiation, special rheological properties, outstanding electrical isolating properties and others [1, 2].

Azobenzene, with two phenyl rings separated by an azo (–N=N–) bond, serves as the parent molecule for a broad class of aromatic azo compounds. The photochromic trans-cis isomerization of azobenzenes has been used extensively in molecular switches, often taking advantage of its shape change upon isomerization to produce a supramolecular result. In particular, azobenzenes incorporated into polymer backbone give switchable receptors and azobenzenes in monolayers can provide light-controlled changes in surface properties [3,4].

The aim of our work was the synthesis of new comb-type organosilicon polymers with azobenzene side groups in the chain. By the insertion of azobenzene chromophoric groups in the siloxane matrix the flexibility, hydrophobicity and thermal stability of obtained polymers as well as films will be increase compared with organic analogues.

For obtaining 1-(4-allyloxy)phenyl)-2-(4-fluorophenyl)diazene on the first stage the diazotization (azo combination) reaction of 4-fluoroaniline with nitric acid carried out and then via combination reaction of obtained diazonium salt with phenol the corresponding 4-((4-fluorophenyl)diazenyl)phenol (I) have been obtained.

On the second stage the reaction of 4-((4-fluorophenyl)diazenyl)phenol with allyl bromide carried out and 1-(4-allyloxy)phenyl)-2-(4-fluorophenyl)diazene (II) have been obtained.

The hydrosilylation reaction of 2.4.6.8-tetrahydro-2.4.6.8-tetramethylcyclotetrasiloxane with 4-((4-(allyloxy)phenyl)diazenyl)phenyl propionate as well as with vinyltriethoxysilane performed in the presence of Platinum catalyst and corresponding organocyclotetrasiloxane (III, IV) adducts have been obtained.

Via polymerization reaction of compounds III and IV in the presence of nucleophilic potassium hydroxide, at various temperature and amount of catalyst in the presence of terminating agent hexamethyldisiloxane or without it comb-type polymers with azobenzene side groups have been obtained. For obtained monomers and polymers FTIR, UV, ^{1}H, ^{13}C, ^{29}Si NMR spectra, GPC and DSC investigation have been carried out.

It has been found by experiment that geometric isomers of azobenzene derivatives can be switched by UV-Visible irradiation. The trans form can be converted to the cis form using an appropriate wavelength of light. A different wavelength of light can be used to convert the molecule back to the trans form. Alternately, the molecule will thermally relax to the stable trans form.

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Abstract

THE MATHEMATICAL DESCRIPTION FOR THEACRINE ELECTROCHEMICAL DETECTION OVER A CONDUCTING POLYMER, BASED ON QUINONIC COMPOUNDS

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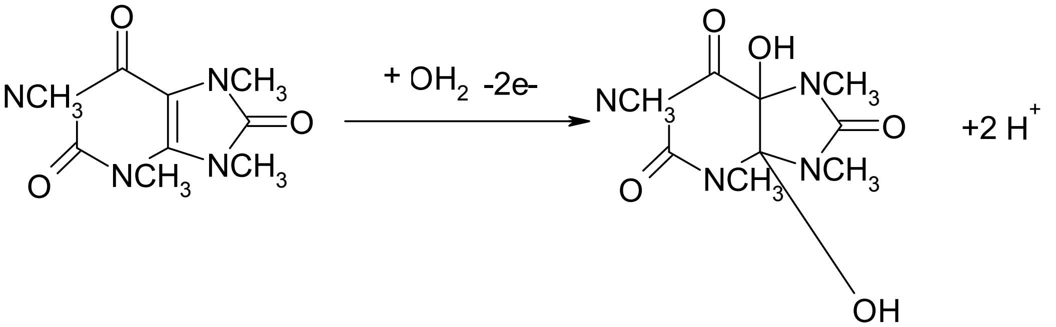
Theacrine, also known as 1,3,7,9-tetramethyluric acid (Fig. 1) is an alkaloid, naturally occurring in cupuaçu plant, growing in the North of Brazil (mostly in the states of Pará, Amazonas, Rondônia and Acre), like also in Colombia, Peru and Bolivia [1]. It is also found in a Chinese tea plant, kudingcha [2].

It manifests anti-inflamatory and analgesic effecs and affects adenosine signaling by mechanism, similar to that of caffeine [3]. Nevertheless, its effect strongly depends on the concentration. So, the development of a cheap, precise, exact and sensitive method of its detection and quantification remains an actual problem, and the use of electrochemical methods, based on chemically modified electrodes, may be applied to it.

The mechanism of theacrine electrochemical oxidation may be described as:



The character of the process leads to a thought that the electrochemical process may be successfully realized on an electrode, modified by a conducting polymer, bearing a quinonic moiety, like in [4].

The possibility of theacrine electrochemical determination has been evaluated from the theoretical point of view. The correspondent mechanism has been suggested, and the correspondent model, developed and analyzed by means of linear stability theory and bifurcation analysis. It was verified that theacrine may be electrochemically detected in neutral media over the polymers of the compounds, belonging to the quinone-hydroquinone system, serving as mediator of electrons and protons transfer. The analytical signal has to be clear and easily interpreted. The possibility of oscillatory and monotonic instabilities has also been verified.

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THE MATHEMATICAL DESCRIPTION FOR DOPAMINE ELECTROCHEMICAL OXIDATION, ACCOMPANIED BY ITS CHEMICAL AND ELECTROCHEMICAL POLYMERIZATION

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Dopamine is one of the most important neurotransmitors in human and mammal organisms [1], being a precursor of epinephrine, one of neurotransmitting molecules with important cardiovascular, hormonal, rhenal effects and the influences on central neurosystem. Its extreme concentrations may cause different illnesses like Parkinson disease or schizophrenia. So, the development of a method, capable to detect its concentration by rapid, precise, exact and sensitive manner is really an actual and important task.

The chemically modified electrodes have various advantages, the main of which is the affinity between the modifier and the analyte, reason why they are one of the modern, cheap and tunable electroanalytic tools. For example, for the hydroquinonic compounds, various electrode modifiers of different nature and composition were developed [2 – 3]. The proper hydroquinonic and quinonic compounds may also serve as electrode modifiers [4]. Nevertheless, it´s unavoidable to admit that dopamine may be a polymerizable compound [5], and its polymer may be used inclusively as an electrode modifier. Moreover, if the support electrolyte contains oxidizing ions, they may promote its chemical polymerization, and to evaluate the effect the polymerization may produce to the electrochemical (electroanalytical) process, it´s necessary to investigate the system with polymerization-accompanied electrochemical oxidation of dopamine from theoric mechanistic point of view.

An interesting case of dopamine electrooxidation, accompanied by its chemical and electrochemical polymerization, and in which either the monomer, or the polymer may be oxidized to the respective quinonic form, was investigated from the theoretical point of view. The analysis of the mathematical model, correspondent to this system has shown that the stable steady-state in this system is easy to maintain, despite of being narrower the topological steady-state stability zone for this case than for similar ones. Yet the oscillatory and monotonic instabilities have been shown as more probable in this case than in the similar systems.

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NANOSILVER CONTAINING BIOCOMPOSITIONS AS ANTIMICROBIAL COATINGS

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Coating surgical devices with nanosilver containing (**AgNP**) antimicrobial, biodegradable, polymeric nanocomposites protect surfaces/devices from biofilm formation. Such type of coatings will play a role of “unstable seating” that will not allow bacteria to occupy the surface. In brief, bio-erodible antimicrobial coating should be an extremely unsuitable and discomfortable foundation for bacteria to build up their shelter and along with releasing “killers of bacteria” should prevent the biofilm formation.

These nanocomposites are also promising as wound dressing materials [1].

For creating bioerodible antimicrobial coatings containing **AgNPs**, we selected ethanol soluble, biodegradable co-poly(ester amide) (co-**PEA**) composed of L-leucine, 1,6-hexanediol and sebacic acid [2].

The **AgNPs** were fabricated according to one-pot procedure by photochemical reduction (using daylight-irradiation) of $AgNO_3$ in polymer/ethanol solution. The **AgNPs** by shape and size were characterized by **UV**-spectroscopy, transmission electron microscopy (**TEM**), and dynamic light scattering (**DLS**). According to the **UV** and **TEM** data the photochemical reduction resulted presumably in spherical **AgNPs** with rather high contribution of the particles below 10 nm that are known as responsible for antimicrobial activity [3]. **DLS** study showed that average size of nanoparticles formed after photo-reduction in ethanol solution ranged within 10-50 nm.

The *in vitro* bactericidal activity of the new AgNPs-containing composites was estimated by standard procedure of disk diffusion method (**DDM**) using bacterial agar lawn.

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ENCAPSULATION OF HYDROPHOBIC DRUGS INSIDE PEG-PLGA MEMBRANE - A POSSIBLE DRUG-CARRIER SYSTEM

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The main point of our study was the preparation and characterization of nanostructures made from a copolymer containing poly(ethylene glycol) and poly(lactide-*co*-glycolide) blocks (PEG : PLGA 2,000:11,500). The PEG : PLGA polymersomes were obtained by the solvent exchange method. Their size and surface potential were determined using dynamic light scattering (DLS) and zeta potential measurements. Cryo-transmission electron microscopy (cryo-TEM) was used to visualize the morphology of the objects.

In the next step, we attempted to apply the PEG : PLGA vesicles as nanocarriers. First, we investigated the interaction between the nanostructures and selected bioactive substances or dyes, especially hydrophobic compounds (e.g. piroxicam, porphyrins, itraconazole). For this purpose, we used measurements of UV-Vis and fluorescence spectra, and Langmuir monolayer isotherms.

NANOSTRUCTURED HYPERBRANCHED POLYESTER BASED ON GLYCEROL-SUCCINIC ANHYDRIDE: SYNTHESIS, CHARACTERIZATION AND INVESTIGATION

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Hyperbranched polymers with random branched and less regular structures compared to dendrimers have been received more attention in the past two decades because of their unique architecture and intrinsic properties such as a large number of branch points and end groups, low viscosity and excellent solubility in organic solvents [1, 2]. So, they have found a lot of applications as additives, sensors and careers in both academic and industrial viewpoints [3, 4]. HBPs could be synthesized by polycondensation using ABx ($x \geq 2$) type monomers or A_3+B_2 methodology. Although the last method benefits from easily available monomers, gelation is the most drawback of this kind of polycondensations. In contrast, polycondensation of ABx type monomers in spite of difficulty in accessing to desired monomers could overcome reaching the gel point [5].

In this report an AB_2 type monomer was synthesized from dihydroxyacetone and succinic anhydride in 1:2 molar ratio in a two step reaction pathway and then was used to prepare a hyperbranched polyester with a nano-sized morphology. To obtain the desired polymer morphology the reaction parameters, time and temperature, were optimized. SEM realized nearly uniform particle size distribution with under 100nm globular morphology. The polyester has carboxylic acid functionality in periphery because of diacid-alcohol nature of the monomer. Using long chain alcohols (luryl alcohol and …), the peripheral carboxylic acid groups of HB-polyester were transformed to a hydrophobic nature. Degree of branching and degree of functional transformation were studied by spectroscopic techniques in both polymers. Then the solution properties of the pristine and transformed polymer, such as solubility, aggregation and viscosity was investigated and compared. The polyacid and hydrophobed derivative showed different solubility and aggregation behavior. Phase transfer utility of the synthesized polymers as a typical application was evaluated for basic (methyl orange and methylene blue), neutral and acidic chemical dyes. In the following, this characteristic will be challenged in drug transfer capability of the synthesized HB-polyesters.

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THE MODERNIZATION OF THE IMMOBILIZED OF THE AZO DYES ON THE SILICA SURFACE BY THE SILICIUM NIRTIDE

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A cylation, bromination, lithiation and reduction synthesis of benzidine was performed. We used the method of immobilization of benzidine on activated silica gel which involved the interaction of a preliminarily chlorinated inorganic matrix with the lithiated benzidine derivative. We elaborated the method of immobilization of benzidine on activated silica gel which involved the interaction of silica gel preliminarily activated with thionyl chloride with lithiatedprimary aromatic amine. We also developed the preparation methods of diazotization and azo coupling of amino groups in the organic fragments immobilized on the inorganic matrix. Six new pigments were synthesized by the method developed [1].

The paper deals with the production of composites, the study of their spectral, technological, physical and chemical properties, and their application to art paints technology. When fabricating the composites, silica gel was used as an art paint base and azo dyes with different substitutes - as surface modifiers. We synthesized benzene-containing silica gels by interaction of thionyl chloride with activated silica gels and lithiated aniline. We have elaborated the preparation methods of diazotization and azo coupling of amino groups in the organic fragments immobilized on the inorganic matrix. Six new pigments were synthesized by the method developed [2].

In the present work, there is conducted: the modernization of the new immobilized 18 azo pigments on the silica surface on the basis of the aniline and benzidine by cycloalkylsilazanes. The modification low-temperature method is elaborated, which anticipates the organosilica processing by the cyclosilazanes at the normal and increased pressure at 60°C, under the concomitance benzoyl peroxide at a rate of 5% [3-5].

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HYDROGEN INTERACTION WITH MATERIALS-AN OVERVIEW

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Development and validation of a lifetime prediction methodology for failure of materials used for hydrogen containment components is of significant importance to the planned hydrogen economy. With the prospect of transitioning to a hydrogen-based economy, many engineering components will be exposed to high-pressure gaseous hydrogen environments.

Hydrogen embrittlement is a severe environmental type of failure; when hydrogen is present, materials fail at load levels that are very low compared with those that a hydrogen free material can sustain.

We will review recent contributions to the understanding of mechanisms of hydrogen embrittlement. In this paper, we describe the role of hydrogen in different structural materials with an emphasis on steels. For components made of high strength steels, we propose a model of decohesion-induced failure that links the microstructural decohesion event with the macroscopic load.

Thermal desorption spectroscopy (TDS) was used to identify and quantify the types and strengths of the hydrogen trapping sites. TDS results support the notion that only the diffusible hydrogen through the lattice sites or the hydrogen residing at the traps with the lowest binding energy contributes to material embrittlement; the deeper traps were saturated in both hydrogen free and charged samples. Hydrogen trapping and diffusion will be discussed in relation with microstructure features and mechanical states. We present a model for hydrogen transport that accounts for trapping of hydrogen at microstructural defects and address the interaction of hydrogen solute atoms with material deformation.

The residual stress state in a material has an important role in the mechanism of cracking, induced or assisted by hydrogen. The hydrogen interaction with residual stresses is studied by synchrotron x-ray diffraction. The results will be discussed in detail.

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DEGRADATION PROFILE OF ALIPHATIC POLYURETHANES (PURS) MODIFIED WITH L-ASCORBIC ACID (AA) STUDIED IN DIFFERENT ENVIRONMENTS

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Polyurethanes (PURs) are used as synthetic biomaterials in biomedical field such as tissue engineering (TE). TE requires highly biocompatible and biodegradable scaffolds, which provide suitable tissue regeneration. By the proper design of the raw materials and the synthesis PURs may reach this requirements. PURs used in this study were obtained by using polyester α,ω-dihydroxy(ethylene-butylene adipate) (PEBA), 1,6-hexamethylene diisocyanate (HDI) and 1,4-butandiol (BDO). To reach the high biocompatybility PURs were modified with the use of L-ascorbic acid (L-AA) [1]. Obtained PURs were subjected to the long-term interactions (LTI) study and accelerated short-term interactions (STI) study to determine their initial degradation profile. The LTI study was performed in distilled water, saline solution and phosphate buffered saline (PBS) at 37°C for 6 months. The accelerated STI was studied in the acidic (2N HCl), basic (5M NaOH) and oxiditive environment (0,1M $CoCl_2$/20% H_2O_2) at 37°C for 15 days. Despite the fact that obtained unmodified and AA-modified PURs possess labile ester bonds in macrodiol no significant signs of degradation were observed after 6 months of LTI study. However, it is suitable performance according to the degradation requirements of the tissue scaffolds [2,3]. The pH did not change significantly during the 6 months of incubation and was in the range of 7,8-7,4. The LTI studies are in contrary to the accelerated STI studies, which revealed that unmodified and AA-modified PUR materials undergo degradation in the selected media. They undergo easily degradation in acidic environment (over 80% mass loss), later on in basic environment (10% mass loss), while in oxiditive environment they remain rather stable (~5% mass loss). The FTIR analysis of remained material after 15 days of the studies showed the degradation progress in acidic and basic environment of both unmodified and AA-modified PURs. The unmodified PURs degrade faster than AA-modified once.The STI studies of unmodified and AA-modified PURs is in good agreement with the literature describing that PURs are more susceptible to degradation in highly acidic or basic environment than in oxidative once [4]. What should to be pointed out here is that accelerated degradation in the acidic environment might be advantage of obtained AA-modified PUR materials, which can serve for example as a bladder tissue scaffold that regenerates and functions properly in the acidic environment [5].

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