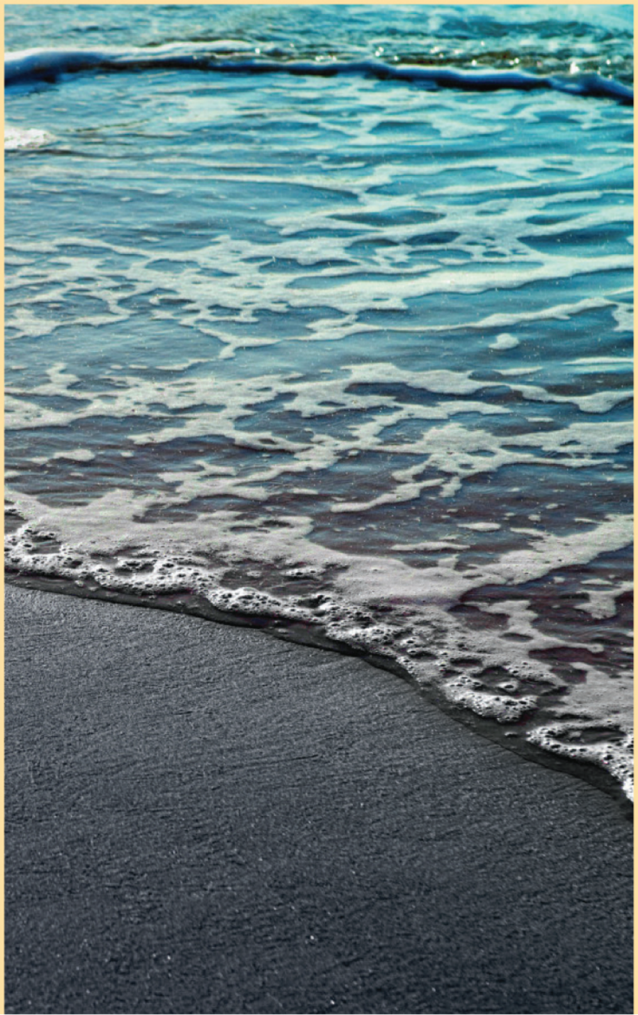
2nd International Scientific Conference and Seasonal School

„Science, Education, Innovations and Chemical Technologies from Idea to Implementation. 2023“



November 23 – 25, 2023
Tbilisi, Georgia

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2nd INTERNATIONAL SCIENTIFIC CONFERENCE AND SEASONAL SCHOOL “SCIENCE, EDUCATION, INNOVATIONS AND CHEMICAL TECHNOLOGIES FROM IDEA TO IMPLEMENTATION. 2023”

მე-2 საერთაშორისო კონფერენცია და სეზონური სკოლა „მეცნიერება, განათლება, ინოვაციები და ქიმიური ტექნოლოგიები - იდეიდან დანერგვამდე. 2023“

November 23 – 25, 2023, Tbilisi, Georgia

23-25 ნოემბერი, **2023**, თბილისი, საქართველო

უნივერსიტეტის
გამომცემლობა

EDITOR
Nikoloz Nioradze

DESIGNER
Giorgi Lezhava

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Dear Colleagues

It is with great pleasure and excitement that I welcome each of you to the opening of the international conference & Seasonal school: “Science, Education, Innovations and Chemical Technologies From Idea to Implementation. 2023.” I am glad that the Georgian scientific society hosts researchers from the World's leading scientific centers: from the USA, Italy, France, Germany, Poland, Bulgaria, Azerbaijan, Belgium, Slovakia, Ukraine, Armenia, Moldova, Portugal, Japan, Iran, Kazakhstan, Uzbekistan, Brazil, Belarus and Tajikistan.

Ivane Javakhishvili State University, in whose walls we are now, is the spiritual and intellectual heir of centuries-old humanistic traditions, educational, scientific and cultural centers. In modern conditions, the values of the university are based on creative and progressive thinking, principles of academic freedom and academic ethics, open, dynamic and transparent relations. The cooperation of business representatives at this type of scientific conference opens up new opportunities for the exchange of ideas between academia and industry and the practical implementation of the topics covered by our program. Regional universities play an important role as hubs of knowledge creation.The final meeting of the conference and seasonal school will be held at Telavi State University.

A three-day seasonal school for PhD and Master's students will run together with the conference, which is an effective initiative for continuous learning and the evolution of ideas. When the Institute of Inorganic Chemistry and Electrochemistry of TSU formed this initiative together with the Teaching-research Scientific Center, we thought that in the field of education we are not only spectators, but also active participants in the transfer of knowledge. Our association is a cluster dedicated to nurturing the next generation of thinkers and innovators, aiming to provide a unique platform for hands-on learning and skill development.

Today's event is accompanied by another uniqueness. It represents the intersection of chemical technologies and social and humanitarian sciences, that often perceived as different disciplines. However, these are arts that have common threads in the search for truth. This connection is a bridge between research challenges and public imagination, contributing to the development of a sense of curiosity and scientific literacy in the interests of business.

Believing that our ties will continue beyond these walls and we will cooperate in the process of creating and transferring academic knowledge "from idea to implementation".

We wish you fruitful, mutually beneficial and new inspiration-filled meetings

Dr. Grigor Tatishvili
Director
R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU

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SEASONAL SCHOOL FOR MASTERS AND DOCTORAL STUDENTS "INNOVATIONS FROM IDEA TO IMPLEMENTETION"

Seasonal school "Innovations - from idea to implementation" - provides a specialized educational program, which is prepared for the purpose of mastering interdisciplinary research methods and raising qualifications in the field of commercialization of research results.

Well-known experts and researchers will share their views on the latest research results and perspectives with school students. The school focuses on such topics as:

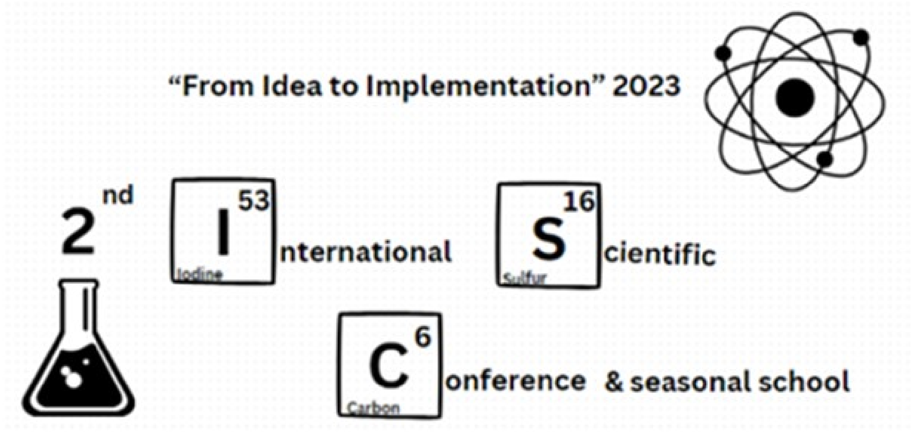
- Culture of applied research;
- Interdisciplinary studies and agro-ecological environment
- Public-private partnership in the field of innovation.

The school gives young researchers the chance to: learn the basic methods of interdisciplinary research in a comfortable and friendly environment, listen to personal examples of success of experienced scientists, new approaches to the promotion of science, deepen your knowledge about the possibilities of integration of educational-research and business processes; to exchange ideas, to connect with mentors, professional researchers, plan an internship and more.

The format of the school is an interdisciplinary approach platform for the cooperation of students from different fields, where students have the opportunity to highlight priority and current topics, promising and interesting scientific research directions; met members of the international scientific community; Peers working on the issues of natural sciences, as well as innovation management, knowledge-based economy, scientific PR, to establish connections with the prospect of creating future joint projects.

Motivated students will have the opportunity to familiarize themselves with the technology of cutting, engraving and 3D scanners in the fablab for innovation and knowledge transfer. Also, the drone laboratory and implementation of various activities through drones: photo-video shooting, measurement of ambient air, spraying of pesticides, movement of cargo, synchronized movement and others.

Seasonal school "Innovations - from idea to implementation" is a training path of excellence with a strong interdisciplinary character for the advancement of research and the integration of master's and doctoral students into the academic community.



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PhD Students of Faculty of Natural and Exact Sciences of
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M.Sc. Levan Londaridze
M.Sc. Sopo Tskitishvili
M.Sc. Archil Benashvili
M.Sc. Nino Gagniashvili

CONTENT

SCIENTIFIC PROGRAM

	THURSDAY, 23 NOVEMBER **TSU, 1 Tchavtchavadze Ave., Bld. I, ROOM 107**
12:00 – 13:00	**Registration, Refreshments**
13:00 – 13:30	**Welcoming Remarks** **Dr. G. Tatishvili,** Director of R. Agladze Institute of Inorganic Chemistry and Electrochemistry of Iv. Javakhishvili Tbilisi State University **Dr. E. Astakhishvili,** Vice-Rector of TSU **Acad. V.Tsitsishvili,** Academician of the Georgian National Academy of Science
	NANO PROCESSES AND NANOTECHNOLOGIES, ROOM 107
	Chair: **Dr. G. Tatishvili**, R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia **Dr. S. Bellucci,** INFN-Laboratori Nazionali di Frascati, Frascati, Italy
13:30 – 14:00	**Invited speaker:** **Dr. S. Bellucci**, INFN-Laboratori Nazionali di Frascati, Frascati, Italy
	INNOVATIVE 2D MATERIAL FOR NANOELECTRONICS, MOLECULAR SENSING, OPTICAL PROPERTIES AND CATIONIC POLLUTANT REMOVAL FROM AQUEOUS SOLUTIONS
14:00 – 14:20	**Invited speaker:** **N. Maisuradze** (Phd student) Iv. Javakhishvili Tbilisi State University, Division of Immunology and Microbiology, Tbilisi, Georgia
	MULTIFUNCTIONAL NANOSYSTEM: AN ADVANCED PLATFORM FOR CANCER TREATMENT
14:20 – 14:40	**Invited speaker:** **Dr. N. Ludwig, Aerial**, Illkirch, France
	UTILIZATION OF IRRADIATION TECHNOLOGY FOR MATERIAL MODIFICATION. CURRENT STATUS AND FUTURE CHALLENGES (on-line)
14:40 – 15:00	**Invited speaker:** **Dr. S.R. Khalilova**, Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan
	SYNTHESIS AND CHARACTERIZATION OF IRON-CONTAINING PP AND HDPE BASED COMPOSITES
15:00 – 16:00	**Lunch**
	GREEN CHEMISTRY, ROOM 107
	Chair: **Acad. V. Tsitsishvili**, Academy of Sciences, P. Melikishvili Institute of Physical & Organic Chemistry of TSU, Tbilisi, Georgia **Acad. D. Tagyev**, Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan
16:00 – 16:30	**Invited speaker:** **Dr. S. Osmanova**, Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan;
	EFFECT OF CALCINATION TEMPERATURE ON THE SURFACE STRUCTURE AND ELEMENTAL COMPOSITION OF MnOx-Na_2WO_4/ BENTONITE CATALYST FOR OXIDATIVE COUPLING OF METHANE

16:30–16:50	**Invited speaker:** **Acad. V. Tsitsishvili**, Georgian National Academy of Sciences, P. Melikishvili Institute of Physical & Organic Chemistry of TSU, Tbilisi, Georgia
	REASONS FOR USING NATURAL ZEOLITES OF GEORGIA
16:50-17:00	**Dr. N. Mirdzveli,** P. Melikishvili Institute of Physical & Organic Chemistry of TSU, Tbilisi, Georgia
	IDENTIFICATION OF IMPURITIES IN PAPER MADE FROM WASTE PAPER
17:00 – 17:20	**Invited speaker:** **Dr. G. Maisuradze**, Baker Laboratory of Chemistry and Chemical Biology, Cornell University, Ithaca, NY USA (on-line)
	INVESTIFATION OF AMILOID FIBRIL FORMATION BY COARSE –GRAINED MOLECULAR DYNAMICS
17:20 – 17:40	**Invited speaker:** **M.Sc. S. Suleymanova**, Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan
	THE INFLUENCE OF ULTRASOUND ON THE DLS, FTIR AND EMR SPECTRA OF A LIQUID-PHASE CATALYTIC SYSTEM FOR THE HYDROXYLATION OF PHENOL INTO DIHYDROXYBENZENES WITH HYDROGEN PEROXIDE IN THE PRESENCE OF IRON-CONTAINING MORDENITE PARTICLES
17:40 – 18:00	**Invited speaker:** **Dr. A. Rustamova,** Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan
	THERMAL STABILITY OF HETERONUCLEAR Fe-Mn(Co) CYCLOPENTADIENYL COMPLEXES ADSORBED ON ALUMINA AND THERMODYNAMICS OF THEIR DECOMPOSITION
18:00 – 18:30	**Coffee break**
12:00 – 18:00	**POSTER SESSION, HALL**

	FRIDAY, 24 NOVEMBER
9:30 – 10:00	**Registration**
	ENERGY SOURCES, CONVERSION AND STORAGE, ROOM 107
	Chair: **Dr. T. Marsagishvili**, R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia **Prof. V. Beschkov**, Leading Researcher, Institute of Chemical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria
10:00 – 10:30	**Invited speaker:** **Prof. V. Beschkov,** Institute of Chemical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria
	CARBON-FREE CHEMICAL SOURCES OF ENERGY: THE HYDROGEN
10:30 – 11:00	**Invited speaker:** **Prof. F. Lisdat. Biosystems** Technology, Institute of Applied Life Sciences and Biomedical Technologies, Technical University of Applied Sciences Wildau, Wildau, Germany
	LEARNING FROM NATURE - APPLICATION OF PHOTO-ACTIVE BIOMOLECULES IN BIOHYBRID SYSTEM

11:00 – 11:15	**Dr. L. Chobaniani**, Georgian Technical University, Institute TECHINFORMI, Tbilisi, Georgia (on-line)
	METHODOLOGY FOR CREATING A SYSTEM OF MONITORING AND EVALUATING SCIENTIFIC AND TECHNICAL PROJECTS
11:15 – 11:30	**Dr. G. Kaishauri,** Biotechnological Centre of Georgian Technical University, Tbilisi, Georgia (on-line)
	SWEET SNACKS FROM THE SECONDARY RAW MATERIALS OF GRAPEFRUIT
11:39 – 11:45	**G. Khachidze** (PhD student), Biotechnological Centre of Georgian Technical University, Tbilisi, Georgia (on-line)
	MODELING IN A FACTORY MANNER
11:45 - 12:00	**Dr, L. Ghurchumelia,** R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia
	COMPOSITE POWDERS OF NATURAL RAW MATERIALS FOR PRODUCTION OF NEW TYPE, ENVIRONMENTALLY SAFE FIRE-PROTECTIVE MATERIALS
12:00 – 12:30	**Coffee break**
	FUNDAMENTAL AND TECHNOLOGICAL ASPECTS OF PROCESSING OF MINERAL PRODUCT AND SECONDARY RAW MATERIALS, ROOM 107
	Chair: **Prof. T. Nakano,** Institute for Catalysis Hokkaido University, Japan **Acad. R. Katsarava**, Georgian National Academy of Sciences, Institute of Chemistry & Molecular Engineering Agricultural University of Georgia, Tbilisi, Georgia
12:30 – 12:45	**Prof. M. Rukhadze,** Department of Chemistry, Exact and Natural Science Faculty of TSU, Tbilisi, Georgia
	EFFECT OF ADDITIVES ON THE PERCOLATION OF WATER /AOT/ DECANE REVERSE MICROEMULSION
12:45 – 13:00	**Dr. I. Khutsishvili,** Elf. Andronikashvili Institute of Physics of TSU, Tbilisi, Georgia
	CREATION AND STUDY OF G4 PAMAM DENDIMERS ENCAPSULATED WITH SILVER AND GOLD ATOMS
13:00 – 13:30	**Invited speaker:** **Prof. T. Nakano**, Institute for Catalysis Hokkaido University, Japan
	NON – CLASSICAL CHIRALITY OF POLYMERS
13:30 – 14:00	**Dr. N. Zavradashvili**, Institute of Chemistry and Molecular Engineering, Agricultural University of Georgia, Kakha Bendukidze University Campus, Tbilisi, Georgia
	HYBRID CATIONIC POLYMERS BASED ON NON- PROTEINOGENIC α-AMINO ACID
14:00 – 14:30	**Dr. F. Sharifian Jazi,** School of Science and Technology, The University of Georgia, Tbilisi, Georgia
	RECENT INNOVATIONS IN SYNTHESIS TECHNIQUES OF NANO BIOACTIVE GLASS FOR TISSUE ENGINEERING AND IMPLANT APPLICATIONS: A COMPREHENSIVE REVIEW
14:30 – 14:45	**Dr. S. Khutsishvili,** R.Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia

	FORMATION OF MAGNETIC METAL-CONTAINING POLYMER NANOCOMPOSITES AND THEIR PROSPECTS
14:45 – 15:00	**Dr. T. Chachibaia,** Iv. Javakhishvili Tbilisi State University, David Tvildiani Medical University, Tbilisi, Georgia
	CONTEMPORARY ISSUES OF NANOTECHNOLOGIES IN THE DRUG DEVELOPMENT OF PHARMACO CHEMISTRY AND INTRODUCTION OF CURRICULUM IN MEDICINE
15:00 16:00	**Lunch**
	PROMOTION AND COMMERCIALIZATION OF SCIENTIFIC INNOVATIONS, ROOM 107
	Chair: **Prof. S. Mrozowska**, Vice-Rector for Innovation and Liaison with Business and the Community, Associate professor at the Institute of Political Science at the University of Gdansk, Poland **Prof. M. Tsatsanashvili**, Georgian Technical University, Director of Teaching-Research Scientific Center, Tbilisi, Georgia
16:00 – 16:30	**Invited speak**er: **Dr. M. Kutsia**, Head, Department of Inventions and New Varieties and Breeds. National Intellectual Property Center of Georgia Sakpatenti https://www.sakpatenti.gov.ge/ka
	Activities of National Intellectual Property Center of Georgia “SAKPATENTI” Supporting Innovation
16:30 – 17:00	**Dr. G. Giorgobiani**, Muskhelishvili Institute of Computational Mathematics of the Georgian Technical University,Tbilisi, Georgia
	MATHEMATICS OF ARTIFICIAL INTELLIGENCE
17:00 – 17:20	**Invited speaker:** **Prof. M. Nalbandyan**, Yerevan Haybusak University, Institute of Geological Science of the National Academy of Sciences, Yerevan, Armenia.
	GEO-ECOLOGICAL ASPECTS OF THE HARMONIZATION PROCESS IN THE ECONOMICS-ECOLOGY SYSTEM DURING THE ENERGY TRANSITION PERIOD
17:20 – 17:40	**K. Karchkhadze** (PhD student). P. Melikishvili Institute of Physical & Organic Chemistry of TSU, Tbilisi, Georgia
	DEVELOPMENT OF BIODIESEL PRODUCTION FROM WASTE BIOMASS IN GEORGIA
17:40 – 18:00	**Invited speaker:** **Dr. L. Jioshvili**, World Bank Consultant, Technology Transfer Pilot Program, Georgia's Innovation and Technology Agency (GITA), Tbilisi, Georgia
	TECHNOLOGY TRANSFER IN GEORGIA PROBLEMS AND OPPORTUNITIES
18:00– 18:30	**Coffee break**
12:00 – 18:00	**POSTER SESSION, HALL**
18:30– 19:00	**CLOSING THE CONFERENCE, ROOM 107**

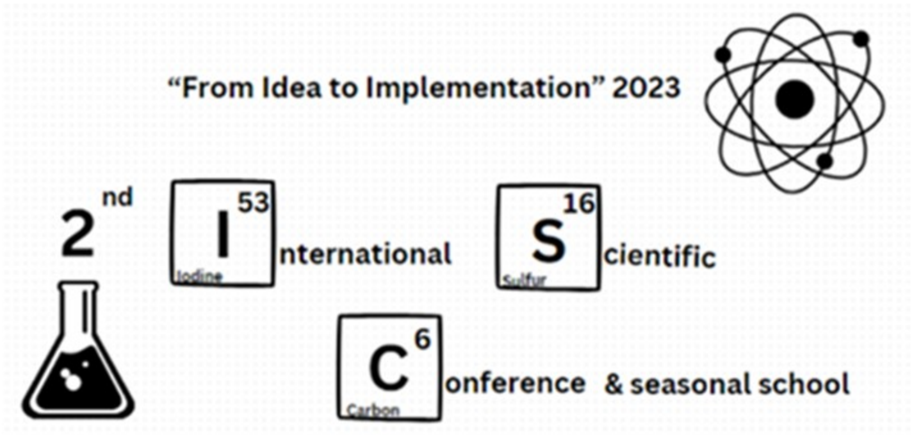
SESSIONAL SCHOOL PROGRAM

14:30 – 18:00	**THURSDAY, 23 NOVEMBER** **TSU, 1 Tchavtchavadze Ave., Bld. I, ROOM 115**
	Moderator: **Ms. Nursaya Makayeva** (PhD student), Institute of Combustion Problems, Almaty, Kazakhstan **Ms. Nino Gagniashvili** (PhD student), Alexander Tvalchrelidze Caucasian Institute of Mineral Resources, Tbilisi, Georgia of TSU
14:30 – 15.00	**Prof. Tamaki Nakano**, Institute for Catalysis Hokkaido University, Japan
	Polymer Chemistry: From Scratch to Finish
15:00 – 15:20	**Prof. Mariam Tsatsanashvili**, Prof., Director of the Research Institute of Public Administration, Georgian Technical University, Director, Teaching-Research Scientific Center, Tbilisi, Georgia
	Public-private partnership in the field of innovation and science
15:00 – 16:00	**Lunch**
	Moderator: **M.Sc. Samira Suleymanova** (PhD student), Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan **Dr. Elizaveta Tskhakaia,** R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia
16:00 – 16:30	**Invited speaker:** **Prof. Matteo Gerlini,** Prof., University of Siena, Italy
	International cooperation as a tool to improve educational pattern: The International Nuclear Security Education Network experience
16:30 – 17:00	**Prof. Roza Lortkipanidze**, Akaki Tsereteli State University, Kutaisi, Georgia
	Global warming processes in the agro-ecological environment of Georgia
17:00 – 17:30	**Invited speaker:** **Prof. Venko Beschkov**, Institute of Chemical Engineering, Bulgarian Academy of Sciences, Sofia, Bulgaria
	Carbon dioxide recycling in fuel cell application
17:30– 18:00	**Dr. Merab Kutsia,** Department of Inventions and New Varieties and Breeds. Sakpatenti https://www.sakpatenti.gov.ge/ka
	Intellectual property – from Idea to Innovation
18:00 – 18:30	**Coffee break**

10:00 – 17:00	**FRIDAY, 24 NOVEMBER** **TSU, 1 Tchavtchavadze Ave. Bld.I, ROOM 115**
	Moderator**: Dr. Salome Chanturidze**, Head of Fab Lab of TSU
10:00 – 11:30	**Fab Lab (TSU (University Str. 2, Fl. III) BLD. 10)**
	Introduction to the drone laboratory and Fab Lab equipment: Epilog laser, UV Print Mimak (cuts, engraves any material) and U-Printer-3D scanners
12:00 13:00	**Coffee break**
	Moderator: **Invited speaker: Prof. Marine Nalbandyan**, Yerevan Haybusak University, Institute of Hydro-ecology and Ichthyology of the National Academy of Sciences of Armenia **Dr. Spartak Khutsishvili**, R. Agladze Institute of Inorganic Chemistry and Electrochemistry of TSU, Tbilisi, Georgia
13:00 – 14:00	**Invited speaker:** **Prof. Arkadiusz Modrzejewski**, Department of Political Science at the University of Gdansk, Poland
	Publication strategy: how to publish the scientific article being a young scholar
14:00 – 14:30	**Invited speaker:** **Prof. Fred Lisdat.** Biosystems Technology, Institute of Applied Life Sciences and Biomedical Technologies, Technical University of Applied Sciences Wildau, Wildau, Germany
	Introductory course in impedance spectroscopy and its usefulness in studying sensing interfaces
14:30 – 15:00	**Invited speaker:** **Prof. Aleko Kalandia,** Chemistry Department, Batumi Shota Rustaveli State University, Batumi, Georgia
	The study of the physical-chemical characteristics of field honey, common in Western Georgia
15:00 – 16:00	**Lunch**
	Moderator: **Prof. Vusala Majidzade**, Institute of Catalysis and Inorganic Chemistry, Baku, Azerbaijan **Dr. Lela Kvinikadze**, Main Researcher, TSU Institute of Inorganic Chemistry and Electrochemistry
16:00 – 16:30	**Prof. Tamaz Karkusashvili**, Faculty of Chemical Technology, basic organic and petrochemical synthesis technology, Technical University of Georgia, Tbilisi, Georgia
	Modern methods of teaching chemistry. 21st century challenges in public school
16:30 – 17:00	**Invited speaker:** **Prof. Etibar Ismailov**, Institute of Catalysis and Inorganic Chemistry, Azerbaijan National Academy of Sciences, Baku, Azerbaijan
	Catalytic hydrogenation of carbon dioxide. Achievements and prospects
18:00-18:30	**Coffee break**

	SATURDAY, 25 NOVEMBER **I. Gogebashvili Telavi State University, Telavi, Georgia)**
	Moderator: **Prof. Arkadiusz Modrzejewski,** Department of Political Science at the University of Gdansk, Poland **Tamar Aslanishvili,** Head of International Relations, Telavi State University, Telavi, Georgia
12:00 – 12:30	**Invited speaker:** **Prof. Sylwia M. Mrozowska**, Vice-Rector for Innovation and Liaison with Business and the Community, Associate professor at the Institute of Political Science at the University of Gdansk, Gdansk, Poland
	Transferable skills for early-career researchers. Challenges and Recommendations
12:30 – 13:00	**Invited speaker:** **Prof. Marine Nalbandyan,** Institute of Geological Sciences of the National Academy of Sciences of the Republic of Armenia, Yerevan Haybusak University, Yerevan, Armenia
	Modern methods of assessing the impact of air/water/soil/pollution on human health. Problems, Solutions
13:00 – 14:00	**Invited speaker:** **Prof. Nino Chkhartishvili,** Faculty of Agrarian Sciences and Biosystems Engineering, Georgian Technical University, Tbilisi, Georgia
	Kvevri wine is a Georgian phenomenon; Kvevri wine production - traditions and modern approaches; Antioxidant compounds and effects of wine on human health.
14:00 – 14:30	**Invited speaker:** **Prof. Mariam Tsatsanashvili**, Research Institute of Public Administration, Georgian Technical University, Teaching-Research Scientific Center, Tbilisi, Georgia
	Technologies in cultures
14:30 – 15:00	**Concluding Remarks**

NPN
NANO PROCESSES AND NANOTECHNOLOGIES



“From Idea to Implementation” 2023

2nd International Scientific Conference & seasonal school

NPN-O-01

INNOVATIVE 2D MATERIAL FOR NANOELECTRONICS, MOLECULAR SENSING, OPTICAL PROPERTIES AND CATIONIC POLLUTANT REMOVAL FROM AQUEOUS SOLUTIONS

S. Bellucci

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This study aims to investigate the electronic and plasmonic properties of Silicene nanostrips (SiNSs) with a minimum width of 100 nm using a semi-analytical model that utilizes the carrier velocity of silicene. Our results reveal that SiNSs with widths ranging from 100 to 500 nm exhibit small bandgaps within the range of a few meV, specifically ranging from 30 to 6 meV, respectively. Furthermore, all the nanostrips analyzed in this study exhibit a √q-like plasmon dispersion within the THz regime (≤ 35 THz).

We then present an analogous analysis of the electronic and plasmonic behaviour of periodic planar distributions of sufficiently wide graphene nanoribbons, for which a thorough ab initio investigation is practically unfeasible. By our approach, we show that the plasmon resonance energies of the scrutinized systems fall in the lower THz band, relevant for optoelectronic and photonic applications.

The lower-terahertz behaviour of the bulk plasmon is explored, highlighting the limits of available non–ab initio approaches, suitable for stripes of graphene being tenths of nanometers wide. Then, an effective model is derived from the ab initio framework, which reasonably accounts for the two-plasmon response of the studied, ultranarrow nanoribbon systems, at small momentum transfers.

Lastly, we review the recent result of our group on the effective and efficient removal of cationic pollutants from aqueous solutions using eco-friendly prepared oxidized graphene. This adsorbent material has the advantage of a fast adsorption and keeps a good efficiency over a wide range of initial cationic pollutant concentrations and a broad range of pH values. Thus, we can propose the use of this adsorbent material, as a green adsorbent for wastewater decontamination.

Acknowledgments

This work was carried out in collaboration with the Grupo de Investigación Ciencia y Tecnología de Materiales, Universidad Técnica Particular de Loja, Loja 110160, Ecuador, the School of Physical Sciences and Nanotechnology, Yachay Tech University, Urcuquí 100119, Ecuador, the ITECA—Instituto de Tecnologías y CienciasAvanzadas, Villarroel y Larrea, Riobamba 060104, Ecuador, the Faculty of Mechanical Engineering, Escuela Superior Politécnica de Chimborazo, Riobamba 060155, Ecuador, the Instituto Tecnológico de Santo Domingo, Área de CienciasBásicas y Ambientales, Av. Los Próceres, Santo Domingo 10602, Dominican Republic, UNICARIBE Research Center, University of Calabria, I-87036 Rende (CS), Italy, the Surface Nanoscience Group, Department of Physics, University of Calabria, Via P. Bucci, Cubo 33C, I-87036 Rende, Italy, and the INFN, Sezione LNF, Gruppo Collegato di Cosenza, Via P. Bucci, I-87036 Rende, Cosenza, Italy

NPN-O-02

MULTIFUNCTIONAL NANOSYSTEM: AN ADVANCED PLATFORM FOR CANCER TREATMENT

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L. Saneblidze[2]***, N. Mitskevich***[1]
[1] Iv. Javakhishvili Tbilisi State University, Division of Immunology and Microbiology, Tbilisi, Georgia.
[2] V. Chavchanidze Institute of Cybernetics of the Georgian Technical University, Tbilisi, Georgia
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Huge number of studies in recent years suggest that the prospect of using magnetic nanoparticles in biomedicine is becoming critical in new drug development process. The nanosystems are equipped with the unique functions, which sometimes remind researchers of medical nanorobots, the ones that worth mentioning are: transportation of various substances, accurate targeting and delivery to the intended organ, the ability to discriminate living organisms in the medium, adsorption and removal of toxins through a magnetic field. Nowadays one of the main focuses in a targeted delivery of drugs are chemotherapeutic agents, due to its broad cytotoxicity and strong side effects it is essential to develop a treatment, which will ensure the effective delivery of the substance to tumor side with few to none complications for the patients. The main goal of the research was the synthesis of medical multifunctional iron oxide nanoparticles and the study of its uptake and effectiveness in an experimental tumor model.

First, nanoparticles were synthesized on the automated continuous technological line of well-known controlled co-precipitation method. It is noteworthy, that so the above-mentioned technological line includes an electrohydraulic unit to maintain the integrity and reproducibility of the nanosystems. within the framework of the project, the obtained magnetic nanoparticles were coated with various different biomolecules such as citric acid or polyethyleneimine, and folic acid to ensure affective targeting and loaded with chemotherapeutic agent Doxorubicin.

On next stage synthesized nanosystems were characterized in our nanocomposite laboratory using X-ray diffraction, Fourier Transform Infrared Spectroscopy, Vibrating Sample Magnetometry, Dynamic Light Scattering, Electrophoretic Light Scattering and UV-VIS Spectrophotometry to ensure the desired physicochemical characteristics were achieved.

Afterwards cytotoxicity was assessed using the MTT method, namely the number of surviving cells was measured by spectrophotometry at 570 nm wavelength using an ELISA reader. And the uptake of the nanosystems were evaluated by means of fluorescence microscopy (Zeiss). As a result, it was revealed that given nanosystems are characterized by rapid uptake into the body, which is confirmed by the *in vivo* study conducted on CD1 mice. And effective antitumor activity was confirmed by in vitro research, where a strong cytotoxic effect was observed in almost all cancer cell lines. As expected, nanoparticles coated with folic acid are more cytotoxic than chemotherapeutic drugs alone. As a conclusion, the effectiveness of nanosystems revealed, first of all, as a therapeutic agent superior to the traditional chemotherapy and then as a successful drug delivery system.

NPN-O-03

FORMATION OF MAGNETIC MATAL-CONTAINING POLYMER NANOCOMPOSITES AND THEIR PROSPECTS

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The uniqueness of metal-containing nanocomposites is determined by their fundamentally different properties compared to the original substances. This uniqueness is closely related to the formation and stabilization of nanoparticles in a polymer material, its supramolecular self-organization and the stabilizing properties of the original matrix. In addition, the formation of nano-sized particles in organic polymer matrices is a complex multi-stage process. Therefore, studying the formation of a nanosystem, establishing the mechanisms of formation of nanoparticles, accurately characterizing the resulting objects and explaining their unusual properties are important and extremely urgent tasks.

This study is of particular relevance due to the widespread use of metal-containing organic nanosystems in biomedicine [1-3], therefore modern nanochemistry is forced to be increasingly demanding both in terms of physicochemical research methods and in monitoring the properties of resulting nano-sized materials, including magnetic nanoparticles. It is known that composites containing particles of transition and noble metals are, as a rule, paramagnetic, superparamagnetic or ferromagnetic. The polymer acts as a stabilizing agent, enveloping the nanoparticle and protecting it from the effects of the external environment. Such shells can be natural (for example, polysaccharides) and synthetic polymers.

Since the world community is wary of the use of new generation materials, the question of the need for systematic development of methods for controlling such substances is urgently raised. The properties of nanomaterials are determined by such parameters as chemical composition, type of crystal lattice and degree of defectiveness, particle size and shape, morphology (for structurally heterogeneous particles), interaction of particles with the surrounding organic matrix and neighboring particles. Thus, the study of synthetic and structural features, magnetism and other properties of nanomaterials based on organic matrices is an integral part of modern science in the global community.

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NPN-O-04

CREATION AND STUDY OF G4 PAMAM DENDRIMERS ENCAPSULATED WITH SILVER AND GOLD ATOMS

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Recently, for scientific research in nanomedicine a major challenge is to deliver medication in the local area of the disease or tumor, which allow us to maximize clinical benefits and reduce the side effects of the drug. Also, the recent attention in modern medicine is drawn to photochemical therapy and photothermo-therapy of malignant and nonmalignant tumors.

The study proposes for the photo-thermotherapy a new stable nano-size metalorganic nanocomplexes – silver and gold atoms encapsulated PAMAM dendrimers -which are less toxic, but after irradiation they become highly toxic, which allows them to be used in nanomedicine.

The main goal of the research was to study by absorption spectroscopy the actual and important object, such as a drug delivery nanoparticle - G4 PAMAM dendrimer - and using the unique properties of G4 PAMAM dendrimer create new, stable nano-sized (~5 nm) metalorganic nanocomplexes with silver and gold atoms, which have a strong absorption in visible area and it can be used as photothermotherapeutical agent for treatment of cancer cells.

We investigated the reduction of metal ions in G4-NH_2 PAMAM dendrimers using sodium borohydride, the reduction takes about an hour. Metalorganic nanocomplexes with low concentrations of silver (up to 28 Ag^0/G4) and gold (up to 16 Au^0/G4) atoms have absorption spectra similar to the spectra of coresponding spheric nanoparticles. An increase in the concentration of silver and gold atoms encapsulated in PAMAM dendrimers leads to broadening of the spectra and the formation of a second peak, which can be explained by a change in the shape of the nanoparticles from spherical to rod-like (see Figure 1).

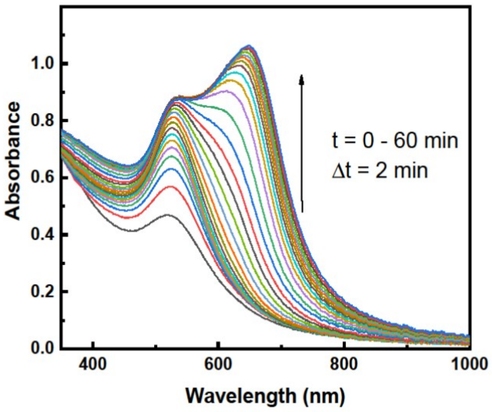

Figure 1. Spectra for gold ions reduction in complexes G4-NH_2 PAMAM dendrimer-Au^{3+}-BH_4^-
The ratio of gold ions over G4-NH_2 PAMAM dendrimer was 22/1.

The work was supported by Shota Rustaveli National Science Foundation of Georgia STEM-22-1347.

NPN-O-05

CONTEMPORARY ISSUES OF NANOTECHNOLOGIES IN THE DRUG DEVELOPMENT OF PHARMACO CHEMISTRY AND INTRODUCTION OF CURRICULUM IN MEDICINE

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Currently, the pharmaceutical industry is dominated by the emerging field of nanotechnology-based pharmaceuticals. After the cyber revolution of the 70s of the 20th century, a new era of next revolutionary technologies began. The US National Nanotechnology Initiative, launched in 2002, was a timely effort supported by the government through science activists.

The first nanosized albumin-bound paclitaxel was approved by the US Food and Drug Administration in 2005. After the expiration of the 20-year patent period, generic forms of the drug appeared on the pharmaceutical market, which are much cheaper than the original. This factor has led to increased cost-effectiveness and budgetary accessibility in healthcare.

It was necessary to include a medical nanotechnology in the curriculum, which proved quite problematic in the already crowded medical training programs. [1] [2] [3]

A questionnaire was developed for submission to the Curriculum Committee for the needs assessment among both academic staff and students. SPSS 11 software was used to evaluate statistical data, then articles were published and presented at conferences.

TSU became the first university in Georgia to approve Medical Nanotechnologies curricula as an elective subject, and from the 2022/23 academic year it have been successfully taught at the Faculty of Medicine, both in Georgian and English speaking faculties.

The curriculum includes the most popular topics of the current state of the science, including, but not limited to the following [4]: 2022 Nobel Prize for technological advances in ‘click’ chemistry by C. Barry Sharpless et al.; water purification using carbon filters enriched with fullerenes, used in the environment, as well as in dialysis centers in the hospital sector; green synthesis of quantum-sized gold nanoparticles using special bacterial strains; RNA nanomotors that provide bacteriophage-controlled movement; Dendrimer polymers for new teranostic (therapeutic/diagnostic) applications; Boron Neutron Capture Therapy in oncology (BNCT) [5]; biodegradable polymers for targeted drug delivery; NMR spectroscopy in analytical chemistry; ‘In silico’ studies of nano-toxicology; transfer of technological innovations from academia to industry and the role of university technology transfer organizations, etc.

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NPN-O-06

SYNTHESIS AND CHARACTERIZATION OF IRON-CONTAINING PP AND HDPE BASED COMPOSITES

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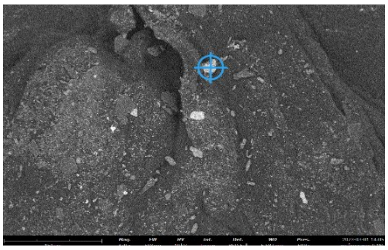
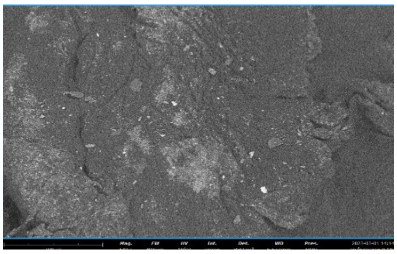
Composites with a polymer base are widespread and are used in various fields, ranging from the electronics to medical industries, in solving a number of special problems. In the presented work the results of a study using scanning electron microscopy in combination with elemental analysis (SEM/EDS), X-ray diffractometry (XRD) and electron magnetic resonance (EMR) and thermal analysis (TG-DTG-DTA) of iron-containing composites based on polypropylene (PP) and high-density polyethylene (HDPE) for the purpose of using them in combination with hydrogen peroxide to purify water from phenol and related organic toxic compounds were given. As precursors for these composites ferrocene, synthesized in the laboratory of catalysts based on metal-organic compounds of the Institute of Catalysis and Inorganic Chemistry (Baku, Azerbaijan), PP and HDPE produced by the SOCAR Polymer plants (Sumgait, Azerbaijan) were used. Samples of the above composites were obtained by hydrothermal synthesis and coprecipitation methods. Figure 1, a and b show, respectively, micro-photos of the surface and EDS data of element composition for composite based on PP obtained by coprecipitation method.



Element Number	Element Symbol	Element Name	Atomic Conc.	Weight Conc.
6	C	Carbon	87.923	78.500
8	O	Oxygen	9.668	11.500
26	Fe	Iron	2.409	10.000

a) FW: 593 µm, Mode: 10 kV - Image, Detector: BSD Full



Element Number	Element Symbol	Element Name	Atomic Conc.	Weight Conc.
6	C	Carbon	89.808	82.900
8	O	Oxygen	8.701	10.700
26	Fe	Iron	1.491	6.400

b) FW: 809 µm, Mode: 10 kV - Image, Detector: BSD Full,

Figure 1. SEM micro-photos and EDS data for 4 wt.% Fe-PP composite for: a) spot and b) region images

The EMR data show the formation of superpara/ferromagnetic iron-containing particles.

NPN-P-01

THE ROLE OF NANOCOMPOSITES IN PHARMACY

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Scientists around the world try to develop and create effective anthelmintic drugs that will play a positive role in well-being ofbothhumans and all kinds of birds and animals. One of our directions is the development and production of nanomaterials and nanocomposites. Anthelmintics are divided into several groups. Albenzimidazole group is the most common and widely used among them, which is a heterocyclic aromatic compound containing benzene and imidazole rings.The drugs included in this group are benzimidazole derivatives.Anthelmintics are a group of antiparasitic drugs. They stun or kill the parasites in the organism and the parasites are expelled from the body without causing minimal damage [1]. Together with albendazole the drugs that are synthesized by us form nanocomposite materials.They, in turn, show maximum safety levels in terms of side effects. Four anthelmintic nanomaterials are the subject of our study:

1. $C_{12}H_{15}N_3O_2S$ x $CuSO_4$
2. $C_{12}H_{15}N_3O_2S$ x $Zn_3(PO_4)_2$
3. $C_{12}H_{15}N_3O_2S$ x $Ca_3(PO_4)_2$
4. $C_{12}H_{15}N_3O_2S$ x $CaCO_3$

The next stage of the synthesis of the presented nanocomposite materials is the study of their physiological activity[2]. The visual images of anthelmintic materials are given below:

Fig.1

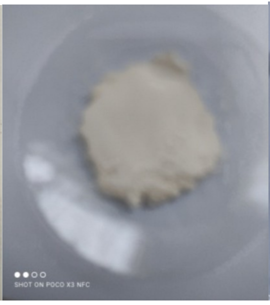

Fig. 2

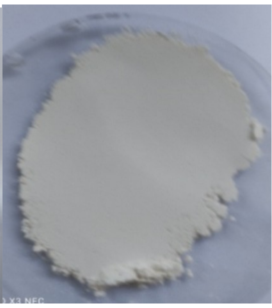

Fig.3

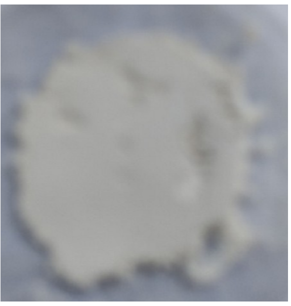

Fig. 4

Research on nanomaterials will continue until 2024-25 as the drugs require trial stages primarily on animals and birds. Minimum and maximum doses, optimal conditionsand contraindications will be determined and other necessary tests will be conducted.

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NPN-P-02

ELECTROLESS SYNTHESIS OF COBALT NANOWIRES IN MAGNETIC FIELD AND THEIR CHARACTERIZATION BY THE NMR SPIN ECHO METHOD

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This work proposes a simple and effective low-temperature electroless chemical method that provides the synthesis of cobalt micro- and nanowires due to the processes of self-organization of magnetic cobalt nanoparticles under the influence of a magnetic field, using the technology of chemical synthesis of magnetic nanoparticles and nanowires of [1].

Cobalt nanoparticles have magnetic dipole moments. The presence of an external magnetic field forces them to be oriented parallel to the field. Dipole-dipole interactions between magnetic nanoparticles lead to attraction between cobalt nanoparticles leading to their self-organization into nanowires, reducing their total energy. The resulting smaller nanoparticles fill the gaps between the ordered nanoparticles, leading to the formation of smooth cobalt nanowires.

The magnetic and structural properties of the synthesized nanowires were studied by NMR and electron microscopy methods. The characteristics of domain wall (DW) pinning (fixing) centers in cobalt nanowires were studied by the NMR spin-echo method using an additional magnetic video-pulse (MVP) acting in between two radio-frequency pulses in two=pulse spin echo method and alternatively in combination with radio-frequency pulses at observation of so-called magnetic echo [2].

It was shown in [2] that the use of nuclear spin echo of cobalt nanowire nuclei located in DWs in combination with MVP is a convenient method for studying DW pinning centers and their dynamics. This method is of interest for optimizing the synthesis of cobalt nanowires with a view to their possible use to create permanent magnets that do not use rare earth elements, as well as in information processing devices and sensors. As is known, the magnitude of the coercive force of a magnetic sample is directly related to the efficiency of pinning of a DW and, consequently, to the difficulty of its separation from the place of pinning.

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [FR-22-7899].

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NPN-P-03

SELECTION OF STARTING REAGENTS, REACTOR MATERIAL AND SYNTHESIS METHOD FOR SEMIINDUSTRIAL PRODUCTION OF PROMISING CATHOD MATERIALS FOR LITHIUM-ION BATTERIES

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The number of samples of nano-sized, phase-pure, cubic, inexpensive and less toxic promising cathode materials for lithium-ion batteries obtained in the laboratory is determined in grams. Works on their production in quantities of 1 kg or more and the study of their characteristics are practically not found in the scientific literature. Technologists are aware of the problems of transition to large-scale production; in particular, with an increase in the mass of the resulting material, their characteristics change noticeably. To obtain cathode materials in a semi-industrial manner, spinel $LiMn_2O_4$ and its derivatives $LiM_yNi_{x-y}Mn_{2-x}O_4$ (where M= Cr, Co; x=0.5 and y=0÷0.3) were synthesized by several methods using different starting reagents and reactors from different materials [1]. Based on the results of X-ray diffraction and X-ray phase analysis of the obtained samples, the initial reagents (Li_2CO_3, Mn_2O_3, Ni_2O_3, Cr_2O_3 and Co_2O_3), the synthesis method (with double quenching at 830^{0}C) and the reactor material (stainless steel) were determined. The synthesized samples were tested in coin-type half-cells (2032) using lithium metal as the anode. Based on the results obtained, we can conclude that the synthesized $LiNi_{0.5}Mn_{1.5}O_4$ sample has a high specific capacity - 110÷120 mAh/g, but at the same time is characterized by a sharp drop in capacity and structural instability, which leads to degradation of the cathode material. In the case of $LiCo_{0.2}Ni_{0.3}Mn_{1.5}O_4$, the initial capacity of the sample is lower (85 mAh/g) than that of the $LiNi_{0.5}Mn_{1.5}O_4$ we synthesized, although it is characterized by stability without degradation during cycling. As for the active material $LiCr_{0.3}Ni_{0.2}Mn_{1.5}O_4$, it has a higher initial capacity (95 mAh/g) than the cathode material $LiCo_{0.2}Ni_{0.3}Mn_{1.5}O_4$. In addition, the structure is stable during cycling and no degradation is observed. Capacity retention after 100 cycles is 97%. According to the results of testing the samples we obtained, despite the relatively low initial capacity, they can be used in a tablet (coin) element, since they maintain the stability of the structure during cycling. The results of the tests indicate the need to continue work to improve the electrochemical characteristics of cathode materials obtained in semi-industrial conditions. If there is demand, cathode materials will be accumulated for transfer to interested organizations.

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NPN-P-04

AQUEOUS SUSPENSIONS OF SUPERPARAMAGNETIC IRON OXIDE NANOPARTICLES STABILIZED WITH ORGANIC MOLECULES: SYNTHESIS AND CHARACTERIZATION

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Nanomedicine has shown immense interest in superparamagnetic iron oxide nanoparticles (SPIONs) for diverse biomedical applications, such as imaging and drug delivery. Achieving precise control over the size, shape, and distribution of nanoparticles is pivotal for their effectiveness [1, 2].

The stability of the SPIONs in a biocompatible dispersion medium, the net magnetic moment, phase composition, type, and properties of stabilizers are other important factors that affect the physicochemical and pharmacokinetic characteristics of SPIONs containing nanocomposite [3, 4].

Our study focuses on the development of aqueous SPION suspensions stabilized with organic molecules (dextran and PVA) using a modified controlled chemical coprecipitation reaction.

Through rigorous characterization techniques including X-ray diffraction (XRD), fourier transform infrared spectroscopy (FTIR), dynamic light scattering (DLS), electrophoretic light scattering (ELS), ultraviolet-visible spectroscopy, transmission electron microscopy (TEM), and vibrating sample magnetometry (VSM), we determined that the synthesized SPIONs consist of magnetite nanocrystals (Fe_3O_4) with an inverse cubic spinel structure. The surface coatings of PVA and dextran did not induce phase changes in magnetic nanoparticles. Notably, PVA-coated nanoparticles exhibited irregular shapes, ranging from spherical to oval to cubic, with a size range of 10–20 nm.

Crucially, our research demonstrated that iron oxide nanoparticles coated with PVA or dextran both had superparamagnetic characteristics and exceptional colloidal stability in water at pH values close to physiological values. Particularly, PVA-coated nanoparticles exhibited higher magnetization compared to their dextran-coated counterparts. These findings underscore the significance of magnetic nanoparticle surface characteristics optimization for biomedical applications.

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NPN-P-05

ELECTRODEPOSITION AND BAND-GAP DETERMINATION IN Fe-Se THIN FILMS

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Thin semiconductor chalcogenide films have attracted the attention of many researchers around the world due to their wide range of applications in photovoltaic, optoelectronic devices, photodetectors, and solar energy converters [1–2]. Recently, much attention has been paid to iron chalcogenides due to their usefulness in magnetoelectronics, spintronics and solar cells. Iron selenides are an understudied semiconductor that is extremely promising for use as an active layer in solar photovoltaic and photoelectrochemical cells. The iron selenide system has two homogeneous and stable phases α-FeSe and $FeSe_2$. The α-FeSe phase crystallizes in tetragonal and hexagonal structures, and the $FeSe_2$ phase crystallizes in the form of marcasite with an orthorhombic shape and a cubic structure. It is a p-type semiconductor with a bandgap of 1.03 eV, which makes it quite interesting for the production of tandem solar cells [3–4]. Iron selenide has recently received much attention due to its unusual structure and electronic properties.

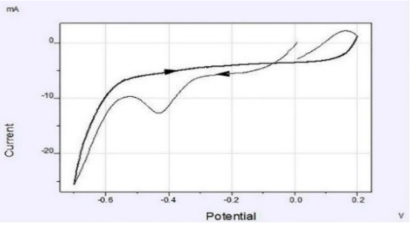

Fig. 1. Cyclic polarization curve of co-electrodeposition of Fe and Se from an aqueous electrolyte onto a Ni electrode. Electrolyte (M): 0.035 $Fe(NO_3)_3$ + 0.0025 H_2SeO_3; T=298 K, E_V=0.02 V/s.

The reduction of selenite ions to selenium is noticeable on the polarization curve of co-electrodeposition of iron with selenium on the surface of the Ni electrode at potential intervals of 0.0 - (-0.3) V, (Fig. 1). Starting from a potential of -0.3 V to -0.4 V, selenium atoms are reduced to selenide ions. Further, after -0.4 V potential, the resulting selenide ions combine with iron ions in the electrolyte forming a thin layer of iron monoselenide. The co-deposition process was also studied on the surface of a Pt electrode. Co-deposition on the Pt electrode occurs at a potential range of 0.65 – (-0.6) V. Here the potential range of 0.65 - (-0.38) V corresponds to the electroreduction of selenite ions. After a potential of -0.38 V, the selenide ions formed in the electrolyte interact with iron ions, and thin Fe-Se layers were deposited. In addition, the influence of some factors, such as the concentration of starting substances, temperature, scan rate etc. was studied. The obtaining of thin Fe-Se films was confirmed using X-ray phase analysis and Raman spectroscopy. The band gap was determined by measuring the resistance of the resulting films on the nickel substrate.

Using resistance, the electrical conductivity is calculated and then the dependence between lnσ - 1/T is plotted. Next, we calculate tanα from the resulting straight line. The band gap of Fe-Se thin films calculated using the equation ΔE=2κ tgα is 1.26 eV.

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NPN-P-06

SHOCK WAVE ASSITED CHEMICAL REACTIONS AND FABRICATION OF TANTALUM ALUMINATES

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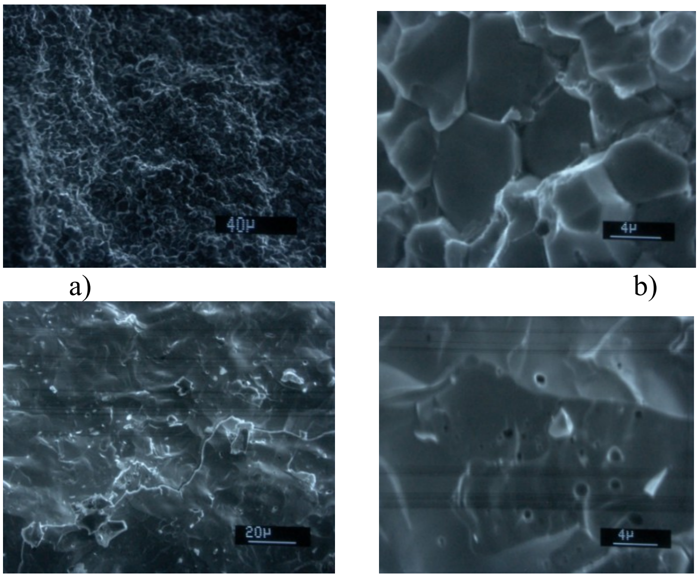
The Ta-Al powder blends were formed into cylindrical rods using a hot shock-wave consolidation method. The aim of investigation was to synthesize and to fabricate different tantalum aluminates near to theoretical value of density without cracking and perfect structure. The processing temperature were changed up to 1000^0C. The intensity of loading was under the 10GPa.



a) b)

c) d)

Fugure 1. The SEM fractures of different composition Ta-Al intermetalic composites obtained after shock wave consolidation-sinthesis at 940 ^{0}C with intensity of loading under 10GPa. a-b) The fractures of sinthesized $TaAl_3$ intermetalics at different magnification; c-d) The fractures of sinthesized Ta_2Al. The difference in sinthesized particle size is observed (b & d).

The investigation showed that the combination of high temperature and shock wave loading was beneficial to the consolidation different stoichiometry tantalum aluminates. The structure and quality of obtained billets depends on value of temperature and intensity of loading. It was established that only above the 900^0C temperature it's possible to obtain full synthesized tantalum aluminate in whole volume of billets. Additionally, it was established too that in the equal conditions during the consolidation-synthesis of different stoichiometry precursors the morphology and characteristics of structure are different too.

The above mentioned as well as other features of structure-property relationship depending on the consolidation-synthesis condition will be presented and discussed too.

NPN-P-07

MODIFICATION OF NATURAL ZEOLITES TO OBTAIN NANOMATERIALS

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Zeolites are aluminosilicates described by the general formula $M_nSi_xAl_nO_{2(n+x)}\cdot mH_2O$ ($M^+ = Na^+$, K^+, $\frac{1}{2}Ca^{2+}$, etc.) with the crystal lattice constructed from alternating SiO_4 and AlO_4^- tetrahedrons forming cavities and channels of molecular dimensions; zeolites find various applications, especially in adsorption, ion exchange and catalysis. Cheap natural zeolites differ from structurally homogeneous and monocationic (usually M = Na) synthetic zeolites in their variable cationic composition, the presence of mesopores with a diameter of over 2 nm, as well as in the presence of crystalline and amorphous mineral impurities (quartz, clay minerals, iron oxides, etc.), the content of which can exceed 20% by weight. Large ions and impurities block the “entrance windows” formed by -O-Al-O-Si-O-... rings, and natural zeolites have a specific active surface area of the order of 10 square meters per gram, while in synthetic zeolites this indicator is several hundred square meters. Acid treatment is a powerful tool for improving the performance of natural zeolites, and using the example of heulandite from the Dzegvi-Tedzami deposit, it was shown that treating tuff with hydrochloric acid solutions with concentration up to 2 N leads to an increase in surface area by more than an order of magnitude. It has been established that as a result of acid treatment, significant dealumination (the molar ratio of Si/Al increases from 3.6 to 9.5) and decationization (the total charge per aluminum atom decreases from 1 to 0.68) occurs; sodium is mainly leached, magnesium to the lesser extent, while calcium and potassium do not take part in the decationization process. Powder X-ray diffraction patterns show that hydrochloric acid solutions do not lead to amorphization of the microporous crystalline structure of the zeolite, but the weight loss of the samples during processing indicates the gradual dissolution of the crystalline structure in an acidic environment. Measurements of the adsorption of water vapor, benzene and nitrogen show that micropores, regardless of treatment, are open to the entry of small polar molecules; as a result of acid treatment, the hydrophobicity of the surface increases slightly, but micropores become accessible to large non-polar molecules, and changes occur in the mesoporous system, leading to the predominance of pores with a diameter of 3–10 nm. In addition, it has been shown that pre-heat treatment slows down the dealumination process, and thereby increases the acid resistance of natural heulandite.

Acknowledgements

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NPN-P-08

DEVELOPMENT OF METHODS FOR OBTAINING NANOCOMPOSITES, CONTAINING REDUCED GRAPHENE OXIDE

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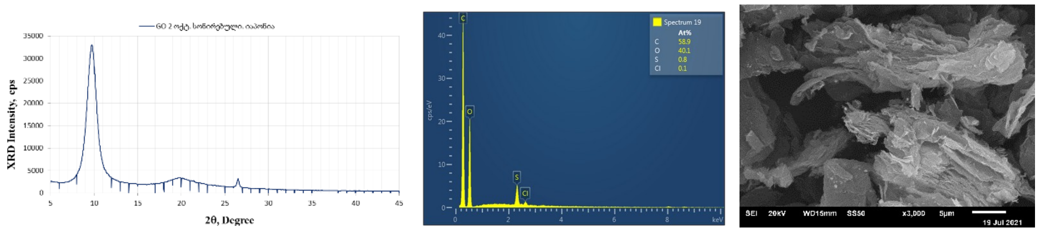
Graphene oxide (GO) and reduced graphene oxide (rGO) are graphite single layer (graphene) oxidation products. rGO is a reduced product of GO [1]. They contain organic functional groups (carboxylic, carbonyl, hydroxyl, epoxide). Their future functionalization (immobilization) with organic or inorganic precursors may be performed. They are macroligands and form various types of complexes with inorganic salts. GO and rGO were obtained by the oxidation of powders of flake graphite and graphite foil (commercial name Graflex, Grapfoil) [2]. The synthesis methods of metal- (rGO-Ag, rGO-Cu, rGO-Au, rGO-Pt) and metal oxide containing GO-MexOy (MexOy=Cu_2O, CuO, Fe_2O_3, Fe_3O_4, TiO_2, ZnO, CoO, NiO, ZrO_2, MgO) nanocomposites has been elaborated, that are based on vacuum-thermal exfoliation of graphene oxide complexes at 100-130^0C [3,4]. Nanocomposites containing nanosized metal and metal oxides are obtained by the following chemical transformations:

$$\text{Graphite} \longrightarrow \text{GO} \qquad \text{GO-salt complex} \longrightarrow \text{rGO-Me (or rGO-MexOy)}$$

By XRD method it is established, that the diffraction maximum GO (2θ = 10-11 °) disappears and a new peak is formed at 22-25°, which corresponds to rGO. By vacuum-thermal treatment is obtained rGO, which is exfoliated into nanolayers on the surface of which metal or oxide nanoparticles with a size of 6-30 nm are deposited. The SEM image of rGO-Ag nanocomposite obtained by this method is given in Fig. 1.



a b c

Fig.1. The X-ray diffraction pattern of GO (a), its EDX spectrum (b) and SEM image rGO-Ag nanocomposite (c), obtained in vacuum at 120^0C.

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NPN-A-01

ELECTROCHEMICAL SYNTHESIS OF MAGNETITE NANO PARTICLES

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Nanomagnetite is used mainly in the biomedical field, namely hyperthermia, targeted drug delivery, magnetic resonance imaging (contrast agent) and others. Magnetite is successfully used in information recording and storage systems, in quantum computers, in ecological direction in the field of cleaning water and soil from organic pollutants; it is a good adsorbent, separator and catalyst. Magnetic nanoparticles are characterized by good biocompatibility and low toxicity. In recent years, magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) have been widely used in the biomedical field. Obtaining magnetite by electrosynthesis is described in many articles, where both simple and complex electrolytes are used as electrolytes. Electrolysis parameters - electrolyte concentration, current density, temperature, voltage, magnetite particle size, magnetic parameters and other properties can be changed [1-3].

The construction of the cathode is of crucial importance in obtaining nanoparticles. The cathode is a disc mounted on a rotating shaft. The disc rotates in a two-layer bath so that one half of it is in the aqueous phase and the other in the organic phase. As the cathode rotates, each point is recorded with angular and linear velocity. Points that lie on the same line from the center have the same angular velocity, period, and frequency, but differ in linear velocity. Accordingly, during the rotation of the steel disc used as a cathode during electrolysis, the points located on it have different linear speed, delay time in the electrolyte, and the current density developed at the points located on a circle with different radii. All of the above causes the polydispersity of the obtained band. A new construction of the cathode was created in order to approximate the linear velocities of the points located on different circles. Instead of a whole disc, a very narrow arc is left, which increases the monodispersity of the metal nanostrip.

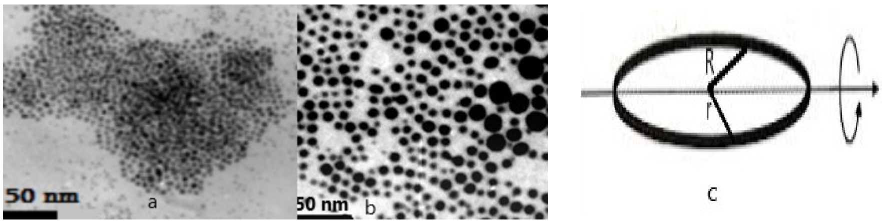

Fig. 1. a) Magnetite nanoparticles synthesis on arc-shaped cathode, b) magnetite nanoparticles synthesis on disc shaped cathode c) arc-shaped cathode

In the case of a narrow arc-shaped cathode, the particles that are recovered on the cathode are characterized by approximately the same linear velocity, delay time in the electrolyte (organic phase), equal sorption of surfactants on the active centers of the cathode, and almost the same current density developed at all points of the cathode. Using an arc instead of a disk provided an increase in the monodispersity of the nanostrip.

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NPN-A-02

ELECTROCHEMICAL DEPOSITION AND CORROSION RESISTENCE STUDY OF NiP@Al_2O_3 AND Zn@Al_2O_3 COMPOSITE COATINGS

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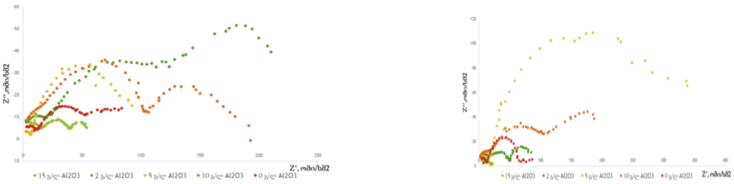
A thin layer of metal, alloy or composite coating protects the product surface from damage. Coatings containing Ni, Zn, its alloys and various composites are used in various aggressive environments due to their good corrosion resistance and low cost[1-3]. Nickel and its alloys are preferred as protective coatings because they are characterized by such important properties as high strength, impact viscosity and high corrosion resistance to air. Due to these characteristics, Ni-Co and Ni-Co-P coatings successfully replace chromium coatings that are hazardous to health and the environment. Nickel-phosphorus alloy is used in electronics, corrosion- resistant coatings, magnetic recording equipment, oil and gas industry and more. Coatings obtained by electrolysis, especially NiP@Al_2O_3 composite material, have a fairly high corrosion resistance, which was confirmed by the stability of the stationary potential taken with a potentiostat. γAl_2O_3 is added to the Zinc and Nickel matrix as a filler to increase the corrosion resistance of the coating. A composite coating of Zn@$\gamma Al_2O_3$is obtained from ammoniacal and sulfate electrolyte solutions. The effect of γ-Al_2O_3 content in the electrolyte on zinc current output and corrosion stability at different current densities is determined. Corrosion potential, corrosion current density and corrosion rate are determined from the polarization curves of coatings obtained in sulfate and ammonia solutions containing different concentrations of γ-Al_2O_3. Impedance spectroscopy is additionally used to study the corrosion processes, which provides a lot of information about the processes taking place at the electrode/electrolyte boundary. It allows studying the kinetics and mechanism of corrosion processes without interfering with the process.



a) sulfate electrolyte b) Ammoniacal electrolyte

Fig. 1 impedance spectroscopy of Zn@γAl_2O_3 coatings bobtained in a) sulfate and b) Ammoniacal electrolyte.

Based on the total impedance determined from the impedance spectroscopy of the coatings obtained in sulfate and ammonia solutions, the optimal content of γAl_2O_3 in the case of ammonia electrolyte is 2-10 g/l, and for sulfate electrolyte it is 5-10 g/l.

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NPN-A-03

FIRST *A*PRIORI THEORETICAL EVALUATION OF THE NANO-CuS-ASSISTED ELECTROOXIDATIVE DETERMINATION OF ANTIBIOTIC FLAVOCILLIN

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The discovery of penicillin by Alexander Flemming in 1929 has changed the history of medicine forever. The cure for many dangerous diseases became more efficient and safe, as it didn't need any dangerous compounds like corrosive sublimate or salvarsan anymore. Penicillins were nearly the first antibiotics successfully applied to the vast variety of infections caused by staphylococci and streptococci. They are still widely used worldwide. Nevertheless, many types of bacteria have developed resistance, due to β-lactamase enzyme action. In this aspect, penicillin antibiotic structure undergoes modification, in order to provide β-lactamase inhibition.

Flavocillin is an antibiotic, newly reported by Mustafa Pehlivan and his group. Containing both flavone and penicillin derivatives, it is claimed to either increase the suscebility of various bacteria to β-lactam group, or relief the oxidative stress, due to the flavonoid group antioxidant properties. Nevertheless, the independent investigation of flavocillin properties are still in course. Moreover, the investigation of side and adverse effect is still pending. Also, the possibility of its veterinary use, by which it will be detected in animal products (milk and meat) is also viable. Either way, the development of an efficient quantification methodology for flavocillin is really actual, and the electrochemical methods, yet applied to both flavonoids and penicillin may be easily applied to it.

Considering the flavocillin structure, we may conclude that both anodic and cathodic determination may be viable for this molecule, being the cathodic route the most preferable, due to the presence of strong acceptors. Nevertheless, the anodic process may also be carried out on strong oxidants. If nano-CuS is used, an aggressive oxidant copper (III) sulfohydroxide is formed. For this reason, the aim of this work is to investigate *a priori* the possibility for flavocillin electrochemical determination on CuS/CuS(OH)-modified electrode, which includes the mechanism suggestion and the correspondent mathematical model investigation with the comparison of the behavior of this system with that of the similar ones.

NPN-A-04

THE THEORETICAL DESCRIPTION FOR AESCULETIN AND QUERCETIN CATHODIC ELECTROCHEMICAL DETERMINATION IN WINES ON CuS NANOPARTICLES

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Douro wine is one of the symbols of Portugal. Douro wine region was the first demarked in XVIII century. It has its own characteristic scent and flavor, due to the presence of some aromatic lactones. But the main alimentary value to the vine is given by its polyphenolic composition.

On the other hand, the chestnut *C. Sativa* is one of the most important product and ingredient for the cuisine of Trás-os-Montes. The districts of Vila Real and Bragança produce 25% of Portuguese chestnut. Its pulp and flowers also possess high concentrations of flavonoid (for example, quercetin) and coumarinic (for example, aesculetin) polyphenols, mainly those with hydroquinonic moiteies (Fig. 1), which, in quinonic forms, act as antioxidants and conservants, being thereby candidates for substitution of sulfite in wine preparation.

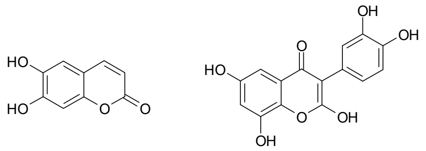


Figure 1. Aesculetin and quercetin

The analysis of the mathematical model, correspondent to the reaction mechanism, lets us conclude that, although the oscillatory behavior remains highly probable, the electroanalytical process, based on CuS-assisted reaction, may be efficient, but, in some cases, less efficient than cathodic route.

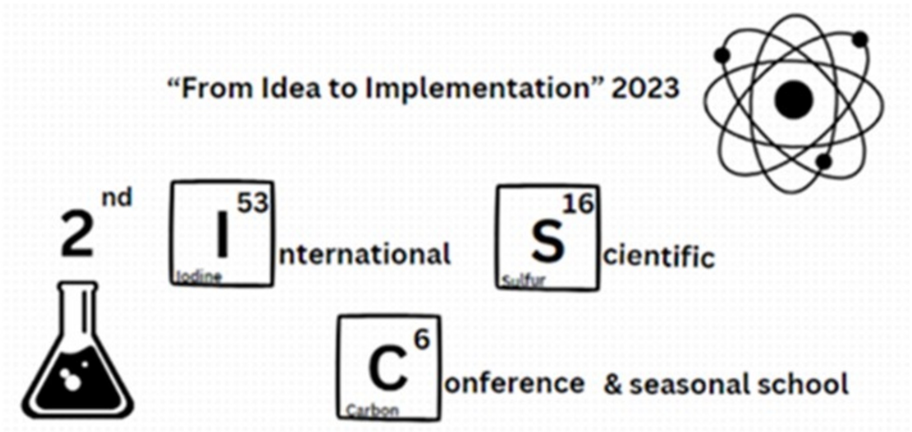
In this aspect, the electrochemical determination of both aesculerin and quercetin in wine becomes actual, and the anodic determination is the most viable in this case, although cathodic one is also possible. If cobalt oxyhydroxide is used for this purpose, the electrooxidation will be given by quinone-hydroquinonic mechanism, manifesting specific oxidation peaks.

Nevertheless, if CuS nanoparticles are used in alkaline medium, the in situ formation of an aggressive oxidant, which is trivalent copper, the electropolymerization scenario also becomes possible. For this reason the behavior of this system will be described by a trivariant equation'set (1):

$$\begin{cases} \frac{da}{dt} = \frac{2}{\delta}\left(\frac{\Delta}{\delta}(a_0 - a) - r_{11} - r_p\right) \\ \frac{dq}{dt} = \frac{2}{\delta}\left(\frac{D}{\delta}(q_0 - q) - r_{12} - r_p\right) \\ \frac{dv}{dt} = \frac{1}{v}\left(r_{11} + r_{12} + r_p - r_2\right) \end{cases} \quad (1)$$

FPTA

FUNDAMENTALS OF PROCESSING OF MINERALS AND SECONDARY RAW MATERIALS AND TECHNOLOGICAL ASPECTS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FPTA-O-01

REASONS FOR USING NATURAL ZEOLITES OF GEORGIA

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The famous American geologist and mineralogist F.A. Mumpton, in an article published at the end of the 20th century [1], called zeolites “La Roca Magica – a magic stone” and predicted the rapid development of research and applications of zeolites in the 21st century. The scientist’s prediction came true, as evidenced not only by numerous reviews of studies on the possibilities of using natural and synthetic zeolites in industry, agriculture, medicine, environmental protection and other fields, but also by the actual implementation of the results of these studies in practice and everyday life. To date, the International Zeolite Association identifies 251 zeolite structures [2], of which about 40 have natural analogues. Georgia is rich in natural zeolites such as heulandite-clinoptilolite, analcime, mordenite, laumontite and phillipsite; scolecite, chabazite and others are also found.

The most studied and used natural zeolite in Georgia is the heulandite-bearing tuff of the Dzegvi-Tedzami deposit (approved industrial reserves of over 36 million tons), which is currently mined for cement production. The tuff from this deposit meets all the requirements of European legislation for use in poultry and livestock farming as a fodder additive; this tuff can also be used for the production of organo-mineral fertilizers. In addition, the tuff of the Tedzami deposit is characterized by a very high content of the zeolite phase (up to 90%) and is a good carrier of biologically active metals such as silver, copper and zinc, so this natural zeolite is suitable for the manufacture of bactericidal filter materials for water purification and fillers for production of paper and polymer materials with a surface that is not susceptible to contamination by microorganisms. There are several occurrences of analcime on the territory of Georgia, but this zeolite has narrow and hard-to-reach micropores, so its use is limited. However, the ammonium form of analcime and its mixture with chicken manure have been shown to be highly effective fertilizers, as well as natural analcime can be recrystallized into a valuable product – LTA type zeolite, and can also be used for the remediation of soil contaminated with oil products. Seven manifestations of laumontite and two manifestations of phillipsite of industrial importance have been geologically explored; these minerals have a high aluminum content and can be used as ion exchangers and carriers of bioactive metals. The possibility of recrystallization of natural phillipsite into zeolite of the FAU type, which is widely used in catalysis, has been established mordenite. Synthetic mordenite is widely used in chemical synthesis; natural samples, as a rule, do not meet the requirements due to the heterogeneity of the structure. However, natural mordenite can be used to purify water from inorganic (lead ions and other heavy metals) and organic (antibiotics) pollutants. Scolecite occurs only near the village of Kursebi (Western Georgia), but the physicochemical properties of this rock have been well studied.

Thus, natural zeolites of Georgia can find rather wide applications.

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FPTA-O-02

NON-CLASSICAL CHIRALITY OF POLYMERS

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Chirality of polymers plays important roles in material sciences and in life. In this context, “helix” has been the focus in this field as a type of macromolecular conformational chirality, and extremely high regularity and uniformity of various helices have been attained. In a sharp contrast to such main-stream achievements, we are reporting polymers with rather irregular and non-uniform chirality (“non-classical chirality”) that exhibit remarkable chiroptical properties including circularly polarized luminescence (CPLm). Once helix does not have to be a mandatory structural requirement, the design scope of chiral macromolecules can be largely extended from linear chain and bundle of linear chains to branched and cross-linked macromolecular architectures encompassing a large variation of chemical structures. As an example, we recently reported that a linear polyfluorenevinylene derivative bearing neomenthyl group (**Poly(NPF-E)**) in the side chain as the chirality source undergoes chain folding forming “turn” moieties in the middle of a chain connecting stretched, helical segments just like turns connect helices in proteins (Figure 1).1 Due to the formation of turns, the polymer showed efficient CPLm properties. As another example, a hyperbranched polyfluorenevinylene derivative bearing neomenthyl group (Poly(NPF-ED)) was synthesized. This polymer included a large excess of aromatic, small molecules, and the hybrid materials exhibited CPLm at an extremely high anisotropy (glum of 10-2 order) (Figure 2).[2] While the polymer is amorphous having no specific, controlled conformation, it can induce liquid-crystal-like special arrangements to the included small molecules. These two examples strongly suggest that useful and remarkable chiral functions may be attained without relying on classical, highly regulated and uniform chiral structures of polymers. In addition, we have reported chirality induction to polymers through circularly polarized light irradiation as a “non-classical” method to create macromolecular chirality[3, 4].

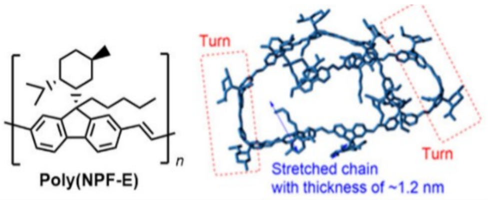

Figure 1. Formation of “turns” by linear poly(**NMPF-E**).

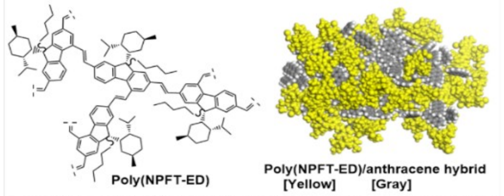

Figure 2. Inclusion of excss anthracene moelcules by hyperbranched poly(**NPF-ED**).

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FPTA-O-03

EFFECTS OF ADDITIVES ON THE PERCOLATION OF WATER/AOT DECANE REVERSE MICROEMULSION

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Mixed microemulsions possess an average degree of hydrophilicity. They also are characterized with properties significantly different from those of the original surfactants separately. Water solubilization capacity, elastic rigidity of the interface, microviscosity of the confined water, percolation of electrical conductance, the dynamics of entrapped water, etc. are considerably changed after mixing [1-5].

The purpose of the proposed work was to study an effect of additives of different surfactants on the water and temperature induced electric percolation of sodium bis (2-ethylhexyl) sulfosuccinate (AOT) based microemulsions with conductivity measurements. Nonionic polyoxyethylene (4) lauryl ether, anionic sodium cholate and cationic promethazine hydrochloride were used as additives to water/AOT/decane microemulsions.

The process of water and temperature induced electrical percolation in reverse microemulsions based on anionic surfactant sodium bis (2-ethylhexyl) sulfosuccinate has been studied. The effect of the additives of nonionic polyoxyethylene (4) lauryl ether, anionic sodium cholate and cationic promethazine hydrochloride on the threshold of thermal electrical percolation of mentioned microemulsions was studied.

Electrical percolation in mixed (AOT and polyoxyethylene (4) lauryl ether, AOT and sodium cholate) microemulsions with a fixed value of the molar ratio of surfactant to water (W=20) takes place at relatively lower temperature than for reversed microemulsion based on sodium bis (2-ethylhexyl) sulfosuccinate alone. The activation energy of temperature induced electrical percolation was calculated for each investigated microemulsion. In contrast to this, quenching of percolation is observed in case of additives of cationic surfactant promethazine hydrochloride in both water and temperature induced electrical percolation.

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FPTA-O-04

COMPOSITE POWDERS OF NATURAL RAW MATERIALS FOR PRODUCTION OF NEW TYPE, ENVIRONMENTALLY SAFE FIRE-PROTECTIVE MATERIALS

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Selection of high-dispersed composite powders of natural raw materials for production of new type, environmentally safe fire-protective materials are discussed in the paper. As is known, that the main components of commonly produced fire- protective materials are: binders, flame retardants and fillers. Organic polymeric compounds are used as binder every so often. According to whether they interact with polymers flame retardants of inert or reactive type are found. The use of inert flame retardants aren't associated directly with polymer production, it mixes mechanically with polymer in the course of its processing. But, along with it, they are characterized by a number of disadvantages which as effect on performance properties of polymeric compounds. Reactive flame retardants -chloro-and phosphororganic monomers participate directly in the processes of polymerization and form co-polymers by high fire-resistance, but every so often by low performance properties. Along with it, it is well-known, that chlorine and phosphorous content enhances smoke formation ability and toxicity of polymeric material. It should be also noted, that the use of reactive flame retardants is associated with quite expensive and complex processes which are not studied completely yet [1,2]. Therefore, development of halogen free, non-toxic, environmentally safe flame retardants is currently a very important problem.

We propose composite powders of natural mineral raw materials (zeolite, perlite, dolomite and barite-calcit), which are halogen free, non-toxic, environmentally safe, far cheap and are characterized by high inhibition properties and fire-extinguishing ability, which has been established by chemical and thermal gravimetric analysis [3]. Here it should be noted, that obtained powders similarly to inert flame retardants, don't participate in the process of polymer preparation, and in contrast to them are characterized by high performance properties: they are practically insoluble, resistant against atmospheric and chemical action and their elution and migration at materials surface doesn't takes place. That's why such powders in fire-protective materials are functioning, as fillers, as efficient inert flame retardants. Therefore, fire-protective materials are manufactured only by mechanical mixing of binders and fillers - high-dispersed composite powders of our preparation, does not need addition of expensive flame retardants, which simplifies technological process of production and decreases price cost of fire-protective materials.

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FPTA-O-05

HYBRID CATIONIC POLYMERS BASED ON NON-PROTEINOGENIC α-AMINO ACIDS

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The last decade has witnessed enormous research focused on cationic polymers (CPs). CPs are non-viral nucleic acid delivery systems with positively charged groups on their molecules that concentrate nucleic acid molecules to form nanoparticles, which help nucleic acids cross barriers to express proteins in cells or inhibit target gene expression [1]. In addition, their inherent bioactive properties such as stimuli responsiveness, antimicrobial, antioxidant, antitumor and anti-inflammatory make CPs more promising for further enhanced therapeutic applications [2]. We have reported on highly charged biodegradable hybrid CPs (h-CPs) composed of naturally occurring building blocks such as amino acid arginine (R) and endogeneous multi-amine spermine (Spm). The h-CPs synthesized showed selective transfection activity towards certain cell lines that could be promising for practical applications in gene therapy [3].

Promising building blocks for constructing biologically active polymers are also non-proteinogenic amino acids (NPAAs), including those ones containing unsaturated bonds in the lateral chains, i.e. allylglycine (AlG) that revealed a wide range of biological activities [4]. The goal of the present work is to combine these two classes of biologically active building blocks (i.e. R and AlG) for constructing new h-CPs with an expanded range of potential biological activity. The goal h-CPs composed of R and AlG were successfuly synthesized under the condition of solution active polycondensation method [5]. Although the polycondensation experiments were done at k/l=50/50 ratio of bis-nucleophilic monomers so far it is also possible to vary the mole ratio (k/l) of R/AlG rather to expend the new family of h-CPs with increased biological activities. These h-CPs are of interest for fabricating biologically active nanoparticles as well as a precursors of cationic hydrogels which could be obtained *via* crosslinking the linear h-CPs by hydrophilic cross-linkers.

Acknowledgment

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FPTA-O-06

RECENT INNOVATIONS IN SYNTHESIS TECHNIQUES OF NANO BIOACTIVE GLASS FOR TISSUE ENGINEERING AND IMPLANT APPICATIONS: A COMPREHENSIVE REVIEW

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In recent years, the rapid advancement of nanotechnology has significantly transformed the landscape of biomaterials, specifically in the realm of tissue engineering and implant applications. Nano bioactive glass has emerged as a promising candidate due to its unique combination of biocompatibility, bioactivity, and tunable properties. This comprehensive review delves into the recent innovations in synthesis techniques of nano bioactive glass, shedding light on their diverse applications in tissue engineering and implantology.

we discusse the various synthesis techniques used to produce nano bioactive glass, including sol-gel, melt-quench, and spray-drying and other cutting-edge techniques.

Furthermore, the review provides insights into the applications of nano bioactive glass in tissue engineering and implantology. It discusses the use of nano bioactive glass as bone graft substitutes, coatings for implants, scaffolds for tissue regeneration, and drug delivery vehicles. The impact of different synthesis techniques on the performance of nano bioactive glass in these applications is thoroughly analyzed. this review brings together recent innovations in synthesis techniques of nano bioactive glass and their significance in tissue engineering and implant applications. The comprehensive understanding of these techniques and their effects on material properties will drive further advancements in the field, leading to the development of tailored biomaterials for improved tissue regeneration and successful implant outcomes.

FPTA-O-07

SWEET SNACKS FROM SECONDARY RAW MATERIALS OF GRAPEFRUIT

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In order to save the environment from the pollution by various factors, it is very important to use food rich with pectin and flavonoids. In this regard, it is important to use the vegetable raw material that has not been used yet in Georgia - grapefruit.

The main purpose of the research was to examine grapefruit from its secondary raw material to get the production containing biologically active substances.

The object of the study was "Duncan" and "Narinji" grapefruit varieties grown in the west of Georgia.

The commodity indices of some grapefruit varieties ("Duncan" and "Narinji") have been investigated.

These varieties contained substances belonging to antioxidants, such as (total polyphenols (respectively) 180 and 164 mg/100g, carotenoids, ascorbic acid $47.8 \bullet 10^{-3}$ and $50.4 \bullet 10^{-3}$ %, etc.). Their antioxidant activity was respectively 378 mg and 344 mg per 100 g (mg ascorbic acid equivalent) [1].

Research has established that the studied varieties met the requirements which satisfy the intension for canning the grapefruit.

Juice was made from grapefruit by using the existing technology, A new confectionery product, sweet snack, is made from the secondary raw materials which is got by processing the grapefruit.

Sweet snack from the secondary raw material of Duncan grapefruit

Sweet snack from the secondary raw material of Narinji grapefruit

It has been identified the useful qualities on the basis of studies. Here is determined the qualitative indices and antioxidant activity of the secondary products.

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FPTA-P-01

A COMPARATIVE STUDY OF SYNTHESIS FROM SOLUTION-MELTS WITH THERMAL SYNTHESIS FOR OBTENTION OF CONDENSED PHOSPHATES

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By crystallization from solution-melts of polyphosphoric acids at the temperature range of 120-600°C we are obtaining for the first time more than 85 new double condensed phosphates of monovalent and trivalent metals. All compounds were identified by roentgen phase analysis and investigated by thermo-gravimetric analysis, some by X-ray structural techniques, IR spectroscopy. The physicochemical properties of various di-&triphosphates, cyclotetraphosphates, cyclooctaphosphates, cyclododecaphosphates, long-chain polyphosphates and ultraphosphates are evaluated. In addition, a detailed comparative study of the thermal synthesis of previously unknown condensed phosphates was carried out in order to obtain new inorganic materials with predetermined valuable properties. For example, during interaction in the polycomponent system, the formation of the acidic triphosphates $GaH_2P_3O_{10}{\cdot}H_20$ (forms I & II) and their crystallization areas were determined. It has been established and confirmed that acidic triphosphate form I is the best ion exchanger and indeed could be used in the future. We have developed an appropriate method for obtaining this new material for subsequent use. The isomorphic indium triphosphate was also obtained.

Synthesized cyclooctaphosphates of Ga, In, and Sc possess zeolitic properties and are widely recognized in the hunt for compounds with novel catalytic and adsorption properties. Consequently, due to the interesting properties of the produced compounds, scientists from other countries are paying great attention to our research. Foreign researchers have shown serious interest in our products, and our compounds have appeared in scientific and energy databases abroad. Additionally, there are numerous references to our inorganic polymers in numerous monographs and manuals, which provide undeniable evidence of their properties and quality. We have also received conclusions from experts regarding the potential usage of our compounds as ion exchangers, catalysts, adsorbents, and more. Several of our publications are reflected not only on the SCOPUS platform but also on INIS-IAEA (International Atomic Energy Agency- International Nuclear Information System Bulletin), ICSD - Inorganic Crystal Structure Database, Energy Citations databases, and so on. [1-2].

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FPTA-P-02

SOME NEW STEROIDAL 1,2,3-TRIAZOLES

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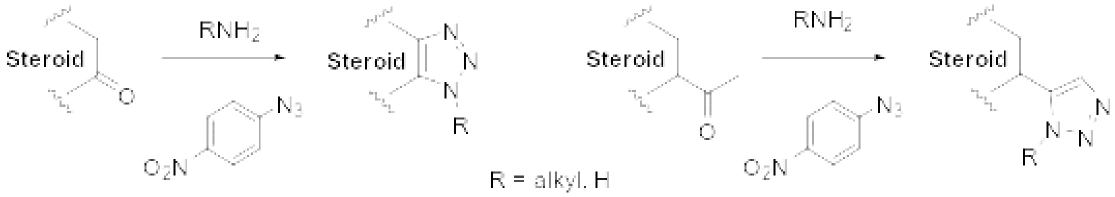
Among the synthetic/semisynthetic steroids majority of nitrogen-containing derivatives are powerful substances. Some of them are used in practical medicine or they are undergoing clinical test as a medicine against tumors, fungus and parasites. It has been established that steroidal azoles capable of interact with some enzymes and are characterized by their potent inhibitory ability, that's why they are considered promising anti-tumor compounds [1- 3].
For the design of novel drug candidates, we took advantage of triazolization methodology [4], based on the fact that the triazolization reaction has proven successful in the synthesis of a number of biologically active compounds as the introduced triazole moiety improves the bioavailability of the compound [5, 6]. The main advantage of this method is that it significantly reduces multistep route synthesis of steroidal triazoles, in which an enolizable ketone can be transformed into a triazolo fused or linked analog by treatment with a primary amine or ammonium salt in the presence of 4-nitrophenyl azide.



The twenty experimental steroidal 1,2,3-triazoles of 3β-hydroxy-5α-androstan-17-one, 3β-acetoxy-5α-androstan-17-one, 3β-(1-adamantylcarbonyloxy)-5α-androstan-17-one, 17β-propionoxy-5α-androstan-3-one and androst-4-en-3,17-dione, 3β-hydroxy-5α-pregnan-20-one, 3β-hydroxy-5α-pregn-16-en-20-one synthesized by using “click-chemistry" method are semisynthetic to the extent that starting steroids are received on the base of tigogenin - the favourable raw material for the synthesis of 5a-steroids, isolated from *Yucca gloriosa* introduced in Georgia [7]. The agonist and antagonist properties of them have been studied. It was found that from these designed steroidal 1,2,3-triazoles, six successfully reduced androgen receptor activity by 40 %.

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FPTA-P-03

STUDY OF ARGININ-CONTAINING ZINC AND COPPER CHELATES

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Essential microelements in chelate form play crucial role in receipt of ecologically safe agricultural products (poultry and animal meat). Among these microelements we focused our attention on zinc and copper chelate compounds: $[Zn(Arg)] \cdot Arg_2 \cdot nH_2O$ (where n = 0÷2) and $[Cu(Arg_n)] \cdot Arg_2 \cdot mH_2O$ (where n = 2÷4; m=0 or 4) [1]. While continuing our research related to synthesized compounds, we have conducted their thermographic analysis. According to the study, thermal decomposition of water-containing compounds begins with water molecule detachment during endo-effect in the range of 120-160°C temperatures. Hereinafter, during exo-effect in the range of 270-350°C temperatures arginine molecules oxidation takes place. Thermal decomposition in all cases ends up in the 390-450°C temperature range. Final products of oxidation and decay of the rest of arginine molecules at strong exo-effect are metal oxides or mixtures of oxide and carbon.

There have been studied infrared absorption spectra of synthesized compounds. Absorption bands of chelates $Zn(Arg)_2 \cdot 4H_2O$; $[Cu(Arg)_2](Arg)_2 \cdot 4H_2O$ in the regions of 3345–3360 cm^{-1} and 2955–2980 cm^{-1} may be attributed to asymmetric and symmetric vibrations of α-amino group, $\nu_{as}(NH_2)$ and $\nu_s(NH_2)$, respectively. Absorption bands in the 1650-1680cm^{-1} region refer to deformation vibrations of α-amino group, $\delta(NH_2)$. Absorption bands manifested in the 1550-1580cm^{-1} and 1410-1440cm^{-1} regions of chelate compounds spectra may be referred to vibrations of arginin dissociated carboxyl groups, $\nu_{as}(COO^-)$ and $\nu_s(COO^-)$, respectively, while absorption bands in the region of 520-560 cm^{-1} and 440-420 cm^{-1} are attributed to valence (stretch) vibrations of metal-nitrogen and metal-oxygen bonds. Based on the above-mentioned, one may assume that in compounds arginine acts the role of cyclic ligand. It creates bonds with a central atom by means of nitrogen atom of α-amino group and oxygen atom of deprotonated carboxyl group (COO^-), with formation of five-membered metallacycles.

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FPTA-P-04

RESEARCH OF THE MECHANISM OF RE-SULFIDATION OF COPPER FORMED AROUND COAL IN THE PROCESS OF SEGREGATION ROASTING RESIDUES OF CHALCOPYRITE AUTOCLAVE TREATMENT

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The segregation method, which is used for the processing of copper oxide ores and is known as the "TORCO" method (Treatment of Refractory Copper Ores), we used for the processing of residues of joint autoclave leaching of the chalcopyrite copper concentrate and the low-grade Chiatura's floatation concentrate - iron cakes (Cu-1.3%, Au-3.8g/t, Ag-38g/t). These residues contain iron oxide and calcium sulfate in increased amounts. The segregation roasting method was also used for the difficult-to-enrich copper oxide ore of the Bolnisi region (Cu-3.6%, Au-0.5g/t, Ag-20g/t).

The segregation method on the first stage implies high temperature (750-900^{0}C) burning of ores in neutral or weak-reduced area in the presence of coal and sodium chloride. Chlorides copper and noble metals, obtained after the burning, are reduced on the surface of carbon with hydrogen, which is formed by the interaction of water vapor with carbon. Metallic copper and noble metals particles are collected around the carbon. In the 2nd stage of processing - flotation enrichment of the segregation product in order to obtain a concentrate, in which copper and noble metals are concentrated around the coal and the content of which is much higher than in the concentrate, obtained by conventional flotation [1,2].

Experimental studies determined the optimal conditions for segregation roasting of iron cakes and copper oxide ore after their preliminary oxidizing roasting: temperature 850^{0}C, consumption of sodium chloride 1% and coal - 1.5%, duration of the process - 30-60 min. Under these conditions, the degree of extraction of copper, gold and silver in the concentrate is 86-93%. During the processing of copper oxide ores by the segregation method, copper accumulates around the coal in metallic form, and during the segregation roasting of iron cakes metallic copper is sulfidate to form chalcosine (Cu_2S).

In order to study the kinetics and mechanism of copper sulphidation, a thermodynamic assessment of the main reactions that could take place in the system Cu-$CuSO_4$-C (750-900^{0}C) was carried out. An experiment was conducted in which samples were taken every 10 min during the segregation roasting of iron cakes. The sulphiding process with the participation of three solid substances - copper, calcium sulfate and coal was also studied separately in the same temperature range.

X-ray, microscopic and micro-X-ray analyzes on MS-46 "Kameka" of the samples taken during the experiments, as a result of observation of their phase and structural transformations, it can be concluded that copper sulphiding can proceed according to the following scheme: thermal decomposition of calcium sulfate in the presence of carbon or carbon dioxide to form sulfur dioxide, which is reduced by carbon or carbon dioxide to elemental sulfur, and sulphiding of copper with elemental sulfur obtained chalcosine (Cu_2S). The advantage of obtaining a segregation product containing copper sulfide is that its flotation enrichment is more successful, and the duration of melting of such a concentrate is reduced and the extraction of copper in the melt is increased.

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FPTA-P-05

QUANTUM CHEMICAL STUDY OF THE PARA-PYRIDINALDEHYDE ISONICOTINOYLHYDRAZIDE MOLECULE

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The goal of this work was to determine the energetic, electronic and structural characteristics of the para-pyridinaldehydeisonicotinoylhydrazide molecule by performing quantum-chemical calculations within the framework of density functional theory (DFT) and was also to select the optimal variant of the functional and basis set [1,2].

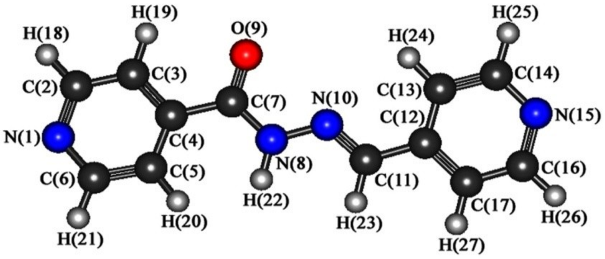
For calculations and visualization of the results, computer software Q-Chem and IQMol were used, respectively. We used functionals of three different categories, in particular functionals based on the local density approximation (LDA), a gradient-corrected functional (BLYP), and a hybrid functional (B3LYP).

We neglected the minimal basis sets and opted for the extended, split-valence basis set 6-31G**.

To describe the orbitals of the electron core (non-valence electrons), six Gaussian functions are used, and for the valence s- and p-orbitals, three Gaussian functions are used and one for the diffuse part, and polarization functions are added, in particular p-functions for hydrogen atoms and d-functions for non-hydrogen atoms. Polarization functions took into account the polarization of orbitals in the molecule, which is explained by the influence of a lower symmetry environment of other atoms.

Calculated Energy characteristics, Charge on an atom and electron population of atomic orbitals, Distribution of valence electrons over atomic orbitals, Values of interatomic bond lengths, Values of bond angles, Ratio of CPU time costs.

B3LYP : BLYP : LDA = 2 : 1.4 : 1



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FPTA-P-06

DETERMINATION OF SOME IMPURITIES IN ALCOHOLIC BEVERAGES BY CHROMATOGRAPHIC METHOD

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The practical use of chromatographic research methods provides a unique opportunity to relate the quality of alcoholic beverage to its chemical composition, which to some extent determines the possibility of regulating its quality on a scientific basis.

Efficiency in the research of these complex objects is largely determined by the effectiveness of the methods used. In the case of alcoholic beverages, the situation is complicated by the presence of a wide range of ingredients of different nature and phase state. Some of these components are of natural origin, while some of them are formed or introduced artificially at various stages of the product manufacturing cycle.

In this study, the qualitative and quantitative analysis of impurities in alcoholic beverages was carried out by gas-liquid and high performance liquid chromatography methods.

Two groups of mixtures were selected as artificial mixtures:

I – acetic aldehyde, methanol, ethanol, acetone, propanol-2, propanol-1, butanone-2, butanol-2, iso-butanol, crotonaldehyde and butanol-1;

II – organic acids – oxsalic acid, lactic acid, malic acid, acetic acid, maleic acid, succinic acid, citric acid and tartaric acid.

These substances are the main components of alcoholic beverages.

In the first case, several stationary liquid phases and polymeric sorbents were tested to determine the optimal conditions for chromatographic separation. A combined column (Poropak-Q+ SE-30) was prepared for efficient identification and maximum separation of impurities.

In the second case, for the determination of organic acids contained in wine materials by the HLPC method, optimal conditions (mobile phase, flow rate, wave length, temperature) are selected using an artificial mixture as an example.

The proposed chromatographic methods, provides a solution to the important problem of determining the quality of alcoholic beverages, as well as detecting the fact of their adulteration.

FPTA-P-07

COMPLEXES OF PALLADIUM (II) WITH MEXIDOL

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Due to the high reactivity of many free radicals, their action in the body is controlled by endogenous and exogenous antioxidants, as well as complex compounds obtained on their basis with various metals. Complex compounds of some metals, including platinum (II) and palladium (II) with various bioactive ligands, have different biological properties.

In this work, 2-ethyl-6-methyl-3-hydroxypyridine-mexidol ($C_8H_{11}ON$) was taken as a complex-forming biologically active ligand.

Mexidol, an inhibitor of free radical processes, is a membrane protector that also has antihypoxic and antioxidant properties.

In an acidic environment (pH = 5.3), mexidol with palladium (II) at a ratio of 2:1 (L:M) forms a complex compound of the cation-anion type - $(LH)_2[PdCl_4]$.

In the IR spectrum of the free ligand molecule, absorption bands of the stretching vibration at 1236 cm-1 are observed, belonging to the C-O group. During complex formation due to hydrogen bonds, this band decreases to 1615 cm^{-1}, which is accompanied by a decrease in the intensity of the band. Absorption bands in the region of 1235 and 1290 cm^{-1} relate to bending vibrations of the free OH group. These facts indicate that the alcohol hydroxyl group does not participate in coordination with palladium. During complex formation in an acidic environment, the pyridine nitrogen atom is protonated and, as a singly charged cation, occupies the outer sphere. This is evidenced by absorption bands at 3250 cm^{-1}.

X-ray diffraction analysis has proven the formation of the tetraacid anion $[PdCl_4]^{2-}$ and the protonation of the pyridine nitrogen atom, which, as a singly charged cation, occupy the outer coordination sphere. There are also facts about a hydrogen bond between the outer-sphere hydroxyl group of the ligand and the chlorine atom of the formed tetraacidanion. Two different lengths (2.289 Å and 2.713 Å) hydrogen bonds indicate the location of the ligands in different geometric planes.

DT study of the complex showed that it remains stable up to 168°C. At this temperature, dehydrohalogenation does not occur with migration of the ligand into the inner sphere.

The resulting 2-ethyl-6-methyl-3-hydroxypyridine tetrachloropalladate acid-mexidazole was tested for radioprotective properties. The radioprotective properties were studied on white mice. The toxicity of the drug is LD_{50} – 240 mg/kg animal weight. Biological tests of the complex showed that it has radioprotective properties. Extensive toxicological studies of mexidazole in mice, rats and dogs did not reveal cardiotoxic, immunotoxic, embryotoxic, nephrotoxic, hematotoxic and other types of side effects. Mexidazole is excreted from the body in the urine 5 to 8 hours after intravenous administration.

It has been established that mexidazole, along with radioprotective properties, also has some antitumor activity, which is very important in radiation therapy.

Thus, the data obtained indicate the possibility of using mexidazole as a radioprotector, as well as in the treatment of malignant neoplasms.

FPTA-P-08

ELECTROCHEMICAL BEHUVIOR OF POLYCARBOXYLIC ACIDS ON SOLID ELECTRODES

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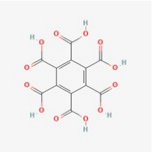
Mellitic, pyromellitic, and trimesic acids are benzocarboxylic acids containing six, four, and three carboxyl groups, respectively. We have already polarographically studied the electrochemical properties of these acids on a mercury drop electrode from aqueous solutions, alcohols and ethylene glycol solutions. Their adsorption properties on the mercury electrode in the same solutions were also studied [1].



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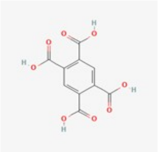
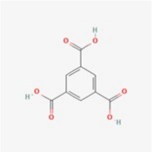
mellitic acid(benzene-1,2,3,4,5,6-hexacarboxylic acid)



pyromellitic acid (benzene-1,2,4,5-tetracarboxylic acid



trimesic acid (benzene-1,3,5-tricarboxylic acid)

In this work, we present the voltammetric study of mellitic, pyromellitic and trimesic acids (CH Instruments, USA) in a three-electrode cell. Glassy carbon was used as the working electrode, graphite as the auxiliary electrode, and saturated calomel electrode as the comparative electrode. It was determined that in 0.9% NaCl aqueous solution (saline, BBraun Melsungen (Germany)) mellitic acid gives a one-wave diffusion curve with half-wave potential $E_{1/2}$=-1.06V, the height of the wave is directly proportional to the concentration of mellitic acid in the bulk of solution. In 0.9% aqueous NaCl (saline, Braun Melsungen (Germany)), mellitic acid has been shown to give a single wave diffusion curve with a half wave potential of $E_{1/2}$=-1.06V, the wave height is directly proportional to the concentration of mellitic acid in the bulk of the solution. The calibration curve was plotted within the limits of concentration $1\cdot10^{-4}\div3.1\cdot10^{-3}$M ($R^2$=0.9957). Pyromellitic acid gives a two-wave voltammetric curve with a half-wave potential $E_{1/2}$=-0.93V and $E_{1/2}$ =-1.44 V, the calibration curve can be used in the concentration range of $2.38\cdot10^{-4}\div4.07\cdot10^{-3}$M ($R^2$=0.9956). Trimezine gives a one-wave curve with half-wave potential $E_{1/2}$ = -1.29V, calibration curve in the concentration range of $6.4\cdot10^{-5}\div3.2\cdot10^{-3}$M($R^2$=0.998271).

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FPTA-P-09

TECHNOLOGICAL ASPECTS OF BIOCOMPOSITES BASED ON YUCCA GLORIOUSA FIBER

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Currently, biocomposites, characterized by low cost, lightness, environmental friendliness and high performance propertie are produced on base of various types of plant cellulose fibers and thermoplastic polymers, Bioorganic composite materials.

Based on renewable plant raw materials - leaves of Yucca gloriousa, a woody plant from the Liliaceae family, we have obtained a bioorganic composite material that is safe for health, where the binder represents one of the world's industrial plastics - isotactic polypropylene powder.Yucca gloriousa is widespread in Georgia as an ornamental plant, while its plantations for pharmaceutical use are cultivated in the Vashlovani Nature Reserve on an area of 300 hectares.

It should be noted that Yucca leaves have very strong cellulose fibers, which are used to make ropes, baskets, carpets and others. In our case, it is a polymer reinforcing ingredient with high fillability. Chopped, dried, crushed yucca fiber was mixed with polymer powder in a propeller mill with high filling - up to 80 wt.%, and the samples obtained by the hot pressing method were tested for their specific gravity, water absorption, bending and flexural strength, impact viscosity. Fire resistance was also tested.

The microstructure of bioorganic composite materials was studied using an NMM-800RF/TRF optical microscope. The resulting samples are distinguished by their lightness, high compressive strength (50-82 MPa) and relatively high impact strength (7-12 kJ/m^2). With high filling, the water absorption of materials is 2-5%. Modification of these materials with 5 wt. % liquid ethyl silicate-40 reduced the rate of water absorption by 1.5-2 times, and the strength properties improved by 10-15%.

In order to increase the fire resistance, such samples of binary composites were made, where together with the fiber, magnesium hydroxide-$Mg(OH)_2$ in the amount of 20-25 wt.%. By the testing of test samples for combussion and ignition in accordance with the ISO 4589-84 so-called standard,.using the “fire tube”,was shown that due to the introduction of a fire retardant, biocomposites are transformed from combustible materials into non-combustible ones, which expands the scope of their use, especially in construction.

FPTA-P-10

ELECTROCHEMICAL STUDY OF OCTAMETHYLFERROCENE/OCTAMETHYLFERRICINIUM ($Me_8Fc/Me_8Fc^+PF_6^-$) REDOX SYSTEM IN DIFFERENT SOLVENTS

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The ferrocene/ferricinium ($Fc/Fc^+PF_6^-$) system has been proposed as a reference electrode in non-aqueous media (organic solvents, ionic liquids) by IUPAC. However, the literature [1] on the instability of the ferrocene/ferricinium system over time has led to the extensive study of systems consisting of methyl homologues of ferrocene [2], which are considered more promising as a reference electrode. Therefore, we have studied the octamethylferrocene/octamethylferricinium ($Me_8Fc/Me_8Fc^+PF_6^-$) redox system by the cyclic voltammetry method in acetonitrile (CH_3CN), dichloromethane (CH_2Cl_2) and dimethyl sulfoxide ($(CH_3)_2SO$), which differ significantly in donor number and viscosity (picture, table).

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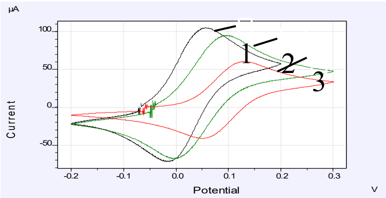

Figure 1. Cyclic voltammograms of $Me_8Fc/Me_8Fc^+PF_6^-$ system in different solvents (1– CH_3CN; 2– CH_2Cl_2; 3–$(CH_3)_2SO$) at scan rate of 0.1 V/sec

Table 1. Values of the half-wave potential of the $Me_8Fc/Me_8Fc^+PF_6^-$ redox system in different solvents (scan rate is 0.1 V/sec)

Solvent	CH_3CN	CH_2Cl_2	$(CH_3)_2SO$
$E_{1/2}$(mV)	23	48	93

It is seen from the obtained data (picture and table) that the value of the half-wave potential ($E_{1/2}$) in the $Me_8Fc/Me_8Fc^+PF_6^-$ system slightly shifts ($\Delta E_{1/2} = 93 - 23 = 70$ mV) to the direction of positive potentials through the $CH_3CN \rightarrow CH_2Cl_2 \rightarrow (CH_3)_2SO$ sequence. The value of the half-wave potential in the $Fc/Fc^+PF_6^-$ system, which is currently used as a reference electrode, varies from 317 – 630 mV [1], depending on the nature of the solvent and the conditions of the electrochemical study. In our opinion, this difference is related to the presence of Me groups provide the redox potential of the $Me_8Fc/Me_8Fc^+PF_6^-$ system to remain constant in any solvent (around 70 mV) both electronally and sterically preventing the contact of the iron atom with the solvent molecules in the system.

Thus, the $Me_8Fc/Me_8Fc^+PF_6^-$ redox system is a more promising system than the currently used ferrocene-ferricinium system as a reference electrode in various organic solvents and can be successfully used instead of it in practice.

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FPTA-P-11

DETERMINING AND TESTING THE RETENTION FILTER COMPOSITION FOR ARSENIC COMPOUNDS (As_2S_2-As_2S_3) ON THE EXAMPLE OF THE RIVER LUKHUN

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The Lukhun (Racha) deposit contains 7-8% arsenic, while the Tsana (Svaneti) deposit contains 15-17%. Our primary focus is on arsenic sulphide ores i.e. forms as natural mineral wealth of our country.
The River Lukhun contains arsenic sulfide (As_2S_2 /As_2S_3) compounds in the amount of 0.04 g/L [1].

Fig. 1. Realgar

Fig. 2. Realgar-Orpiment

Our goal is to trap these sulfide compounds using the appropriate filter. A type of filter was madeconsisting of a mixture of calcium and charcoal. The optimal conditions were determined [2].

Fig. 3. Prepared filter sample

Fig. 4. Filtrate

The filter prepared by us worked positively and trapped 39.7 mg/L of arsenic; the filtrate contained 0.03 mg/L of arsenic which can be considered to be a great achievement. Research continues in this direction.

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FPTA-P-12

QUANTUM-CHEMICAL STUDY OF CAPRYLIC ACID HYDRAZIDE MOLECULE BY AM1 METHOD IN DIFFERENT SOLVENTS

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Hydrazides of aromatic and aliphatic carboxylic acids contain biologically active groups of atoms. This circumstance increases the prospect of their use as ligands.

/Calculation of the geometry and electronic structure of our selected ligand - caprylic acid hydrazide molecule was carried out by quantum-chemical, semiempirical method in different AM1 solvents. It is known that solvents have a significant effect on the ability of organic molecules to form complexes with metals. Conducting this type of research allows us to identify potential electron donor atoms, their ability to form a coordination bond, to speculate on the ability of the caprylic acid hydrazide molecule to exist in a ketone or imidoalcoholic form; Also analyze the obtained data for different solvents, which is very important for planning the synthesis of coordination compounds, selecting optimal conditions and carrying out.

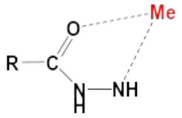
Various solvents were selected for this research: water, dimethylsulfoxide, hexane, acetone, chloroform, methanol and ethanol. Both dipole moments (μ, Debye) and heat of molecule formation (ΔH, kJ/mol) were calculated for the mentioned solvents and also for gas.

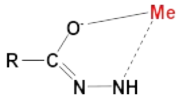
The structural and geometrical parameters of AM1 caprylic acid hydrazide molecule have been established by quantum-chemical semi-empirical method.

The heat of formation of molecules in different solvents, Dipole moment, effective charges on atoms, occupancy of electrons on atomic orbitals, valence angles in the molecule are calculated.

Potential donor atoms in the caprylic acid hydrazide molecule have been identified - the oxygen atom of the carbonyl group and the nitrogen atom of the hydrazide group.

The ability of the caprylic acid hydrazide molecule to coordinate with the central atom in the keto or enol form is assumed.As is known, hydrazides of carboxylic acids have the ability of prototropic tautomerism to form keto-enol forms. If we take into account the positive charge of the hydrogen atom according to the calculations, it can migrate from the NH – NH_2 group to the oxygen of the C = O group (amido-alcohol form).





The obtained data allow us to choose the optimal conditions for the synthesis of complex compounds.

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FPTA-P-13

THERMOELECTRIC PROPERTIES OF $Ca_3Co_4O_{9+\delta}$ CERAMICS: EFFECT OF HEAT TREATMENT AND MODIFICATION WITH COPPER

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Layered calcium cobaltite ($Ca_3Co_4O_{9+\delta}$) is one of the most prospective materials for *p*-branches of high-temperature thermoelectrogenerators, which can directly and effectively convert waste heat evolving into environment during operation of industrial enterprises and autotransport into electrical energy. To increase its functional properties, different strategies are used: doping [1], modification [2], special sintering techniques (methodics) [2,3] etc. This work shows the possibility to enhance thermoelectric performance of $Ca_3Co_4O_{9+\delta}$ using special heat treatment (two-step sintering) and modification it by copper particles.

$Ca_3Co_4O_{9+\delta}$ was prepared using common ceramic method and sintered without (349/0) and with addition of 4 (349/4) and 8 mas.% of copper (349/8) at 1373 K for 6 h and then heat treated at 1173 K for 70 h. Reference sample (349) was sintered at 1173 K for 12 h. Samples were characterized using XRD, SEM, IRAS, and their electrical resistivity (ρ) and Seebeck coefficient (*S*) were measured using LSR–3 measuring system within 320–1070 K.

Apparent density of sintered ceramics increased from 57% for reference sample to 80–85% for the heat-treated samples, which was resulted in the essential decreasing of ρ: from ≈600 (349) to ≈(115–250) μΩ·m at 1070 K. *S* values of the samples increased when temperature raised and for copper-modified samples at high temperatures were slightly lower than for the others. Power factor (PF) values of ceramics increased from 62 $\mu W/(m\cdot K^2)$ (349) to 160, 298, and 227 $\mu W/(m\cdot K^2)$ for 349/0, 349/4, and 349/8 samples respectively at 1070 K. Charge carriers concentration values for all samples were close each other and varied within $\approx(3–12)\cdot10^{19}$ cm^{-3}, but their mobility essentially increased for heat-treated/copper-modified samples: from ≈2 to ≈9–17 $cm^2/(V\cdot s)$ near 320 K.

Thus, special heat treatment enhanced PF of $Ca_3Co_4O_{9+\delta}$ ceramics by ≈2.6 times and its modification with copper by another ≈1.9 times.

This work was supported by the National Scholarship Program of the Slovak Republic.

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FPTA-P-14

ASPECTS OF USE KISATIBI DIATOMITE, A POROUS MINERAL RAW MATERIAL OF GEORGIA

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It is known that the porous mineral diatomite is used as filter powders for the purification of medical solutions, wine, beer, fruit juices, etc. Solid carriers for chromatography and catalysts are made from it. It is also used as a fine filler in mineral fertilizers and polymer composites.

The Kisatibi diatomite has unique properties. It contains silicon dioxide almost up to 95%, which is represented by nano-sized porous shells of this flint measuring 15-30 microns, where the size of the pore openings is 140-200 nm, and its properties are not inferior to the world-famous deposit of California, USA. However, Georgian wineries and breweries currently filter both products with diatomite imported from abroad. We have such cases of its use. For example, Georgian scientists together with Swedish scientists have developed a highly efficient, environmentally friendly, wear-resistant friction material for cars based on Kisatibi diatomite [1]. This diatomite has also proven to be successful as a catalyst support for the conversion of greenhouse gases, methane and carbon dioxide into synthesis gas (H_2+CO), which is about 95%. [2].

The most interesting thing for us was to analyze the use of diatomite in medicine. It is known that negatively charged diatomite shells, when entering the human body, attract positively charged bacteria, fungi, molds, protozoa, viruses, endotoxins, pesticides and heavy metals, absorb them into the cylindrical structure of the shells, and then are excreted from the body naturally. This kind of detoxification of the body improves the condition of the human body and promotes its healing. American medical diatomite's (FSF) instructions state that diatomite protects and treats diseases such as osteoporosis, regulates blood pressure, improves the condition of people suffering from Alzheimer's disease and others.

Large pieces of Kisatibi diatomite were crushed, ground in a vibrating mill, dried, and then fired at 900^0C for 5 hours, as a result of which a medicinal product was obtained based on this diatomite for further use for the purpose of treatment.

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FPTA-P-15

INNOVATIVE TECHNOLOGY FOR UTILIZATION OF MANGANESE MINING-ENRICHMENT WASTE

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The operational life of Chiatura manganese deposit counts almost 140 years. During this time, 20-25 million tons of waste have been accumulated in the industrial basin, the composition of which is heterogeneous and varies widely. As a result of waste washing, not only the industrial area is polluted with compounds of manganese and other metals, but also the basins of the rivers Kvirila and Rioni.

Two versions of the waste utilization technology of manganese mining-enrichment production have been developed. Both options are based on the electro-reductive leaching of manganese oxidized forms in wastes (tails, sludges) in the sulfuric acid environment, using the Fe^{3+}/Fe^{2+} redox system as a mediator. With the developed technologies, it is possible to completely process manganese containing man-made waste into products demanded by the consumer market under the conditions of minimizing environmental hazards.

The first option considers the extraction of Mn^{2+} from manganese oxides in manganese-containing waste by the percolation method using iron (II) ions as the reducing agent regenerated in an electrolyzer on a solution-permeable carbon felt cathode with a developed surface and production of technical electrolytic manganese dioxide (TEMD) on the anode [1].

According to the second option, under conditions of strong air blowing in the electrolyzer, a regeneration of iron (II) ions of the reducing agent on the grid-cathode takes place. Regenerated iron (II) ions leach manganese oxides in the waste suspension. As a result, manganese (II) ions are transferred into the solution forming manganese (II) sulfate, and iron (III) ions formed after leaching reaction are again reduced generating iron (II) ions on the grid-cathode. After purification of obtained manganese sulfate solutions from iron and other ions, 98% pure manganese sulfate monohydrate is obtained by autoclave treatment. [2].

In both versions, the co-product of production is a gypsum-containing material ($CaSO_4 \cdot 2H_2O$ – 30÷40%, SiO_2 – 50÷60%, Mn- 1,5 ÷2%) usable in the production of cement and gypsum-containing dry mixtures.

A pilot technological line has been created and full-cycle testing of the developed utilization technology options has been carried out on a large-laboratory scale at the base of waste (sludge and tailings) obtained in the process of enrichment of Chiatura deposit crude ore. Testing has shown that extraction of Mn^{2+} from waste containing 14-18% Mn is 97-99%;. The consumption of electrical energy per ton of product (TEMD) in the first technological option is 1200-1400 kWh/t, and in the second option, - obtaining a solution containing 60-70 g/L Mn^{2+} It is possible to use 1500-1700 kWh/m^3 of electric energy.

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FPTA-P-16

CHEMICAL -TECHNOLOGICAL PROCESSING OF CHIATURA MANGANESE ORE BENEFICIATION WASTE

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Recycling of Chiatura manganese ore beneficiation waste and improvement of current environmental situation in the region is of great importance and at the same time, is hard-to-solve problem, settlement of which has to be a subject of common concern for scientists, production workers and government.

The L. Japaridze laboratory of chemical current sources and electrode materials at the Institute of Inorganic Chemistry and Electrochemistry has a long-term experience of receipt manganese-containing compounds from Chiatura manganese ore and industrial introduction of related research results. In 70's of the past century, on the basis of technology developed in the laboratory the electrolytic manganese dioxide (EMD) receipt technology was introduced on industrial scale in the Rustavi production association "Azoti." There is no EMD production in Georgia today, but laboratory keeps working on improvement of its production.

Manganese (II) oxide and manganese sulfate are among the intermediate products of EMD receipt, but at the same time these compounds are independent target products of multiple use. This distinguishing sign of EMD gives rise to an idea of establishment of industrial complex producing the above-mentioned products of high market demand, which may have a number advantages (reduction of service cost, increase of complex stability, reduction of production cost, possibilities for production diversification). Detailed information on the complex will be given in the report.

Today, the laboratory of chemical current sources and electrode materials is in active collaboration regarding industrial waste recycling with one of the Chiatura-based companies working in the field of manganese ore dressing. Laboratory studies of chemical-technological processing of waste have been carried out and positive results have been obtained. In particular, MnO_2 content in EMD received by us was equal to 92-93% (according to international standards, it has to be more than 91%); manganese content in our MnO equals to 70-71% (there is 52-65% of Mn in manganese monoxide produced by foreign companies); as for manganese sulfate monohydrate, Mn content in our product is reaches 32,4-32,7% (Mn $\geq$32,0% according to foreign firm standards). Research in this direction are on their way. As of today, assembling of pilot plant for large-scale tests of the above-mentioned products based on the manufacturing equipment takes place in the laboratory.

FPTA-P-17

OBTAINING POLYMER FILLER FROM ADSORBENT PRODUCTION WASTE

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In the process of industrial production of adsorbents from natural zeolite (clinoptilolite), is formed waste, as a highly dispersed fraction zeolite, with a particle size of less than 0.25 cm. The possibility of obtaining polymer filler from these wastes has been studied. The effectiveness of the resulting filler was tested by studying the performance properties of filled organosilicon varnish (KO-921).

The main requirements for polymer fillers - high dispersion and organophilicity of the particle surface, is ensured by wet grinding of waste in a dispersant, in a solvent of organosilicon polymer (toluole), in the presence of a surfactant (octadecylamine - ODA). In the process of dispersion, in a toluene medium, on the active centers of freshly formed particles of zeolite waste (at the sites of rupture of Si-O-Si and Si-O-Me valence bonds), chemisorption fixation of octadecylamine occurs and organophilization surfaces of particles.

The sizes and nature of the distribution of the obtained organophilized particles of zeolite waste were studied, with the content of octadecylamine in the dispersion medium, in the range of 0.025 - 1.5% (relative to the mass of air-dry zeolite waste). It has been established that with an increase in the ODA content in the dispersed system, a decrease in the proportion of large particles is observed. With a content of 1.0% ODA in the dispersant, there are virtually no particles larger than 10 microns. A further increase in the content of octadecylamine in the system does not significantly change the nature of the distribution of particles by dispersion.

The study of the physical and mechanical properties of composite coatings prepared on the basis of organosilicon varnish KO-921 showed an extreme dependence of their strength, hardness, adhesive strength and internal stress on the content of the developed filler in the composition. The optimal filler content for KO-921 varnish is 40-50% by weight of the organosilicon polymer. The optimal combination of values for dielectric permeability, breakdown voltages, arc resistance and dielectric loss tangent was established at the same filling degree, of varnish KO-921. The above composite coatings are characterized by high water, salt, acid, alkali, and weather resistance.

FPTA-P-18

EFFECTIVE ORGANOMINERAL SORBENTS OBTAINED ON THE BASIS OF ASCAN CLAY

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Composite organo-mineral sorbents for practical use were obtained by thermal destruction of Ascan clay with glucose and molasses - a residue from sugar production (contains 50% sucrose, 4% raffinose, etc.). Carbonization of compositions with different ratios of Ascan clay and organic compounds was carried out in the temperature range of 200-500 ^{O}C.

It has been established that during the carbonization process, the surface of Ascan clay is covered with soot-like products of thermal destruction of organic matter, the content of which averages 9.8 - 4.4%. Carbonized Ascan-clay, containing carbon, is characterized by high sorption and ion-exchange properties. The preferential sorption of cations and anions on carbonized samples is expressed in the following sequence: Ba^{2+}, K^{+}, Mn^{2+}. Ca^{2+}, Mg^{2+}, PO_4^{3-} SO_4^{2-}. Carbonized samples of Askan clays are characterized by a sharply increased total porosity (from 0.169 cm^3/g to 0.339 cm^3/g). In this case, a significant increase in the volume of secondary pores occurs, mainly due to macropores.

Samples of carbonized Ascan clay obtained by processing a clay-molasses composition at a temperature of 500 0C were tested in the nephrology department of the L. Managadze Institute of Urology as a sorbent for dialysis. The patient's ascitic fluid was used for the experiment. According to the results of a clinical trial, potassium and creatinine are well adsorbed on carbonized Ascan clay, their content in ascitic fluid is reduced by half.

FPTA-P-19

THERMOGRAVIMETRY OF SOME MANGANESE COMPOUNDS

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Thermogravimetric analysis gives information about physical as well as chemical phenomena of substance transformation such as phase transition, adsorption, chemisorptions, thermal decomposition and oxidation-reduction. The principle of thermogravimetric analysis is based on measurement of the mass of a sample over time as the temperature change.

We carried out thermogravimetric study of manganese compounds ($MnSO_4$, $MnSO_4 \cdot H_2O$, MnO_2, $MnCO_3$). The measurements were conducted on a NETSCH STA 2500 Regulus thermal analyzer. Samples substances were heated in an air atmosphere in a corundum crucible up to 500 ^{0}C or 1000 ^{0}C in increments of 10 ^{0}C per minute and results are shown at the differential heating analysis DTA (differential thermal analysis) curve, which illustrates the course of thermal effects on the given sample, at the TG (Thermogravimetry) mass change curve obtained as a result of thermal impact on the sample and DTG (derivative of TG) differential curve, which indicates the rate of change in the mass of the sample at a particular stage of the process.

According to results given by DTA thermal curve, the decomposition process of $MnSO_4$ takes place in the interval of 800^0-975^{0}C and the mass decrease with the maximum result of 27% is observed in the last stage; the 59.32% of initial mass remains.

On the DTA thermal curve of $MnSO_4.H_2O$ one molecule of water removal peak is observed at 290 ^{0} – 307 ^{0}C; the second peak at 890 ^{0}C results from the decomposition process of $MnSO_4 \cdot H_2O$ and the 62.26% of initial mass remains.

On the thermal curve of MnO_2 the removal of water is noted at 87.9 ^{0}C; exothermic effect at 467.4 ^{0}C is the result of coal combustion; During the first effect initial mass loss is 10%; 9.25% - during coal burning. In the end, 35.53% of the initial mass remains.

According to the thermal curve of $MnCO_3$, MnO is formed at 270 ^{0}C and quickly transforms to MnO_2; At 556 ^{0}C MnO_2 transforms to Mn_2O_3; at 952 ^{0}C Mn_2O_3 transforms to Mn_3O_4. The largest initial mass loss is observed during the first effect before the formation of MnO_2 (11.11%); In the end remains 82.77% of the initial mass.

FPTA-P-20

SPECTRAL CHARACTERISTICS OF PRODUCTS OF 2-ETOXYCARBONYL-5(P-NITROPHENYLTHIO) INDOLE

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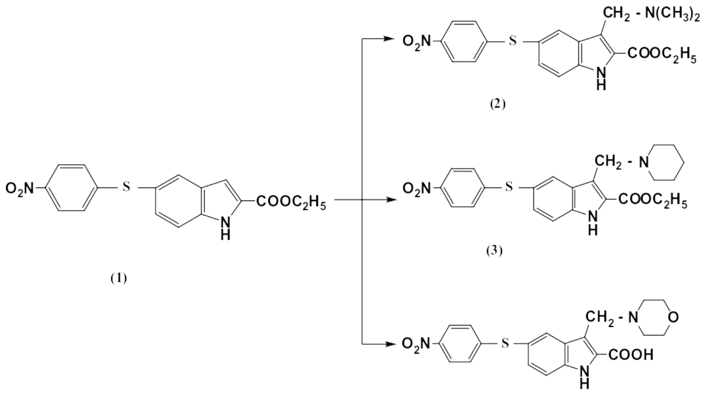
Aminomethylation of 2-ethoxycarbonyl-5-(p-nitrophenylthio) indole (1) was carried out with dimethylamine, piperidine and morpholine at the temperature of 90-95°C to the scheme:



The composition and structure of the compounds obtained (2-4) was determined on the basis of the data of, IR, UV, mass- and PMR spectra [1].

Characteristic absorption bands are observed in the IR spectra of the Mannich bases (2-3) in petroleum jelly oil at 1520, 1340 (NO_2), 3380 (NH) and 1690 cm^{-1} (CO-ester) for compounds (2), at 1515,1340 NO_3), 3330 (NH) and 1690 cm^{-1} (CO- ester) for compounds (3) and 1515 1340 (NO_2), 3280 (NH) and 1705 cm^{-1} (CO-ester) for compounds (3).

Intensive absorption maxima exist in the UV spectra of compounds (2-4), in the ethanol in the longwave region of 228, 239 and 223 nm, respectively.

Molecular masses of synthesized compounds (2-4), determined by mass spectrometry, correspond to the calculated ones.

In the ^{1}H NMR spectra of gramines (2-4), in addition to the proton signals of the indole rings and the ethoxycarbonyl group, there are proton signals of the N-CH_3 groups at 2.31 (2) and N-CH_2 at 3.96; 3.95 and 4.01 ppm, respectively [2] .

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FPTA-P-21

ENZYMATIC SYNTHESIS OF ANALOGUES OF BIOPOLYMER FROM PLANTS OF BORAGINACEAE FAMILY

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The first enzymatic synthesis of analogue of biologically active biopolymer poly[2-methoxycarbonyl-3-(3,4-dihydroxyphenyl)oxirane] (PMDHPO) was performed using lipase from *Candida rugosa.* Natural biopolymer was isolated within high molecular fractions from roots and stems of different species of Boraginaceae family: *Symphytum asperum* (SA), *S.officinale* (SO), *S.caucasicum*, *S.grandiflorum* (SG), *Anchuza italica* (AI), *Cynoglossum officinale* (CO), *Paracynoglossum imeretinum* and *Borago officinalis* (BO).

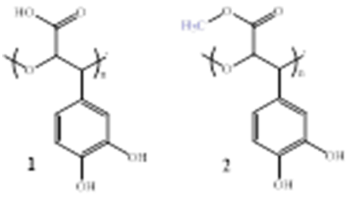
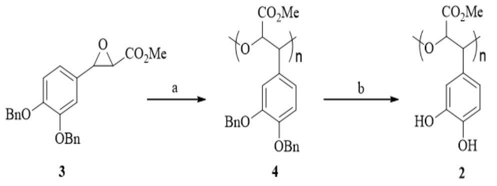


Figure 1. Poly[3-(3,4-dihydroxyphenyl)glyceric acid] (PDHPGA) (1) and poly[2-methoxycarbonyl-3-(3,4-dihydroxyphenyl)oxirane] (PMDHPO) (2)

In distinction to PDHPGA-SA, PDHPGA-SC, PDHPGA–SO PDHPGA–CO and PDHPGA–PI most of carboxylic groups of PDHPGA-SG, PDHPGA-AI and PDHPGA-BO are methylated (Fig.1, **2**). Water soluble PDHPGA exhibits wide spectrum of pharmacological activities: immunomodulatory (anticomplementary), antioxidative, anti-inflammatory, wound and burn healing, and anticancer both *in vitro* and *in vivo* [1-6]. Enzymatic ring opening polymerization of 2-methoxycarbonyl-3-(3,4-dibenzyloxyphenyl)oxirane (MDBPO) (3) using lipase from *Candida rugosa* leads to formation of poly[2-methoxycarbonyl-3-(3,4- dibenzyloxyphenyl)oxirane] (PMDBPO) (4) with degree of polymerization up to 5. Catalytic debenzylation of PMDBPO using H_2 on Pd/C yields poly[2-methoxycarbonyl-3-(3,4-dihydroxyphenyl)oxirane] (PMDHPO) without loss in molecular mass (Scheme1).



Scheme 1. a) *Candida rugosa*, toluene, 800 °C, b) H_2, Pd/C, THF/EtOH

The formation of these analogues by avoiding toxic catalysts is a highly beneficial undertaking and opens the new window for obtaining of various synthetic non-toxic polymers for biological investigation.

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FPTA-P-22

FEATURES OF THE SYNTHESIS OF METAKAOLIN BASED ON CALCINED SHALES

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The cement industry is known to be one of the largest carbon dioxide polluters in the air, so efforts are underway throughout the scientific world to replace Ordinary Portland Cement (OPC) with clinker-free cementitious materials. Replacing OPC with geopolymer material (GPM) is one of the most realistic strategies to reduce environmental impact.

One of the main components for the production of GPM is a synthetic mineral - metakaolin, which is obtained by heat treatment of the kaolin mineral or kaolin clays at 500–800°C. The amount of these materials in the world is limited, so the production of metakaolin from shale (a widely distributed raw material) is of particular interest, which is the purpose of this work.

Clay shales from the banks of the Duruji River, near the city of Kvareli, were selected as the object under study. The shales were studied using chemical, X-ray diffraction and DTA methods.

Calcination of clay shales was carried out at 600, 700 and 800°C with different times of exposure at the maximum temperature. After which the optimal regime for the synthesis of metakaolin was established.

Based on granulated metallurgical slag, calcined clay shales and an alkaline activator, GPM with good physical and mechanical properties were obtained.

The data obtained confirmed the ability of calcined clay slates to react with granulated slag in an alkaline environment and form GPM [1-3].

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FPTA-P-23

THE STUDY ON ENRICHMENT OF GLAUCONITE SANDS FROM THE GVERKI DEPOSIT/ORE OCCURRENCE

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The research work was aimed at studying the enrichment of glauconite-containing raw materials from the Gverki deposit. The Gverki ore occurrence is located 8 km northwest of the Kharagauli railway station. It is represented by greenish glauconite sandstones of Albian age, the thickness of which reach 3 m, and extend for 200 m.

Macroscopically, the rock is a greenish gray sandstone with fine (<0.5 mm) glauconite grains, moderately cemented and moderately carbonated.

According to the mineralogical analysis, the following minerals are found in the rock: glauconite, quartz, hematite, magnetite and carbonate clay, which occupies the main of the mass and plays the role of cement. Glauconite occurs in two forms, the first form (80%) - isometric dark green grains with small white (presumably carbonate) veinlets, and the second form - light green, shapeless fragments (20%).

A technological scheme for the enrichment of glauconite-containing raw materials from the Gverki deposit has been developed, combining the following operations: crushing of raw materials to 0.63 mm, disintegration and desludging, drying of the sandy fraction and magnetic separation, fourfold cleaning of rougher concentrate /magnetic fraction/ in a closed circuit, resulting in production of 227 kg of concentrate with an iron oxide content of 15.3% from 1 ton of ore.

FPTA-P-24

STUDY OF THE CHEMICAL COMPOSITION OF ACTIVATED SLUDGE USING INFRARED SPECTROSCOPY

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With the help of the Infrared (IR) spectroscopy, the presence of organic and inorganic components was established by the absorption bands within the IR region in the activated sludge (AS) after wastewater treatment. Its IR spectra contained absorption bands of functional groups of aromatic compounds, polysaccharides, peptides, proteins, lipids, aliphatic chains, ester compounds, nitrates, nitramines, nitroso compounds, nitrosamines, nitro compounds, amine salts, ammonium salts, silicates, phosphates PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$ [1, 2]. When comparing samples of AS obtained by different methods, a difference was revealed in the intensities of the bands within the range of 1500-1400 cm^{-1}, 1236 cm^{-1}, related to the characteristic absorption bands of components containing nitrogen, as well as within the range of 1100-900 cm^{-1}, characteristic for absorption bands of components containing phosphate ions and polysaccharides. The Spectrum 100 Fourier transform spectrometer (Perkin Elmer, USA, 2007) was used to study the composition of AS. The spectra were recorded using an ATR (Attenuated Total Reflectance) accessory in the form of a fine powder in the range 4000-650 cm^{-1}. The Figure 1 shows the IR spectra of two sludge samples 1 and 2. Their spectra have differences in the intensities of the absorption bands. In spectrum 1 the intensity of the peak at 1236 cm^{-1} (nitrites NO_2^-) is several times more pronounced than that for sample 2. There is an increase in the intensity of peaks 1450 and 1406 in sample 1, which is perhaps associated with an increase in the content of organic components containing nitrogen by a factor of 2 (Fig. 1)

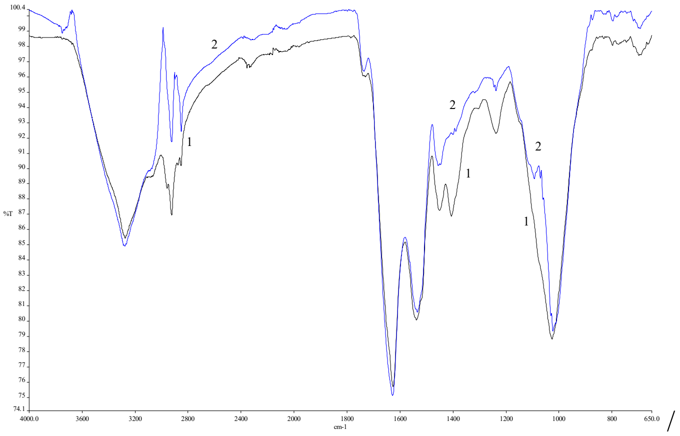

Fig. 1. IR spectra of activated sludge samples 1 and 2 obtained under different conditions.

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FPTA-P-25

NEW AZO DYES BASED ON 4-AMINOANTIPYRINE

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Throughout history, dyes have played a significant role, and today their applications have expanded even further. Azo dyes represent one of the largest and most commonly used categories of dyes, constituting a significant portion of dye manufacturing capacity [1], and their importance continues to increase.

Due to their toxicological side effects, it is crucial to synthesize azo dyes that can be less toxic after metabolism. Therefore, our main goal was to synthesize azo dyes with non-toxic metabolic fragments.

4-Aminoantipyrine turned out to be a great diazo partner during coupling reactions. At the same time, it possesses significant biological characteristics, such as protection against oxidative stress, as well as prophylaxis of some diseases, including cancer [2, 3]. Quercetin, a member of the group of natural dyes known as flavonoids, renowned for its antioxidant and anti-inflammatory characteristics, was used as one of the azo partners [4].

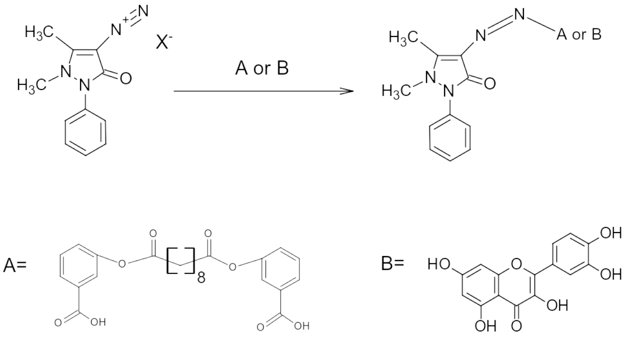

Figure 1. Synthetic route of azo dyes.

Obtained dyes have been recrystallized and the purity has been established by TLC.

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FPTA-P-26

HYDROBROMINATION OF ALLYLATED ACETYL GLYCOSIDES

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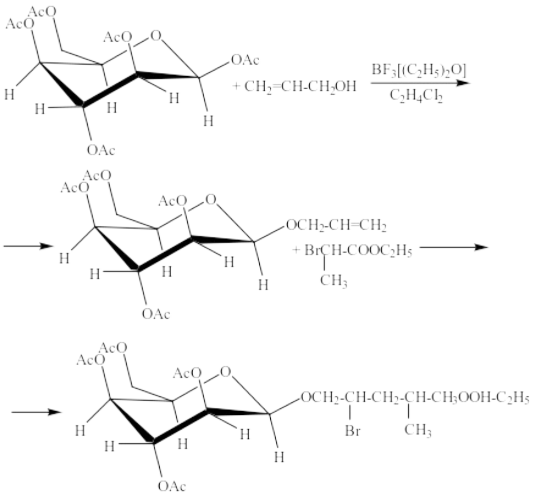
Bromoglycosides occupy a special place among pharmaceutical preparations. They are tranquilizers, used in cases of bronchial asthma, lung inflammation, and diseases of the nervous system. Also there is great interest in the synthesis of glycomimetics for biochemical and medical purposes [1].

Coupling reactions of acetylated allyl derivatives of idopyranose with 2-bromopropionic acid ethyl ester were studied. The Synthesized new compound: β-O-(2,3,4,6-Tetra-O-Acetyl-D-idopyranosyl)-2-methyl-4-bromopentonate is widely used in drug technology and is also an interesting starting compound for obtaining hydrocarbon polymers [2].



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FPTA-P-27

POSSIBILITY OF CREATING BIOCOMPOSITES BASED ON BIOMASS OBTAINED FROM HAZELNUT SHELL

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Cellulose is the most abundant polysaccharide and the main structural component of plants. In most plants, the cell is about 0.5 micrometers thick and contains a mixture of cellulose, pentosans, and a chemically inert polymer-lignin [1]. Cellulose fiber from various types of woody plants, together with lignin, are used to make paper, building materials, textiles and polymer composites. Today, cellulose and bioorganic polymers based on cellulose have gained great popularity in the pharmaceutical and other industries due to their low cost, lightness, environmental friendliness, stability in natural conditions and other properties [2].

For today it is very relevant in the production of industrial synthetic polymers (polyethylene, polypropylene) to give the property of biodegradation, which is mainly done by introducing cellulose-containing biomass into them or their waste. For this, a large amount of coniferous and deciduous wood (timber) sawdust is used, in many cases together with starch. It is also used, for example, rice husk, the introduction of a large amount of which into the polymer ensures is increased thermal stability, which is due to the high content of silicon oxide in the rice husk.

Hundreds of tons of nuts are produced in Georgia, and the remaining shells remain unused, either burned or used in the form of briquettes for heating. From the crushed biomass we obtained from hazelnut shells, is obtained a biocomposite material where isotactic polypropylene powder is served as a binder. They were filled by mixing in a propeller mill from 40% to 80% by weight, and prototypes were prepared by hot pressing. Optimal conditions have been established for the technology for producing bioorganic composite material that is safe for health. The surface structure, thermal and physical-mechanical properties of the obtained samples were studied.

It has been experimentally confirmed that the physical and mechanical characteristics of bioorganic composite materials are depend on the filler concentration, and their increased heat resistance is explained by the influence of phenolic compounds contained in hazelnut shells on the structure of the composite.

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FPTA-P-28

ADSORPTION AND REMOVAL OF PARACETAMOL FROM WATER BY SORBENTS OBTAINED FROM CELLULOSE CONTAINING RAW MATERIAL OF NECTARINE KERNEL

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Nowadays, worldwide concern is caused by pollution of water with pharmaceuticals as they can cause negative effects on animal and human health.

Due to its attractive advantages, including environmental friendliness and simple operation, adsorption is considered one of the most promising approaches.

The purpose of this work is to study the sorption properties of carbonaceous materials obtained from nectarine kernel by a technology developed [1, 2] at the Iv. Javakhishvili TSU Institute of Inorganic Chemistry and Electrochemistry and to determine the possibility of their use for purifying water polluted with pharmaceuticals. The produced adsorbent showed a high surface area of 640 $m^2\ g^{-1}$. In order to assess the adsorptive properties of carbon material, it was applied for paracetamol removal. The effects of adsorbent dose, contact time, pH, and initial paracetamol concentration on adsorption were studied.

Studies have shown that:

- The maximum amount of paracetamol that can be bound by 0.1 grams of sorbent in a 50 ml solution is 98.55% (in 30 minutes);
- An increase in the amount of adsorbent was reciprocated in the value of sorption efficiency (100%) by largely improving it;
- In case of low concentrations complete adsorption of paracetamol occurs;
- Adsorption process was well described by the Langmuir and Freundlich isotherm models.
- Adsorption capacity of obtained carbon material reaches the max value when the pH value is set at 5.

It is established that the produced nectarine kernel carbon material showed to be an efficient adsorbent (without activation and modification) for removing organic pollutants in aqueous solutions.

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[2] Patent P 2021 7309 B

FPTA-P-29

OBTAINING BORON AND ITS COMPOUNDS FROM NATURAL BORATES AND PRODUCTION WASTE

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Boron and its compounds have significant potential to play crucial roles in the metallurgical, chemical, electrochemical, nuclear, and space industries. High-purity crystalline boron is essential for manufacturing semiconductor systems, electronic and optical devices, as well as for producing special steels and alloys in metallurgy [1]. Borax and boric acid find applications in the production of leather, starch, glazes, and enamel paints. They also play a vital role in nuclear technology, slowing down thermal neutrons in nuclear reactors and serving as converters of isotope energy sources, among other uses.

Shortcomings in modern industrial methods for obtaining boric acid significantly impact the yield of the target product. When borate ores are processed using the sulfuric acid method, the output of boric acid typically ranges from 65% to 78%. A portion of the boric acid is lost in the mother solution, accounting for 18% to 30% of the total loss due to the co-solubility of boric acid and magnesium sulfate. The higher the ratio of MgO to B_2O_3 in the starting ore, the greater the loss of boric acid. During the sulfuric acid treatment of borate ores, the yield of boric acid is negatively affected by the formation of insoluble calcium sulfate and hydrated silicic acid, taking the form of a gel. Both of these factors complicate the filtering process [2, 3].

We have developed a highly efficient laboratory method for extracting boric acid from boron production waste, where boron is in the form of boric acid, and from natural borates, transforming it into various products [4]. This method is based on the property of boric acid, which, when interacting with aliphatic alcohols, forms the corresponding alkyl borates. The hydrolysis of these alkyl borates yields boric acid in nearly quantitative yield. Boron exists in the form of boric acid in all production residues or can be easily converted from natural compounds into boric acid through the action of mineral acids:

$$CaMgB_6O_{11}\cdot 6H_2O + 2H_2SO_4 + nH_2O \rightarrow CaSO_4 + MgSO_4 + 6H_3BO_3 + mH_2O$$

$$H_3BO_3 + 3ROH = (RO)_3B + 3H_2O$$

where R=n.- C_5H_{11}; izo-C_5H_{11}; C_6H_{13}.

According to this method, the output of boric acid from natural minerals, industrial wastes, as well as from artificial fertilizers is 87-97%.

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FPTA-P-30

THERMAL CHARACTERISTICS OF MAGNETIC ANOMALIES OF LANTHANIDE-IRON GARNETS

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Lanthanide iron mixed oxides form a large family of garnet type compositions (RIG). Because of specific magnetic properties of this group of insulators they are widely applied in many fields of technology. Magnetic properties of garnets can be verified by compositional modification and by thermal treatment. This stipulates the study of magnetic behavior of garnets in the large temperature and compositional range and analysis of their influence on energetic parameters.

In present work we report the effect of magnetic anomalies on thermal characteristics of the main group of garnet-type rare earth ferrites with general formula $R_3Fe_5O_{12}$ (where R is lanthanide ions from Sm to Lu). The study is based on investigation of heat capacity as temperature function Cp(T) in the range 20-1300 K using low-temperature calorimetry (20-300 K), and differential-scanning calorimetry (T>300 K).

Based on Neel's theory, which explains the specific magnetic properties of garnet-type ferrites as the result of their three-sublattice crystal structure, and also taking in view the electronic structure of lanthanide ions, we present the heat capacity function of RIG as complex quantity including following components: $C_p=(C_{reg})+C_{ex}$ (1). Except of the regular lattice C_{reg} part, there is the excess C_{ex} increment which represents the summary effect of cooperative and non-cooperative magnetic origin. By applying the special suggested methods for separating the C_{ex} from total experimental value, it was revealed and characterized following anomalies: 1. the "low-temperature" magnetic anomaly ($T_v<100$ K), due to the magnetic disordering process with participation of lanthanide ions. 2. The lambda-tape anomaly associated with ferromagnetic-paramagnetic phase transitions which take place in the region T>500 K. 3. Schottky-type anomaly caused by reorganization of electrons distribution over lanthanide ions Stark levels.

The following data are evaluated and reported: the temperature limits of anomalies, temperature of peaks (Curie Point-T_c, the peaks of Low-temperature anomaly - T_v); The excess thermodynamic properties - heat capacity (C_{ex}), entropy (S_{ex}), enthalpy (H_{ex}) associated with anomalies of magnetic origin.

It is shown, that in the garnet series the low-temperature point and Curie temperature have the tendency of linear decreasing in dependence with decreasing the lattice parameter. H_{ex} and S_{ex} of SmIG and EuIG slightly exceed the values of these parameters for the group of garnets from Gd to Lu. The obtained results are considered on the basis of the features of the magnetic and crystal structure of garnets.

FPTA-A-01

THE THEORETICAL DESCRIPTION FOR CENOBAMATE CuS-ASSISTED ELECTROCHEMICAL DETERMINATION

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Epilepsy is one of the most widespread chronic brain diseases, affecting people of all ages. It is esteemed that one of each 160 people has epilepsy, most of them from developing countries.

As for now, no complete epilepsy treatment is known. Nevertheless, the patient state may be controlled by uptake of certain drugs, one of them cenobamate (Fig. 1). It is known in the US as XCopri and in the EU as Ontoxry. It is used to treat partial-onset seizures in adults, like also focal-onset seizures with or without secondary generalization. It is in fact a tetrazolic carbamate (ester of unstable aminomethanic acid).

/Nevertheless, as cenobamate shortens the QT interval of the heart rhythm, it is contraindicated to people with heart electgrical system disorder. The most common side effects are dizziness, drowsiness and fatigue, like also potassion hyperconcentration, sight disorders and headache. For this reason, the development of an efficient analytical method for cenobamate quantification is really actual, and the electroanalytical processes, yet used for the similar analytes would give it a good service.

Considering the cenobamate structure, we may conclude that both cathodic and anodic processes may be applicable to its determination, but cathodic process is preferable, due to the presence of highly accepting groups, including the electronically deficient tetrazolic moiety. As for the anodic process, it is also possible, although requires the presence of the strong oxidants, one of which is trivalent copperö *in situ* obtained by copper sulfide nanoparticles electrooxidation in basic medium.

For the first time, the theoretical description for cenobamate antiepileptic drug on anode, assisted by copper sulfide nanoparticles in alkaline medium, has been given. Two mechanisms, involving either tetrazolic ring, or the carbocyclic aromatic moiety, are possible for this process, reason why the mconbcentration of the drug will be identified and quantified by two peaks. Despite of the mechanism hybroidicity, both of the peaks will produce an easy interpretable analytical signal, being thereby possible to confirm the efficiency of the electroanalytical signal.

FPTA-A-02

THE THEORETICAL DESCRIPTION FOR SUCRALOSE AND BISPHENOL C2 ELECTROCHEMICAL DETERMINATION AND DEGRADATION ON BIVALENT CHROMIUM

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Bisphenols consist a group of compounds, used mainly in polyester plastics, including polycarbonates, fast-drying epoxy resin adhesives and anticorrosion coatings. They are also used in odontology for implant fixation. One of the bisphenols is bisphenol C2 (Fig. 1 to the left), containing two chlorine atoms.

On the other hand, sucralose (Fig. 1 to the right) is an extremely stable artificial sweetener up to 1000 times as sweet as common sugar. Its effects on human and animal organisms hasn´t been completely studied yet. Moreover, being hardly metabolized, it is accumulated in the environment. A recent 2023-dated study has shown that the use of sucralose by pregnant women can influence the neonates´ gut microbiota. Also, the organisms capable to metabolize it transform the sucralose transform it into toxic chloroorganic derivatives like dioxines and tetrachlorodibenzofurans.

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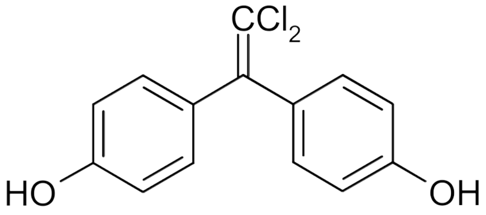

Fig. 1. Bisphenol C2 and sucralose

If the food products containing sucralose are heated in a vase, made of bisphenol C2-based polycarbonate, both of the compounds will be accumulated in the food and in the wastewater. For this reason, the development of a method, capable of detecting rapidly and exactly both of the substances is really actual.

In this work, we describe theoretically the possibility of $Cr(OH)_2$-assisted electrochemical detection and elimination of both bisphenol C2 and sucralose. By $Cr(OH)_2$ chemical oxidation, the hydrogen *in statu nascendi* will appear, dechlorinating thereby both bisphenol C2 and sucralose, yielding inorganic chloride.

This process wil be realized by a membrane electrolytic process, impeding the passage of the chloride ion towards the anodic compartment.

Despite of the higher probability of the oscillatiry behavior, this process may be efficient for both detection and removal of both of the chloroorganic compounds from the wastewater and natural waters.

FPTA-A-03

THE THEORETICAL DESCRIPTION FOR THE ELECTROCHEMICAL DETERMINATION OF THEACRINE IN CUPUAÇU TEA

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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 and the Centre-West of Brazil (mostly in the states of Pará, Amazonas, Rondônia and Acre), like also in Colombia, Peru and Bolivia. It is also found in a Chinese tea plant, kudingcha.

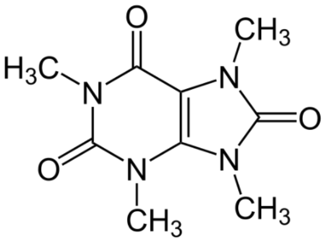

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Fig.1. Theacrine

It manifests anti-inflammatory and analgesic effects and affects adenosine signaling by mechanism, similar to that of caffeine. Nevertheless, although theacrine is a relatively safe drug, its effect strongly depends on the concentration. Moreover, while used in formulations, theacrine may be confused with other uric acid derivatives. Thus, the development of a cheap, precise, exact and sensitive method of its detection and quantification remains an actual problem.

Although the electrochemical techniques have been developed and successfully applied to other uric acid derivatives (the proper uric acid, caffeine, theobromine), none of these methods have been applied to theacrine yet. The similarity of its composition to that of the mentioned compounds makes think that theacrine may also be electrochemically detected. Moreover, the discovery of the proper theacrine has been realized recently, so this work has to be interesting also from this point of view.

In this work the theacrine electrochemical determination on the CuS nanoparticles-modified conducting polymer electrode has been theoretically described. It is shown that the electrochemical determination of theacrine in the presence of caffeine in kombucha is possible. The analytical signal is clear and easy to interpret.

FPTA-A-04

THE THEORETICAL DESCRIPTION FOR FIROCOXIB CATHODIC ELECTROCHEMICAL DETERMINATION IN MEAT AND MILK

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Firocoxib (Fig. 1) is a veterinary anti-inflammatory drug and painkiller, acting as a COx selective inhibitor. It was the first COx inhibitor, approved for use in horses (Equioxx) and dogs (Previcox).

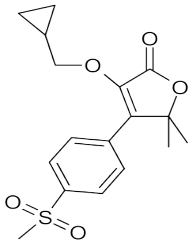

Figure 1. Firocoxib

Its use in human medicine is forbidden. Nevertheless, its molecule, like also the molecules of its metabolytes may appear in horse meat and milk products,which are very popular in Turkish countries, including Türkiye, Azerbaijan and especially Kazakhstan, Kyrgyzstan, Turkmenistan and Uzbekistan. In Kastamonu, Türkiye, the horse and donkey milk is used to produce local yoghurts and cottage cheeses. Therefore, firocoxib may appear in those milk and meet products, if the horse, from which they are prepared, has taken firocoxib and the problem of its determination in the mentioned products becomes really actual, and the electrochemical methods may provide it a good service.

In this work, the possibility for firocoxib electrochemical determination in meat and milk has been theoretically described. The electroanalytical process is given on cathode, providing an efficient electroanalytical process. The analysis of the correspondent model, by means of linear stability theory and bifurcation analysis has confirmed that the conducting polymer may serve as an efficient electrode modifier for firocoxib electrochemical determination. As for oscillatory and monotonic intabilities, it will depend on the nature of the monomer, used to yield the conducting polymer.

FPTA-A-05

SYNTHESIS, PHYSICO-CHEMICAL PROPERTIES AND THEORETICAL PREDICTION OF ELECTROANALYTICAL PROPERTIES OF THE NOVEL BENZO-[B][1,8]-NAPHTHYRIDINE-5(10H)-ONE AND THIONE

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Pyridine, quinoline and acridine are heterocyclic compounds, possessing derivatives with highly expressed biological activity and dyeing properties. It is known that some of the pyridinic derivatives are caclcium ion antagonists by blocking the calcium channels and possess radioprotecting cardioprotecting, hepatoprotecting antitumor, antimutagenic, antibacterial, antiprotozoal and hypotensive activities, reason why they are widely used in medicine, pharmacy and agriculture. They are also used as dyes and pigments, some of them fluorescent and as monomers for conducting polymers for electroanalytical use.

Nowadays, a search of novel quinolinic biologically active compounds, dyes and their polymer is caused by the necessity of treatment of neglected tropical diseases (malaria, dengue, chikungunya, zika etc), new infections diseases, like COVID-19, Ebola, analytical detection of other biologically active and environmentally aggressive compounds including chemical warfare agents and environmentally stable food additives. For this reason, the goal of this work is to obtain the novel aza-acridonic and aza-thioacridonic heterocyclic compounds, characterize them and and investigate theoretically their electroanalytical activity in the electrochemical determination of biologically active compounds using dopamine and ascorbic acid as models This investigation will also include the analysis of the correspondent mathematical model and comparison of their behavior with the behavior of the similar compounds in the similar systems.

The schematic representation of the synthetic procedures has been described on the Fig. 1:

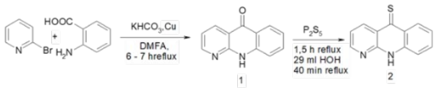

Figure 1. Scheme of the synthesis of the compounds

The mechanism of the first reaction is analogous to Ullmann coupling with the only difference that the coupling is accompanied by heterocyclization with the 4-pyridonic ring closure in the middle of the product, due to the enhanced electrophylicity of the 3rd position of pyridinic ring, activated by bromine atom. 8-aza-9-thioacridone has been obtained for the first time by the reaction of 8-aza-9-acridone with phosphorus pentasulfide. Both of the substances are yielded as yellow needle crystalline substances, unsoluble in alkalies and organic solvents and limitedly soluble in carbonate water solutions.

The spectral data of both of the compounds confirm the stability of radical-cation in different resonance forms, which favors the electropolymerization and chain propagation of both of the synthetized compounds, analogously to [22 – 27]. The electropolymerization will be given by the positions 2 and 6 of 8-aza-9-(thio)acridonic ring, and for the anodic route the polymerization potential of the compound 2 will be lower than for the compound 1 (especially in the form D, compared to the form A), as the thiolic group possesses more donating properties, which enhances the molecule electrophylicity.

The cathodic route, in which radical-anion acts as a chain initiator, is also possible, being more expressed for the compound 1, in which the pyridonic moiety in the middle acts as an acceptor (Fig. 3).

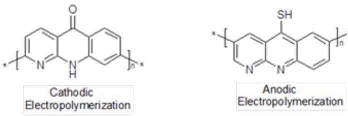

Figure 2. Conducting polymer structures for the cathodically synthetized poly(1) and anodically synthetized poly(2)

Both of the polymeric forms may be excellent electrode modifiers for the electrochemical determination of biologically active compounds, as theoretically proven.

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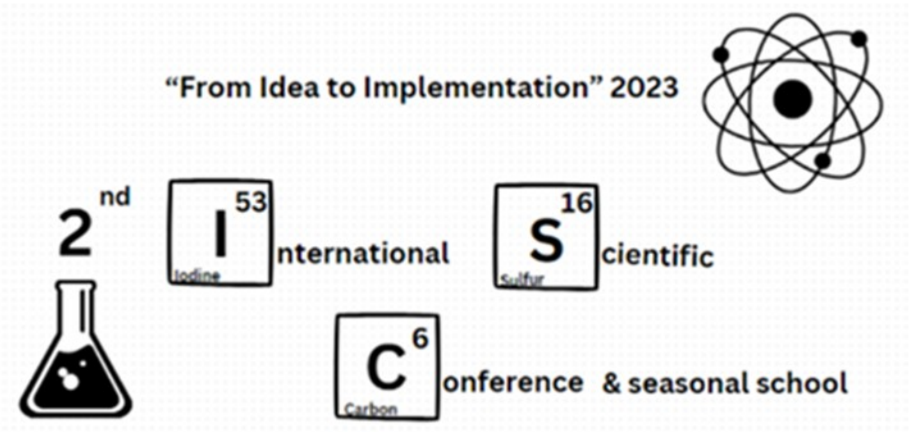
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GCH-O-01

UTILIZATION OF IRRADIATION TECHNOLOGY FOR MATERIAL MODIFICATION. CURRENT STATUS AND FUTURE CHALLENGES

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Irradiation, especially using electron beams, is a physical cold treatment process without residues that has been implemented for material modification in multiple applications for several decades. Among desired effects, we can mention microbiological decontamination or sterilization of material, modification of properties (either surface or within a matrix) of materials, radical degradation of molecules of interest, or even the creation of new materials through radio-polymerization. This technology could help overcome future challenges, such as promoting bio-sourced materials or developing more efficient recycling methods.

In the field of recycled or bio-sourced products and materials, this technology could help overcome certain drawbacks in their implementation. For instance, it could replace chemical or thermal treatments against molds or insects, improving their thermo-mechanical properties through radiation cross-linking or composite compatibility (fiber-resin or blends of recycled materials). The irradiation process can add value by altering the quality of raw materials, improving the properties of bio-sourced materials, or degrading petroleum-based materials to facilitate their recycling. Areas of application include construction materials, medical device or phytopharmaceutical products, as well as automotive or space industry.

Aerial has several irradiation plateforms based on low, medium [3], and high-energy electron accelerators, offering its services for diverse applied studies and research projects. Moreover, associated laboratories specializing in dosimetry, physicochemistry, NMR, microbiology, sensory analysis, and even lyophilization contribute to projects by characterizing samples pre or post-irradiation in terms of composition and functionality.

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GCH-O-02

PERSPECTIVS' OF ARTIFICIAL INTELLIGENCE IN PHARMACOVIGILANCE STUDY

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Ever since the intense scrutiny faced by organizations that developed COVID vaccines, pharmacovigilance has become a hotly discussed area of interest. The practice of pharmacovigilance basically aims to reduce the entry of drugs with adverse side effects into regular circulation. Artificial Intelligence (AI) has been permeating this field in recent years due to the immense potential for automated pharmaceutical discovery that it offers.

Pharmacovigilance is a non-negotiable activity in the pharmaceutical industry that helps weed out drugs that do not meet safety standards. The various benefits of automation that AI can inculcate into this practice can lead to faster and more accurate screening of drug data.

In this abstract, we talk about pharmacovigilance and the various ways that the implementation of pharmacovigilance automation and AI-allied tools can boost the efficacy of this practice in general.

Pharmacovigilance involves the systematic collection, analysis, and reporting of information about the safety of medicines, including prescription drugs, over-the-counter medications, and herbal supplements. Concerns regarding drug safety come to the fore as Adverse Events (AE) are reported, which are the occurrence of unfortunate consequences from the consumption of a specific drug. This information is gathered from various sources, such as healthcare professionals, patients, clinical trials, and scientific literature.

The integration of AI technologies in pharmacovigilance offers significant advantages, including early detection of adverse drug reactions, improved data quality, and faster response times. By leveraging AI algorithms and machine learning techniques, pharmaceutical companies and regulatory agencies can better ensure the safety of patients and improve public health outcomes. While challenges remain, the potential benefits of AI in pharmacovigilance make it a promising area for continued research.

Social media platforms and online forums have become places where individuals often share their healthcare experiences, including adverse drug reactions (ADRs). AI-powered sentiment analysis can sift through these vast amounts of unstructured text data to identify and categorize mentions of drug-related experiences. It can determine whether the sentiment expressed is positive, negative, or neutral and understand the context in which the drug is discussed.

Despite of some speaking against Al usage in different areas of practical or even scientific work, it can be very helpful because, of its high speed, in comparison.

GCH-O-03

INVESTIGATION OF AMYLOID FIBRIL FORMATION BY COARSE-GRAINED MOLECULAR DYNAMICS

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With the rise of life expectancy, the 21st century is challenged with the increase in emerging age-related neurodegenerative disorders, such as Alzheimer's (https://www.alz.org) and Parkinson's (https://www.parkinson.org) diseases, which are among the top ten illnesses ending with death that cannot yet be cured or slowed significantly. In this Abstract, focus is placed on Alzheimer's disease (AD) - the most common neurodegenerative disorder. One of the hallmarks of AD is the overproduction and accumulation of amyloid--β (Aβ) plaques in certain regions of the brain, leading to neurodegeneration. Despite huge effort (both through *in vitro* and *in vivo* studies), there is still no remedy that can slow the progression of AD. A number of drugs available currently are effective only for a short period of time and for half of the patients with milder forms of AD. There are several reasons making this problem so difficult to solve, including mechanisms that are not fully comprehended by which small oligomers evolve into their fibrillar form and then how these fibrils grow. Because of the inability to identify and follow the low concentration of oligomers over time experimentally, it is difficult to determine the fundamental microscopic reactions taking place during aggregation. Molecular dynamics (MD) simulation is the only method with which to study the details of fibril formation; however, the time scales over which fibrils form limit its usefulness. The time scale problem in our studies was surmounted by employing a physics-based coarse-grained united-residue (UNRES) force field, developed in our laboratory. In these studies, [1, 2], by performing replica-exchange molecular dynamics simulations with UNRES force field, we were able to to model the entire process of Aβ fibril elongation. Scrutiny of simulation data by different methods, such as principal component analysis, time-structure based independent component analysis, Markov state model, transition path theory, enabled us, at atomistic level, (i) to elucidate the mechanism for amyloid fibril formation; (ii) to identify a hydrophobic segment of the sequence playing a crucial role in aggregation; (iii) to gain mechanistic insights into critical steps during the fibril elongation process. Our theoretical findings were validated by experiment [3].

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GCH-O-04

EFFECT OF CALCINATION TEMPERATURE ON THE SURFACE STRUCTURE AND ELEMENTAL COMPOSITION OF MnOx-Na_2WO_4 BENTONITE CATALYST FOR OXIDATIVE COUPLING OF METHANE

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In the last decade, MnOx-Na_2WO_4 catalysts based on oxide supports and their modified forms have been tested as preferred catalysts for the oxidative condensation of methane (OCM) reaction [1, 2]. This report presents the effect of calcination temperature on the surface structure and active element distribution of MnOx-Na_2WO_4/bentonite catalyst for OCM. The synthesized samples were characterized by SEM/EDS, XRD, FTIR and EPR. Figure 1 shows the effect of calcination temperature on the surface structure and distribution of active elements in the MnOx-Na_2WO_4/citric acid/triethanolamine/bentonite catalyst after the OCM reaction.

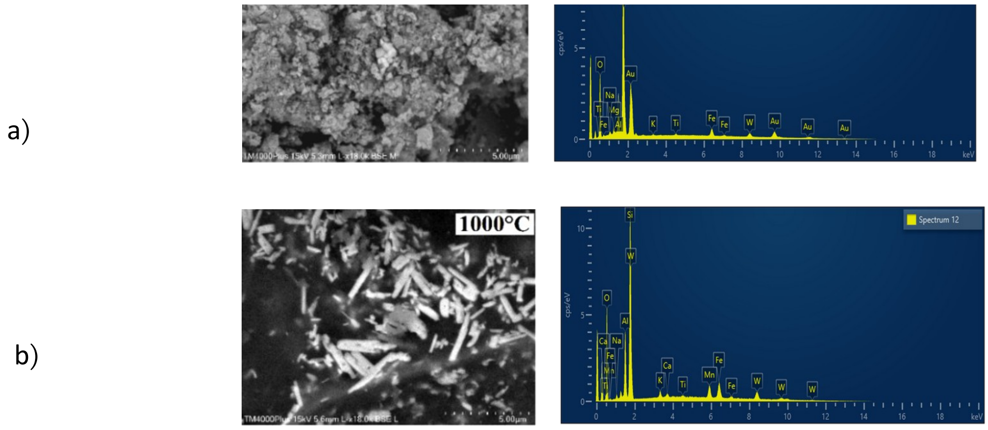

Fig.1. SEM/EDS MnOx-Na_2WO_4/citric acid/TEA/ bentonite samples calcined at a) 850 and b) 1000°C for 4h after the OCM reaction

It should be emphasized that the calcination temperature of these samples significantly affects the surface structure, the distribution of active elements in the catalysts and, as a consequence, their catalytic efficiency and stability in the OCM reaction.

Acknowledgements

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GCH-O5

IDENTIFICATION OF IMPURITIES IN PAPER MADE FROM WASTE PAPER

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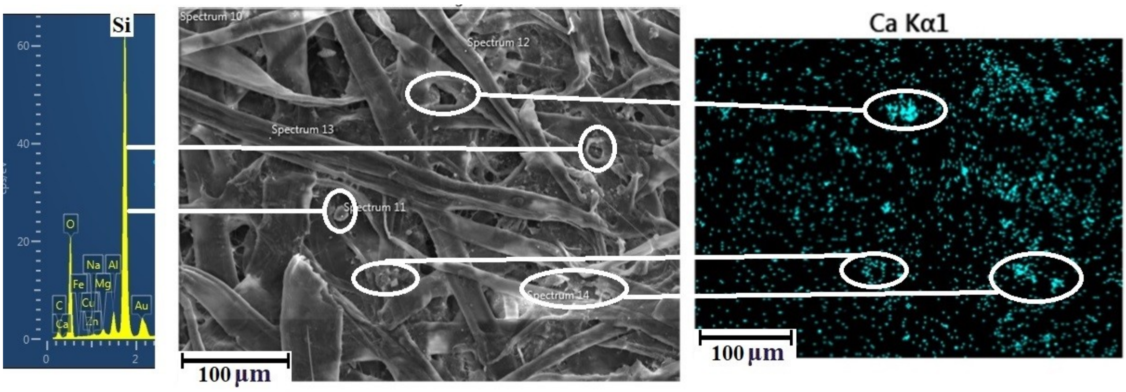
During the coronavirus pandemic, demand for new antibacterial and antiviral materials has increased, especially for paper packaging for food and agricultural products, and this interest continues in the context of the post-pandemic period. Recently we have developed special zeolite fillers, containing biologically active metals such as silver, copper and zinc, and which give packaging paper bactericidal properties [1]. As a rule, packaging paper and cardboard are made from recycled materials, waste paper containing various impurities, and their identification is a necessary and important task, since impurities can interact with bioactive metal ions. The large-scale X-ray energy dispersion spectrum (XR-EDS, taken from an area of 400 µm x 500 µm) of filler-free paper shows intense lines from carbon C and oxygen O atoms of plant material, as well as weak lines of calcium Ca atoms. The X-ray diffraction (XRD) patterns of paper samples show broad peaks of cellulose in the region $5<2\Theta<30^o$, and narrow peaks of calcite ($CaCO_3$) at large 2Θ angles. Calcite particles were identified using XR-EDS mapping of Ca atoms, as well as very common micrometric glass ($SiO_2{\cdot}nNa_2O{\cdot}mCaO$) particles were highlighted.



Zn-XR-EDS mapping shows a small amount of zinc oxide ZnO in the form of nanoparticles, Mg- and Si-mappings identify large particles of silicate of magnesia (talc, $(MgO)_n{\cdot}(SiO_2)_m$).

Acknowledgements

This work was supported by the Shota Rustaveli National Science Foundation of Georgia under the project AR-22-610 “Production of paper with bactericidal and improved surface properties”.

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GCH-O-06

THE INFLUENCE OF ULTRASOUND ON THE DLS, FTIR AND EMR SPECTRA OF A LIQUID-PHASE CATALYTIC SYSTEM FOR THE HYDROXYLATION OF PHENOL INTO DIHYDROXYBENZENES WITH HYDROGEN PEROXIDE IN THE PRESENCE OF IRON-CONTAINING MORDENITE PARTICLES

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This report presents the results of an in situ study using dynamic light scattering (DLS), Fourier transform infrared spectroscopy (FTIR) and electron magnetic resonance (EMR) of the changes in the average size, size distribution, magnetic properties, organic composition of the surface of catalyst particles during reactions of direct hydroxylation of phenol into dihydroxybenzenes with hydrogen peroxide, depending on the reaction temperature in the range of 278-343 K and its duration. As a catalyst for this reaction, we used samples of mordenite with different amount (0.1–5.0 wt.%) of supported iron(III) chloride, dried at 120°C, calcined in air and reduced with hydrogen at 400°C, and then dispersed to particles with a size of ~1 µm using a planetary mill PM200, Retsch, Germany, before introducing into the reaction mixture. A Hielscher UP 200S ultrasonic (US) device with a frequency of 26 kHz and a power of 200 W was used as an US source (USA). It has been shown that the effect of US on the activity of the catalytic system during the liquid-phase hydroxylation of phenol to dihydroxybenzenes with hydrogen peroxide is resulted in maintain the catalyst in a highly dispersed state, cleaning its surface from reaction products. Catalytically active in this reaction are nanosized particles of iron oxide FeOx, more precisely, Fe_3O_4, formed during the reduction of Fe_2O_3 particles in oxidized samples in a stream of hydrogen, which initially react with hydrogen peroxide, forming the $^{\bullet}OH$ radical. Research shows that sonication is a good tool for modifying the surface of solid catalyst particles and thereby activating hydrogen peroxide. We believe that when a liquid-phase catalytic system is exposed to US, catalyst particles are dispersed and small particles are formed that have coordinatively unsaturated ions with increased reactivity. US has a positive effect on the processes of hydroxylation of phenol to dihydroxybenzenes, allowing to increase and maintain its catalytic activity for a long time. Research shows that particle dispersion increases with increasing duration of US exposure. High dispersion with a narrow particle distribution interval for this system is achieved after 30-40 minutes of ultrasonic exposure to the catalytic system. Exposure to US makes it possible to restore almost the original activity of the catalyst after its operation for 4 hours, as well as preserve it for a long time by cleaning its surface from reaction products and maintaining the ultra-dispersed state of the catalyst.

GCH-O-07

THERMAL STABILITY OF HETERONUCLEAR Fe-Mn(Co) CYCLOPENTADIENYL COMPLEXES ADSORBED ON ALUMINA AND THERMODYNAMICS OF THEIR DECOMPOSITION

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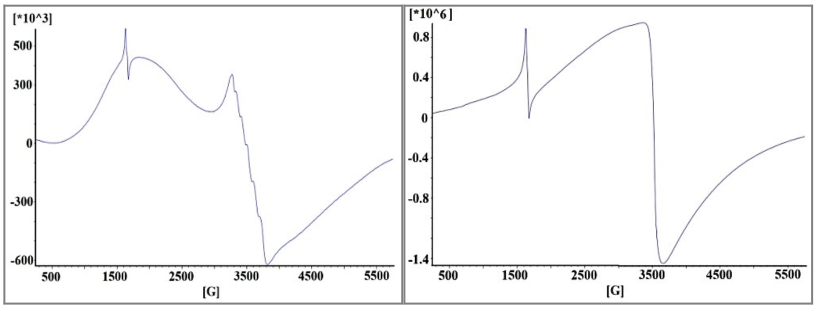
In this report the results of a study of the thermal stability of bimetallic heteronuclear compounds of the composition $(C_5H_5)_2FeMnX_2(\mu\text{-}CO)_n$ (I) and $(C_5H_5)_2FeCo)X_2(\mu\text{-}CO)_n$ (II), where X=Cl, Br and n=1.2, supported on alumina and thermodynamics of their decomposition are presented.

The textural characteristics (specific surface area and total pore volume) of the samples were determined by low-temperature nitrogen adsorption on a Belsorp Mini II instrument, BEL Japan Inc. The infrared spectra of the synthesized samples were recorded on a FT-IR Alfa and the EPR spectra were recorded on an EMR_{micro}, Bruker, Germany spectrometers. Thermal analysis (TG/DTG/DTA) was performed on a NETZSCH STA 449 F3 Jupiter setup in a nitrogen flow in the range of 25-700°C at a temperature rise rate of 10°C/min. For catalytic measurements micro-reactor-mass-spectrometer Catlab system from Hiden Analytical, UK is used. The Ulich equation

$$\Delta G_T^0 = \Delta H_T^0 - T\Delta S^0_{298} - \Delta C^0_{p,298}\, T[\ln(T/298) + (298/T)-1]$$

where ΔG_T^0 ; ΔH_T^0 ; ΔS^0_{298} - free energies, enthalpies and entropies of reaction was used to determine the temperature dependences of the free energy of the pyrolysis reactions of these compounds in the range of 700-1500 K.



a) b)

Fig. 1. a, b EPR spectra recorded at room temperature of calcined at 600 °C in air current for 2 hours of 0.5 and 2,4 mas. % of (I) and (II) supported over Al_2O_3, respectively.

X-ray diffraction patterns of catalysts prepared on the basis of aluminum oxide with supported compounds I, II with a content of Fe, Mn, Co less than 15 wt. % and below show a highly dispersed amorphous state. Features of the thermodynamics of the reaction of pyrolysis of these compounds with the formation of nano-sized iron and/or iron oxide and the role of MOx nanoparticles, where M = Fe, Mn, Co and isolated Fe^{3+} ions (Fig. 1, a, b) in the hydrogenation of CO_2 into C_{2+} hydrocarbons are discussed. The thermodynamics of the transformation of metal into metal oxides, small clusters of iron, cobalt, iron-cobalt, iron-manganese and their oxides has been studied. It has been shown that the reduction of MeO with hydrogen is accompanied by the formation of metal and metal oxide structures with a reduced degree of metal oxidation and small metal clusters. Note that the results obtained in this work are most likely of a general nature and may be typical for many systems.

GCH-O-08

CARBON DIOXIDE RECYCLING IN FUEL CELL APPLICATION

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The considerable charges on the atmosphere by greenhouse gases overwhelming the capacity of nature to cope with them is considered as a fundamental challenge for the climate change.

One of the most important reason of use of biomass as a renewable energy source is the fact that the present biomass is almost completely recyclable, as the released carbon dioxide by combustion is converted by the present vegetation by photosynthesis. A good example for this approach is the treatment of organic waste to produce biogas. The latter is mostly used as a fuel but its application as a feed stock for chemicals is also considerable.

On the other hand the inevitable release of carbon dioxide could be remediated after its conversion into chemicals (e.g. synthesis gas. methanol, formic acid) and to fuel, like methane by chemical, electrochemical or biotechnological processes.

The present work summarizes the up-to-date methods and approaches for carbon dioxide recycling recent author results conversion and carbon dioxide conversion to chemicals and fuels. The fuel cell approach enables the drastic reduction of carbon dioxide release during it conversion into value-added chemicals, i.e. formic acid, methanol, etc. Our results show the formic acid production with reasonable yields in a fuel cell where bicarbonate and carbonate are used as oxidizers.

Acknowledgement

This work was supported by the project GA D01-160/28.08.18 „Research Infrastructure Energy Storage and Hydrogen Energetics“(ESHER), by the Ministry of Education and Science, Republic of Bulgaria.

GCH-P-01

EXAMINATION OF THE CHEMICAL COMPOSITION OF WATER FROM THE WELL OF RUFOTI VILLAGE, TERJOLA MUNICIPALITY

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We aimed to study the chemical composition of the waters of the Rufoti well in Terjola municipality.

As water moves through the Earth's crust, it touches many minerals, dissolves them, and carries them along the circulation path. Natural water is a solution containing substances of different nature and state.

Water is the most common substance in nature. In a gaseous state, water is mixed with atmospheric air, where its amount varies depending on meteorological conditions[1].

The relevance of the issue lies in the fact that the content of the above-mentioned ions was determined for the first time in the given waters, for which highly sensitive methods were chosen [2].

Thus, magnesium, calcium, hydrocarbonate, chloride and sulfate ions were determined for the first time in the waters of the Rufoti well of the Terjoli municipality.

N	Name of the well waters	Mg/l							
			Ca^{2+}	Mg^{2+}	HCO_3^-	Cl^-	Dissolved oxygen	Permanganate Oxidization	CO_2
1	Megrelishvili Shota	0,054	4,74	1,42	5,74	5,02	14,42	3,44	1,69
2	Kupatadze Mikheil	0,099	4,78	2,18	4,86	4,82	20,48	2,94	1,04
3	Todadze Mzia	0,029	2,64	1,34	3,92	2,10	16,64	3,46	1,08
4	Megrelishvili Gulgezi	0,058	7,12	1,62	7,70	3.12	14,04	0,56	1,62
5	Nikoladze Ivane	0,025	4,41	1,98	3,58	4,81	15,36	2,64	1,11

The content of carbon dioxide, calcium, magnesium, hydrogen carbonate, chloride, sulfate, permanganate oxidization and dry balance in the studied well waters of Rufoti village of Terjola municipality is within the norm and its usage for drinking and from the economic point of view is appropriate.

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GCH-P-02

EXAMINATION OF THE CHEMICAL COMPOSITION OF SPRING WATERS OF AKETI VILLAGE OF LANCHKHUTI MUNICIPALITY

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We aimed to study the chemical composition of the spring waters of Aketi village of Lanchkhuti municipality.

Water is a good solvent and dissolves the substances it touches in its circulation. Gases are mainly transferred from air to it, and solid substances from rocks and minerals [1]. Many biogenic elements are found in living organisms in very small amounts and are called microelements.

Thus, for the first time in the spring waters of Aketi village of Lanchkhuti municipality, the following were determined: magnesium and calcium, hydrocarbonate, chloride and sulfate ions, dry balance, otal Iron, permanganate oxidation, dissolved oxygen and carbon dioxide content [2] The analysis of the results are given in table.

N	Regional names of spring waters	Mg/l								
		Ca^{2+}	Mg^{+}	HCO_3^-		Cl^-	Dissolved oxygen	permanganate oxidation	CO_2	Total Iron
1	Megreladze spring	0,64	0,34	2 ,04	0,045	1,06	5,76	1,14	0.94	0.028
2	Doghadze spring	0,38	0,52	2,24	0.065	1,46	4,48	3,04	0,78	0.034
3	Gujabidze spring	0,94	1,06	3,62	0,008	1,54	5,12	0,48	0.98	0,026
4	Shukhuti spring	2,46	2,22	6,06	0,037	1,52	3,58	0,56	0,92	0,038

The content of calcium, magnesium, chloride, bicarbonate, sulfate and common iron ions, dissolved oxygen, carbon dioxide, dry balance and permanganate oxidition in the studied spring waters of Aketi village of Lanchkhuti municipality are within the norm and its usage for drinking and agricultural purposes is appropriate.

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GCH-P-03

ASSESSMENT OF THE IMPACT OF EMERGENCY DISCHARGE OF LEACHATE ON HYDROLOGICAL OBJECTS

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This research FR-21-759 has been supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG). In Georgia, since 2010, three state companies have been managing municipal solid waste (MSW) and operating landfills (Solid Waste Disposal Site (SWDS)) in Georgia: Waste Management Company (whole Georgia, except Adjara and Tbilisi - 54 SWDS), Tbilservice Group (Tbilisi - 1 SWDS) and Adjara Waste Management Company (Adjara - 2 SWDS) [1, 2, 3]. 51% of the solid waste generated in Georgia (400 tons of MSW/year) [4] is placed at a new type of SWDS of capital city, where immediately from the start of operation, due to the shortage of power, of the reverse osmosis system and its subsequent deactivation, there was a problem of treatment the leachate, and, accordingly, a problem of their discharge into the sewerage system. On the territory of SWDS installed 2 reservoirs (volumes: 7500 m^3 and 4000 m^3) with an area of 0.65 hectares. Leachate is pumped into reservoirs, settled, and then pumped back to the SWDS area [5].

Based on monthly eco-monitoring of leachate water, an increased content of particularly problematic microbiological indicators of Total Coliforms was revealed, the values of which in the leachate are tens of times higher than the maximum permissible discharges (MPD) norms into water bodies, established by the Georgian Requirements for Environmental Quality [5]. Leachate is formed when the humidity of MSW is >55% and precipitation significantly exceeds the amount of moisture evaporated from the surface of the SWDS [6]. If the reservoirs are filled, at least 4000 m^3 of leachate can enter the Norikhevi River through a dry ravine, which means that due to the small water consumption of the Norikhevi River (0.12-0.08 m^3/s) [5,7] this can pose an environmental hazard.

Acknowledgements : The authors wish to express their thanks Shota Rustaveli National Science Foundation of Georgia (SRNSFG) for financial support and Institute of Hydrometeorology at Georgian Technical University for technical and research supports.

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GCH-P-04

RESEARCH ON MYCOTOXINS IN DAIRY PRODUCTS

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Food contamination is still a subject of study, both worldwide and in Georgia. Pollution can be physical, biological or chemical.

Aflatoxin M1 is a chemical compound of the aflatoxin class, which is produced by mycotoxin fungi species - Aspergillus flavus, Aspergillus parasiticus and rarely Aspergillus nomius. They contaminate the plants and their fruits. Aspergillus flavus produces only type B aflatoxins. Aflatoxin M1 is a hydroxylated metabolite of aflatoxin B1, it is found mostly in milk and dairy products obtained from livestock [1-3]. Aflatoxin M1 is a less carcinogenic mycotoxin than aflatoxin B1. The main sources of aflatoxins in children are peanuts, flour, corn and cotton seeds.

Aflatoxin M1 ($C_{17}H_{12}O_7$) is a hydroxy derivative of aflatoxin B1 and is excreted in the milk of mammals that consume aflatoxin B1 as food.

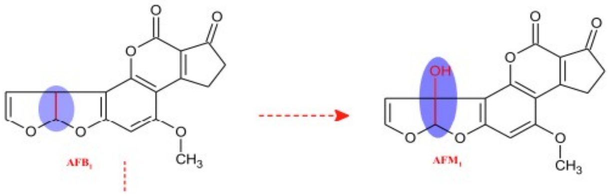

Fig. 1. Aflatoxin M1

Determination of aflatoxin M1 in milk is performed by high performance liquid chromatography (HPLC). The purpose of the experiment was to detect one of the strongest toxins in milk by R. Biopharm method AFLAPREP® M WIDE. The analysis was carried out in accordance with ISO 9001 and ISO 13485 standards.

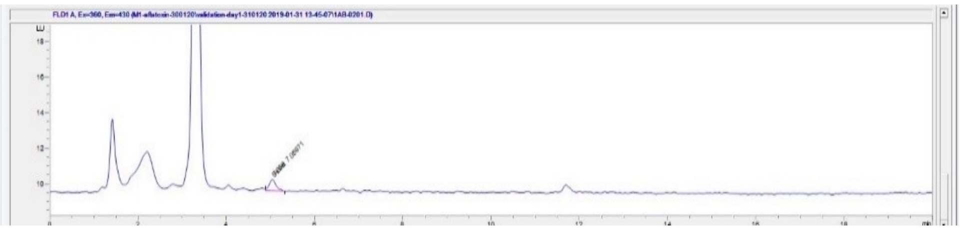

Fig. 2. Chromatogram at a concentration of 0.0001 mg/kg.

R. Biopharm and AFLAPREP® M WIDE methods detected one of the strongest mycotoxins in milk.

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GCH-P-05

ADSORBENT FOR REMOVAL H_2S FROM THERMAL WATER

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Every state organizes its development strategy based on its own resources. The energy sector, which has a leading role in the development of country, should be revived using these resources. In 21st century, in the background of global warming, irreversible pollution of the atmosphere and reduction of mineral resources, it has become urgent to find and utilize alternative renewable and cheap sources of energy. The share of renewable energy sources has remained virtually unchanged over the past 20 years in every region of the world except Europe, where it has doubled.

Georgia is rich in geothermal waters. More than 300 thermal water wells are registered. Since August 1993, almost all deposits have been stopped, except Tbilisi Lisi and Saburtalo deposits. To a large extent, this is due to the high content (5-18 mg/l) of gaseous hydrogen sulphide (H_2S) and dissolved hydrosulphides ion (HS-) in thermal waters.

Of the many methods of water purification from hydrogen sulphide, the most practical is sorption using inexpensive natural porous systems.

The goal of our work was to use the natural mineral, namely clinoptilolite (CL) of Georgia in natural and modified forms and activated carbon AU-3 to purify thermal water from H2S. CL processing and initial adsorption studies were carried out under laboratory conditions, then on a small-sized pilot plant at Tbilisi well No.4, and finally on a complete cleaning system installed, where composite sorbent AU-3 and CL base was sequentially loaded. The filter worked successfully for 20-22 days until the amount of skip reached 60%. Both sorbents were regenerated with 1200C heated air supplied at a rate of 160 L/min for 2 hours.

On a laboratory flow device, where the composite consisted of AU-3 and iron-modified CL, a better result was obtained - up to 30 days of operation without regeneration. So, dynamic sorption capacity increase as follows: DeCL <CL <CuDeCL <MnDeCL <FeDeCL <AC / CL <AC.

Thus, the advantages of our chosen method are: a simple purification unit, a one-step filtration process using local natural zeolite, the implementation of the developed technology ensures complete purification of thermal water from sulfur compounds.

Only in the case of using purified thermal water in Tbilisi, it will be possible to save more than 2.5 million tons of conventional fuel every year, the content of CO2 in the atmosphere will decrease 6 times, which will have a very important ecological and economic effect.

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GCH-P-06

DETERMINATION OF LEAD IN THE TERRITORY OF SOME REGIONS OF GEORGIA IN THE SOILS ADJACENT TO THE OOOUUUTGOING FREEWAY

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Heavy metals enter the biosphere through technogenic pollution, which is carried out in different ways. The lead that has fallen into the soil near the freeway comes from the exhaust of cars. According to the United Nations, from 2021, the use of ethylated gasoline for cars is prohibited in all countries, but for many years its use has caused great damage to the soils in which it accumulates. The object of the research is to determine the amount of lead in the soils of the surrounding area of the highway (Kutaisi - Batumi). Lead and other elements in the prepared solution were determined by the physicochemical method (atomic absorption) using the PerkinElmer (Atomic Absorption Spectrometer Analyst 200) tool. It was found that the amount of lead, copper and zinc in all the samples exceeds the limit permissible concentration (LPC). The highest amount of lead was found in samples taken in areas of heavy traffic and, presumably, low speed (sharp bends of the freeway), the least was in the samples that were taken from the places where a small river flows and where it is likely that some of the topsoil is carried into the river by rain. The increased amount of zinc and copper in the studied soils reduces the toxicity index of lead (antagonism). A moving (migrating) lead is very dangerous, because it moves into a plant, then into an animal and into a person. The ratio of humic and fulvic acids in the soil has a great effect on the amount of migratory lead, since humic acid binds it, and folvic acid converts it to a soluble state. The amount of migrated lead in the studied samples ranges from 5 to 6 mg/kg, i.e. within the limits of LPC. According to modern studies [1, 2], lead interacts with organic substances in the soil by forming complexes, the toxicity of which is significantly less than that of lead ions. Because of this, some scientists [2] have moved lead and zinc from the highly dangerous class to the slightly dangerous class, and copper - to the moderately dangerous class. It should also be noted that the iron (iron hydroxide) and manganese oxides present in the soil bind it and, although they do not change the degree of pollution, they reduce the toxicity index [1].

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GCH-P-07

PROCESS OF GLOBAL WARMING IN THE AGRO ECOLOGICAL ENVIRONMENT OF GEORGIA

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The aim of our research is to focus on the anthropogenic factors causing air pollution. Carbon oxides are widely spread in big cities that have been promoted by combustion of organic compounds, decomposition, rusting and other processes ongoing on landfills mainly causing CO_2 emission. Landfills pollute agro ecological environment. In addition, all fields of global economics around the world are responsible for emission of greenhouse gases. This process began back to the industrial revolution, causing fundamental changes in agricultural processes. Nowadays, 60-70% of greenhouse gas effect is caused by CO_2 emission, this type of gas is a natural constituent part of the atmosphere, but increase of its concentration is mainly promoted by human activity. Main source of CO_2 emission in Georgia is fuel consumption going up to 80-85%. Based on the data collected in 2018-20, in Georgia number of vehicles is around a million and a half, which are mainly registered in big cities of Georgia. 50% falls on Kutaisi and Tbilisi. Considering the official state policy number of vehicles with zero emission will rise.

Greening and agro ecological protection of highways and surrounding forests and space in western Georgia is very important. Number of automobiles in big cities will be filled with hybrid cars and electric automobiles. Consequently, state of agro ecological environment will be greatly improved and the emission of transportation fumes' greenhouse gas will be decreased to its minimum. The engines of such type automobiles consume relatively small amount fuel. Another factor of CO2 emission worldwide and in Georgia is deforestation; forest is an important source absorbing CO2. The process of wood burning and decomposition brings CO2 into the atmosphere. In the first state report, forest was indicated as a main absorbent; after the forest coverage has decreased the data of report needs to be reevaluated. Cement production of Georgia is responsible for great amount of CO2 emission, which is around 3-4%. Carbon oxides obtained through cement production is of subsoil origin, as it is gained through processing of limestone layers, mainly sea shells and ancient ocean bio deposits. This process also includes ammonia, nitric acid and adipic acid production.

Technical flaws should be taken into consideration, detected while technological inspection, 55% of vehicles is technologically out of order. Their number needs to be decreased to 30 %. The decrease will cause the necessity of automobile replacement.

GCH-P-08

APPLICATION OF GEORGIAN ZEOLITES FOR PURIFICATION OF SEWAGE WATERS

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Waste waters are one of the most active environmental pollutants that have direct impacts on a living organism due to the harmful substances in them that are taken by humans along with food and water. Over the years, this issue has been very acute for industrialized regions. One of the steps in the various technological schemes for sewage waters treatment is their filtration using widespread, easily available, and effective natural filtering materials zeolites. Nano-dimensional structure of natural zeolites conditions their well-developed specific surface, unique adsorption and ion exchange properties that enable them to extract certain amount of dissolved organic or inorganic substances.

To investigate feasibility of application of natural zeolites for decreasing mineralization of sewage waters and extraction undesired toxic impurities by improving adsorption activity of sorbent, we studied clinoptilolite and loumontite of Georgian origin. A four layered combined filtration column (5cm x 20cm) was prepared: 1st layer (5cm) - quartz sand washed with 1N HCl and heated at 200^0C for removing suspended materials and turbidity; 2nd layer (5 cm)- clinoptilolite (granules of 2-2.5 mm) washed with 1N HCl and heated at 200-250^0C; 3rd layer (5 cm) – loumontite (granules – 1.5-2 mm) prepared the same way; 4th layer (5cm)- natural clinoptilolite (0.5-1mm granules) [1].

Table 1. Chemical composition of sewage water before and after treatment

Cations (mg/dm^3)			Anions (mg/dm^3)		
	Before treatment	After treatment		Before treatment	After treatment
Ca^{2+}	215.00	129.00	Cl^-	1611.37	975.2689
Mg^{2+}	208.00	125..00	Br^-	1.8798	1.1279
Na^+	655.00	357.00	I^-	2.9277	1.6102
K^+	8.2100	2.9556	HCO_3^-	462.988	0.0000
Co^{2+}	0.0500	0.0200	CO_3^{2-}	2.6517	0.0000
Ni^{2+}	0.0600	0.0300	HSO_4^-	0.0000	0.0000
Sr^{2+}	3.4000	0.3862	SO_4^{2-}	684.1150	410.469
Cs^+	0.0000	0.0000	HS^-	0.0000	0.0000
Li^+	0.1000	0.0500	$N0_2^-$	0.0329	0.0329
Fe (total)	2.2300	0.1800	NO_3^-	0.1500	0.1100
Cu^{2+}	0.7030	0.2530	$H_2PO_4^-$	0.0042	0.0032
Pb^{2+}	0.4900	0.0000	HPO_4^{2-}	0.0478	0.0000
Mn^{2+}	0.3100	0.0500	PO_4^{3-}	0.0478	0.0000
Zn^{2+}	0.0600	0.0120			
total	1093.6	615.0842	total	2766.2131	1388.6221

It is concluded that the application of local natural zeolites can be used as a relatively inexpensive and effective filtering material for wastewater treatment.

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GCH-P-09

PECULIARITIES OF THE STUDY OF COMPLEX FORMATION PROCESS OF HEAVY METALS WITH FULVIC ACIDS

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Fulvic acids, the most important macromolecular organic substances form stable complexes with heavy metals. Fulvic acids were found in natural waters, soils and atmospheric precipitations [1-3]. In spite of researches, experimental data on stability constants (β) of complex compounds of FA with heavy metals are heterogeneous and they differ in several lines from each other . This condition is mainly stipulated by the ignoring the average molecular weight (Mw) of the associates of FA, which value in its turn depends on the value of pH and finally causes the wrong results. Therefore, it is difficult to investigate complex formation processes, taking place in natural objects, identify migration forms of heavy metals and evaluate and assess chemical-ecological condition of natural objects.
In homogeneous system, the $Me(OH)_2$(solid) —Me(II)(solution) —FA—H_2O system, complex formation processes between heavy metals and fulvic acids are studied by the solubility method[1]. In heterogeneous system, Me(II)(solution) —FA—H_2O system, complex formation processes between heavy metals and fulvic acids are studied by the gel chromatographic method[4,5,6]. In both systems, complex formation process are studied at different values of pH. Average molecular weights of "active associate" and oligomer of FA were used for determination the composition of metal fulvate complex and average stability constant. Through the obtained results, (especially the results obtained by the using of molecular weight of oligomer), is possible to calculate the migration forms of heavy metals in natural objects, to determine toxicity and bioavailability and to evaluate the ecological condition of natural objects.

Acknowledgements

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GCH-P-10

RAW MATERIALS AND STUDY OF THEIR TRIBOLOGICAL PROPERTIES ACQUISITION OF NICKEL COMPOSITE COATINGS FROM SECONDARY CARBONACEOUS

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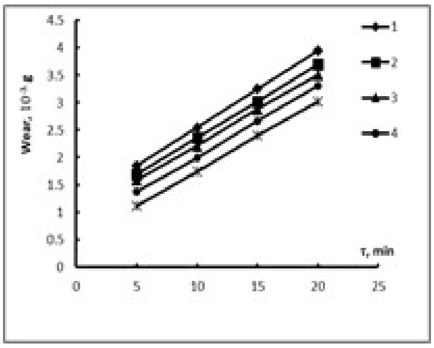
The creation of composite electrochemical coatings (CEC) is one of the main areas of modern electroplating. The purpose of the work is to obtain composite coatings out of nickel-carbon materials using the method of electrochemical deposition at direct current while employing carbon obtained from an original method invented by the authors [1] of this article using recycled materials, specifically nectarine kernel. The physicochemical properties of the obtained product have been investigated. The wear of the acquired composite coatings has been observed as well.

Nickel composite coatings were obtained from standard nickel plating Watts solution based on stainless steel. The coating thickness was ~40μm. In order to improve the uniformity of the CM distribution in the electrolyte and to reduce the size of agglomerates, the electrolytes were treated in advance in an ultrasonic bath with a frequency of 40 kHz for 960 seconds. The concentration of the second phase in suspension is as follows - 0.04; 0.06; 0.08; 0.1; 0.4; 1.2; 2.0; 5.0 g/L.

The table and the picture below show the composition ranges of carbon materials obtained from nectarine kernel in composite coatings (Table). The content of the second phase 4.8-7.05 % (weight) increases relative to the increment of carbon material concentration 0.04-0.4 g/L in the suspension

Further increment of the concentration of the second phase (1.2-5.0 g/L) in the suspension does not have a significant effect on the second phase content in the coating 6.79-7.05 %. The wear of the obtained samples was tested. The results of the experiment are shown in Figure

#	Carbon material concentration insuspension, g/L	Carbon material composi-tion ranges Ni-$C_{nect.}$ in composite samples (weight%).
1	0.04	4.8
2	0.06	5.64
3	0.08	6.57
4	0.1	6.65
5	0.4	7.05
6	1.2	6.79
7	2	6.72
8	5	6.65



Wear of composite coating (Ni-$C_{nec.}$) (g), in relation to the amount of second phase (weight %) in coating and time: 1 - 0; 2 -4.8; 3 -5.64; 4 – 6.72; 5 – 7.05;

As it is seen in the picture the wear of Ni-C_{nect} for every observed concentration in the suspension (0.04-5.0 g/L) and coatings with carbon weight % range of 4.8-7.05, is less than the wear of coating obtained from "pure" electrolyte.

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GCH-P-11

CHARACTERIZATION OF SULFUR-CONTAINING COMPOUNDS IN WASTEWATER AND SLUDGE

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Sulfur-containing compounds in wastewater and sludge originate from food waste, fecal matter, pharmaceuticals, and personal care products. They enter the wastewater system in discharges from residential and industrial (food, paper, and livestock) sources, and seawater and groundwater infiltration [1]. The sulfur-containing compounds include sulfate, Sulfide, thiosulfate, proteinaceous compounds that contain cysteine and methionine, nonprotein amino acids such as glutathione, some lipids (sulfolipids), and polysaccharides such as chondroitin sulfate [2-4]. Anaerobic biodegradation of sulfur-containing compounds can generate volatile sulfur compounds (VSCs) including hydrogen sulfide, methyl mercaptan, dimethyl sulfide, etc. In anaerobic digestion, VSCs are impurities of biogas that can damage biogas utilization equipment such as turbines, engines, and fuel cells [5-7]. VSCs have also been detected in wastewater treatment and sludge centrifugation and dewatering processes [8]. They are compounds that have extremely low odor thresholds and very negative hedonic values [9]. The release of VSCs often results in odor complaints from people living close to wastewater treatment facilities [10] and land application sites [11]. Studies of anaerobic sludge treatment have frequently reported quantification and transformation of inorganic sulfur compounds in the sludge, mainly sulfate. Sulfate can be quantified by standard methods [12], including ion chromatography, precipitation, and color-metric methods. The final product of biological sulfate reduction in anaerobic digestion is hydrogen sulfide, which can be precipitated by heavy metals present in municipal wastewater/sludge. Pyrite and element sulfur may also be generated as intermediate products. Hsieh and Yang [13] have developed a diffusion method to measure inorganic sulfur species in the sediments, including monosulfide (S^{2-}), pyrite (S_2^{2-}), and elemental sulfur (S_0). The dominant organic VSCs in the biogas emitted from anaerobic digestion, such as methyl mercaptan, dimethyl sulfide, and dimethyl disulfide, are generated from decomposition of organic sulfur components in sludge. However, quantitative information on the conversion of organic sulfur compounds in sludge digestion has been rarely reported. One reason for the lack of quantitative information is the need for increased study of the biochemical pathways and stoichiometric relationships involved in sulfur transformation reactions. The other reason is the absence of an analytical method that is feasible and practical for sulfur characterization in sludges.

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GCH-P-12

DETERMINATION OF MANGANESE (Mn) AND SOME HEAVY METALS, SUCH AS NICKEL (Ni), COPPER (Cu) AND ZINK (Zn) IN THE SOILS OF SIMONETI VILLAGE IN THE BASIN OF RIVER KVIRILA BY MICROWAVE PLASMA ATOMIC EMISSION SPECTROMETRY (MP-AES) AND ATOMIC ABSORPTION SPECTROMETRY (AAS) METHODS

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One of the world's richest manganese (Mn) deposits and largest Mn mining areas lies in the city of Chiatura in the Republic of Georgia. The waters of river Kvirila have been used some time ago in the mining process and are severely contaminated on only with Mn but also with other heavy metals. Earlier studies have indicated that the waters of the Kvirila River have very high concentrations of total Mn downstream of the industrial discharges in the mining area compared to an upstream location. The river bed sediments also contained elevated metal concentrations. Mn and Ni, in particular, were very high in the Kvirila River near the discharges compared to background soil levels. The contaminated sediments can also serve as a long-term residual source of metal contamination of river water, with potentially significant adverse ecological and human health effects. Thus, the waters of the Kvirila River are contaminated long therm and remediation of these waters will definitely take decades.

The aim of our work was to quantify manganese (Mn) and some other heavy metals in the soils of the village of Simoneti, in the Terjola municipality, near the Kvirila river. Samples were taken at 0-30, 30-60 cm on the horizon. A total of 6 soil samples were studied on the content of following heavy metals: Zinc (Zn), Manganese (Mn), Nickel (Ni) and Copper (Cu).

To test accuracy and reliability of the results, we used two instruments: Microwave Plasma Atomic Emission Spectrometer (MP-AES) and Atomic Absorption Spectrometer (AAS). The results were compared first with each other and then with maximum permissible levels (MPL). Due to the different values of the maximum permissible levels (MPL) of heavy metals in different literature according to their pH, we also determined the pH of the soils [1].

Based on the results obtained, we can conclude that the soils of the investigated territory of the village Simoneti belong to weak alkaline soils (pH 7.49-8.06); Manganese (Mn), content varies in 34-54 g/kg (MPL 1.5 g/kg) Nickel (Ni) content– 80-130 mg/kg, (MPL 85 mg/kg), which in both cases, exceeds the MPL and indicates the pollution of the mentioned area. The content of Zinc (Zn) and Copper (Cu) comply with the established norms by law [1].

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GCH-P-13

DETERMINATION OF SOME HEAVY METALS IN HAIR SAMPLES OF AKHALTSIKHE, ZESTAFONI, AND TBILISI CITIES POPULATIONS USING THE DIFFERENTIAL PULSE POLAROGRAPHY METHODOLOGY

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To assess the impact of the environment on human health and, in particular, of some heavy metals, four cities were selected in Georgia: one of the “cleanest” cities - Akhaltsikhe, and two of the most environmentally polluted cities - Bolnisi and Zestafoni, as well as Tbilisi. The measurements were conducted on a PU-1 polarograph in the differential pulse polarography mode.

Experimental data of the assessment of the certain metals content (copper, lead, cadmium, and zinc) in the hair of the Bolnisi town population confirmed the environmental pollution of the Bolnisi municipality. The copper content in some hair samples was below the standard established by the World Health Organization. The lead content in all samples was within allowable concentrations. The increased cadmium content in some hair samples is alarming, as is the increased zinc content in hair samples from the region mentioned above.

Hair samples in Akhaltsikhe, Zestafoni and Tbilisi were taken during the COVID-19 pandemic. In almost all hair samples from residents of Akhaltsikhe and Zestafoni cities, the copper content was below the norm of the World Health Organization. Lead and cadmium content in all samples did not exceed the maximum allowable concentration. As for zinc, its content in some hair samples exceeded the norm, but in some, there was a deficiency, which was dangerous during a COVID-19 pandemic since zinc deficiency weakens immunity and increases the risk of COVID-19 infection.

The accumulation of heavy metals mostly is observed in the bodies of people who directly work with the sources of these elements. Therefore, the content of heavy metals: copper, lead, cadmium, and zinc, was monitored in the hair of employees of the chemical institute in Tbilisi. In almost all samples copper content was below the norm established by the World Health Organization; lead content did not exceed the maximum allowable concentration; cadmium in only one sample exceeded the maximum allowable concentration; zinc content was higher than the norm.

Since the experiment was carried out during a pandemic, the data obtained on copper and zinc ware quite expected. As for lead and cadmium, it was re-confirmed that the accumulation of heavy metals is observed in the body of people who directly work with the sources of these elements.

GCH-P-14

USE OF POLARIZED CARBON FIBER MATERIALS FOR ELECTROCHEMICAL EXTRACTION OF COPPER FROM QUARRY AND INDUSTRIAL WASTE WATER

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An important environmental problem is the pollution of surface waters with heavy metal ions, the toxic effect of which on living organisms leads to disruption of enzymatic reactions.

To solve the problem of treating wastewater from heavy metal ions, the most promising is the use of the electrolysis process, which ensures minimal costs for their further processing and creates the possibility of implementing resource-saving and low-waste technological processes.

The electrolysis process was studied by us when treating wastewater from copper (II) ions, which are characterized by high toxicity and are one of the main sources of hydrosphere pollute.

To solve the problem of intensifying the electrolysis process of copper separation from dilute sulfate solutions, we used carbon fiber materials with a highly developed reaction surface as cathodes instead of flat electrodes.

The studies were carried out on an electrochemical reactor designed by us with an improved hydrodynamic regime and with cathode block with flowing three-dimensional electrodes made of carbon fiber materials.

The object of our research were carbon fiber materials of the new generation “Ural” -TM-4-22 and “UVZh”-22-S/A.

We investigated the effect of preliminary cathodic treatment of the above-mentioned carbon fibrous materials in alkali and acid solutions on the intensification of the process of copper extraction from dilute sulfate solutions.

It has been shown that preliminary polarization of the above-mentioned carbon materials in different environments contributes to the modification of their electrode properties of the surface of the constituent carbon fibers obtained by high-temperature treatment of synthetic and fossil coals with activating agents.

The electrodes were polarized to potentials that ensure copper deposition with high polarization of hydrogen evolution. The use of such cathodes with a highly developed surface makes it possible to pass a significant current through them with low polarizability of the electrode.

It has been established that the rate and degree of copper extraction from dilute sulfate solutions largely depends on the duration and density of the cathodic polarization current, as well as on the type of carbon fibrous material studied.

It has been shown that the extraction of copper from dilute sulfate solutions on the original CFM and CFM subjected to preliminary cathodic polarization proceeds at a higher rate and degree of copper extraction.

It is important to note that electrolysis copper can be recovered from the surface of a carbonaceous material by burning it to produce pure copper or by electrolytic or chemical regeneration methods to produce a concentrated sulfate solution.

GCH-A-01

ON THE ISSUE OF SAFE RECYCLING OF AMORTIZED LEAD BATTERIES

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The reserves of natural resources of lead are almost exhausted. Therefore, more than 70% of lead is produced by recycling waste batteries. 81-82% of lead produced in the USA is obtained from secondary raw materials. At the same time, 86% of recycled lead is used for the production of new batteries.

Amortized lead batteries, due to their complex composition, belong to a certain type of secondary raw materials, which determines the need to develop a technological scheme for their processing that would ensure maximum environmental safety and economic efficiency.

None of the existing options for processing amortized starter lead batteries ensures maximum environmental safety and economic efficiency of production.

In the works of the leading scientists of our institute, priority is given to a scheme that provides for the complete transformation of the oxide-sulfate fraction into oxide with further production and refining of lead based on molten electrolytes.

The advantages and prospects of the technology developed by the authors in comparison with existing methods are due to the following circumstances:

1. The technological circuit is closed and environmentally practically safe.
2. The disposal of all components of monoblocks with the receipt of a marketable product is provided.
3. In nodal operations, inexpensive and affordable secondary raw materials are used instead of expensive reagents and materials.
4. Due to recycling, the volume of industrial wastewater has been reduced to a minimum.
5. The main part of the equipment is non-standard, it is possible to produce on site, which requires minimal capital costs.

GCH-A-02

ELABORATION OF HIGH ENERGETIC PLASTIC EXPLOSIVES ON THE BASE OF UTULUZED GUNPOWDER

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Scientific research in the direction of creating new explosive (energetic) substances and perfecting production technologies is ongoing and intensive around the world. These problems concern Georgia as well, where the consumption of explosive substances is characterized by increasing rates. This especially applies to the development of mining production, which is one of the important pillars of the country's economy. At the same time, it is noteworthy that the utilization of ammunition continues in Georgia with the support of the Euro-Atlantic structure. The waste products of the utilization of expired ammunition are various types of high-energy materials, explosives, and gunpowder. Their long-term storage involves high-security risks and at the same time requires high financial costs, both in the form of protection and the arrangement of the warehousing infrastructure. Their processing technologies are quite complicated, unprofitable, and contain high risks. They can be destroyed by burning, which causes extremely great ecological damage to the environment. At the same time, it should be noted that the explosion energy of the utilized explosives is quite high, it ranges from 3000-5770 kJ. With these indicators, they are equal to known industrial explosives [1-3]. Therefore, their use in the civil sphere, as industrial explosives, is the most attractive. Since these substances have a negative oxygen balance (ranging from -24% to -37.28%), their direct use (without processing) for industrial purposes is not recommended due to the release of a large amount of toxic gases (250 L/kg). (They are mainly used in water wells since the volume of toxic gases released during the explosion in water is reduced by almost 50 times [4]).

Thus, the creation of a safe technology for the production and use of industrial explosives on the basis of graphitized gunpowder released during utilization is relevant both from a scientific and practical point of view. In order to meet these requirements, it is necessary to carry out studies for the correct and qualified selection of components of new explosives. The use of filler ensures an even distribution of components in the mixture. The advantages of plastic explosives are ease of use, the safety of charging wells, and high density. The last one ensures high performance. The purpose of the research is to study the possibilities of receiving utilized graphitized gunpowder, ammonium nitrate, and special filer mixture type, environmentally and safe for use, plastic explosives.

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GCH-A-03

THE CONCEPT OF ASSESSMENT OF ECOLOGICAL STATUS OF SURFACE WATERS THROUGH HYDROCHEMICAL INDICATORS

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There are 26,000 rivers on the territory of Georgia. Determining the ecological state of all these rivers using empirical methods is associated with a large material and instrumental problem. Therefore, we propose a modern research method that allows us to assess the ecological state of the main rivers and classify them according to some hydrochemical indicators, which involves assigning a water quality classification to surface water in accordance with the European Union Water Framework Directive - 2000/60/EC.

At this stage, the aim of the work is to determine the water quality class of rivers such as Aragvi, Iori and Liakhvi based on the statistical data of hydrochemical and physico-chemical indicators of the years (taking into account the European Union Water Framework Directive - 2000/60/EC).

For this purpose, during the study, those indicators specific to these rivers were processed and selected, with the help of which it was possible to most accurately assess their ecological state. Also, at the suggestion of European directives, an equation was used to calculate the pollution index of each river, and then the water quality class of the rivers (Aragvi, Iori and Liakhvi) was assessed.

According to the obtained results, it can be considered that the hydrochemical indicators of the rivers over the years indicate that they belong to the category of surface water, and the rivers are in an ecological state.

It should be noted that the methodology proposed in the work was used for the first time in the studies of Vere, Dighmula and Gldanula rivers in 2019-2021 to characterize small rivers, which increases the interest in the presented work. In the research, the geographical and hydrological condition of the given rivers is well characterized, and what is most important is the assessment of what type of anthropogenic load they experience.

Using a similar method, based on environmental and chemical studies of other rivers on the territory of Georgia and, accordingly, determining the degree of their pollution, it is possible to calculate the pollution index of each river, and then assess the class of river water quality, accordingly, the need for preventive measures.

GCH-A-04

TARGETED FUNCTIONALIZATION OF COMPOSITE MATERIALS TO IMPROVE DURABILITY AND PERFORMANCE DATA

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Polyfunctional polymers with linear macrochains and regular structure have the prospect in modern technologies (architectural, optoelectronic, automotive, aerospace and aeronautic industries, microelectronics, chemical engineering, dental materials, artificial joints etc.) for the purpose of the creation of high-performance bioactive hybrid composite materials and systems with specific properties. The versatility of the inorganic-organic hybrids offers polymers that improve the durability, the mechanical, thermal, chemical and heat resistance, the weatherability, gloss and color retention [1-3]. The use of composite materials as a method to protect microbiologically-influenced corrosion is focused on the application of non-toxic products based on polymer matrix (silicones, polyurethanes, epoxy resins and fluorinated compounds etc.); modifiers of polymer networks; bioactive additives (inorganic, organic and organometallic compounds, bio-molecules, clusters, etc.); curing agents [4, 5]. The low refractive index and high optical transparency make amorphous perfluoropolymers a promising candidate for applications in protecting coatings, surface modifiers, and optical materials.

Multifunctional composite materials have been elaborated by targeted functionalization of easily curable polymer matrices based on F_nMAs with epoxy group in their macro chain and selected bio-additives. The investigation of developed photostable, transparent, hydrophobic materials have been shown improved tribological characteristics: lower values of wear rate, higher scratch resistance, appropriate viscosity, high viscoelastic recovery in scratch testing, acceptable dynamic friction, and good adhesion to various surfaces (plastic, wood, etc.); an improvement with an increase in glass transition temperatures and thermal stability for high temperature application; observations of surface microstructures displayed in SEM micrographs of modified systems has been shown no phase separation. Thus, transition from fundamental researches to the broadening the fields of applications of hybrid inorganic-organic materials is expected to motivate future developments in the inspiring area of composite materials.

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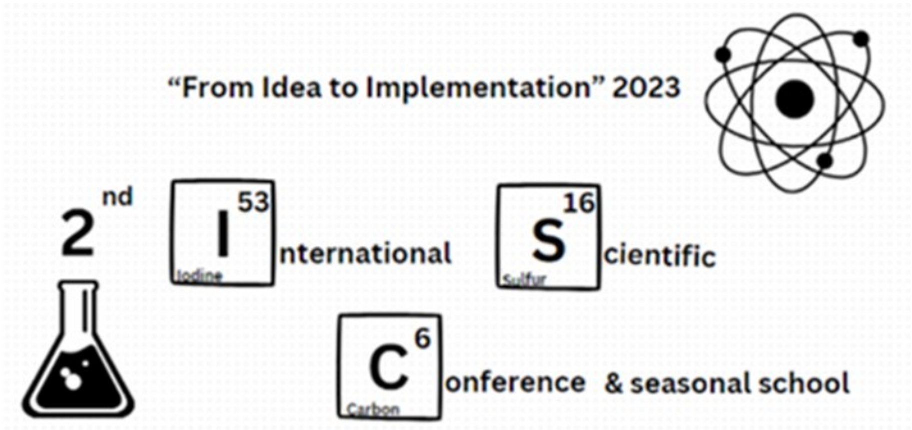
ESCS

ENERGY SOURCES, CONVERSION AND STORAGE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ESCS-O-01

CARBON-FREE CHEMICAL SOURCES OF ENERGY: THE HYDROGEN SULFIDE

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The main challenges of the present society are the depletion of fossil fuels and the considerable charges on the atmosphere by greenhouse gases overwhelming the capacity of nature to cope with them. The replacement, at least partially, the fossil fuels by renewable ones is a way to remedy the severe situation associated with air pollution and the resulting climate changes.

The present study demonstrate a possibility for simultaneous solution of the above problems by energy production with no air pollution by means of liquid phase fuel cells. The example is hydrogen sulfide removal in sulfide-driven fuel cells generating electricity.

For the Black Sea region, power plant based on sulfide-driven fuel cells (SDFC) is a base load power plant with continuous operation during the entire period of operation.

This SDFC power plant behaves as a battery for the electricity grid. It means, that it produces the amount of energy that is demanded in the moment, i.e. there is no over-production at missing users. The power station can operate continuously with regulated capacity from 0 to 100% output power.

The process does not generate any harmful emissions in air and water. The energy production is fully automated and does not demand personnel. The entire technological process is remotely controlled. The SDFC power plant does not represent any threat for the environment at possible accident.

The produced energy does not require subsidies for green energy and it can compete on the free non-regulated market.

Drastic decrease of the import of energy sources (oil, natural gas, nuclear fuel) in Bulgaria will be attained. With the running changes in the transport structure to increase the share of electricity this importance will increase. This power source will guarantee the energy security of the country in electricity. The development of this method will lead to creating of export potential for green energy.

The present study summarizes the experimental data for electricity generation in sulfide-driven fuel cell. Different catalysts and cell construction are tested. The optimum sulfide concentration is determined. Since it is one order of magnitude higher than its values in the genuine sea water, enrichment is required. This challenge is overcome by combined adsorption and electrochemical oxidation in the fuel cell operation.

Acknowledgement

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ESCS-O-02

LEARNING FROM NATURE – APPLICATION OF PHOTO-ACTIVE BIOMOLECULES IN BIOHYBRID SYSTEMS

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Photosynthesis is a very old biological process which provides the basis for our existence here on earth. Significant progress has been made in clarifying the different aspects of this process and the structure of the involved complex molecules. Thus, a lot of inspiration has been come to modern research by these achievements. There is a whole bundle of different directions of developments which goes from purely biological approaches to purely semiconductor-based ones. From the time line a little behind are biohybrid systems which try to combine the efficiency of biomolecules in the interaction with light with technical surfaces and their advanced preparation technologies. As a particular advantage one can envisage the use of photoelectrons not only for current generation – i.e. the conversion of light into electrical energy – but also for the synthesis of valuable substances.

The presentation will introduce in the concept of photobioelectrodes and will show some examples how these electrodes can be constructed [1-5]. Emphasis will be paid to the electrode structure and the kind of communication between the photo-active component and the electrode. Furthermore, the potential for enzyme coupling and synthesis application will be illustrated [6]. Besides individual electrodes also complete photobio-cells can be constructed. The construction principles will be highlighted with two examples which also can demonstrate some of the key advantages of such systems although several aspects need further developments for a practical break through [7, 8].

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ESCS-P-01

SYNTHESIS AND RESEARCH OF THE PROPERTIES OF NEW SEMICONDUCTOR NANOMATERIALS

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The development and research of semiconductor nanomaterials is an urgent problem in modern materials science. Due to size effects, such materials have unique properties that have potential applications in various fields of science and technology. At the Department of Physical Chemistry of the National University of Uzbekistan named after Mirzo Ulugbek, scientific research is conducted on synthesis and structural design, studying the properties and searching for areas of practical application of nano-sized semiconductor nanomaterials for various purposes.

Among the materials under study, g-C3N4 occupies a special place, being the most promising object for producing hydrogen from water [1]. The synthesized new allotropic forms of oxygen- and sulfur-doped g-C3N4 and their composites have been shown to be effective in solar-initiated photocatalysis reactions. It has been revealed that g-CxNy effectively decomposes toxic organic compounds, in particular amoxicillin, through the formation of electron-hole pairs (excitons) as a result of absorption of solar light quanta [2], the mobility of which is close to the mobility of a traditional organic semiconductor, but the recombination time is significantly high. The most significant discovery is that in such materials charge transport occurs one-dimensionally perpendicular to the graphite-like layers. For this reason, conventional organic semiconductors cannot compete with carbon nitrides. On the contrary, using their one-dimensional semiconductor property, it is possible to create organic optoelectronic components of a fundamentally new type. Growing such graphene-based polymers seems to be particularly important: a combination of conductivity perpendicular to layers of carbon nitrides with in-plane conductivity of graphene can be obtained.

New conjugated polyelectrolytes based on polythiophene derivatives with several optically active (fluorophore) centers, multifunctional “conjugated polymer – quantum dot” nanocomposites, molecularly imprinted polymers have been synthesized, and the range of their applications as optical targets (test systems) for DNA molecules and biosensors in medicine and food industry. Research is underway to create highly efficient lithium-polymer batteries and electrically conductive polymer systems based on polyaniline, polypyrrole and polyvinylimidazole with exceptional physical and chemical properties for the creation of various electronic devices, chips, sensors, solar cells, photoluminescent devices [3-4].

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ESCS-P-02

EFFECT OF MODIFIER La_2O_3 AND Ce_2O_3 ON Ni-Co BASED CATALYSTS ACTIVITY IN CCM

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Growing concerns about greenhouse gas emissions have led to increased demand for strategies to convert these air pollutants into valuable products. Carbon dioxide methane reforming (CCM) is one such process that takes two of the most potent greenhouse gases, carbon dioxide (CO_2) and methane (CH_4), and converts them into carbon monoxide (CO) and hydrogen (H_2) in ratio 1:1, which can be used for conversion to heavier or partially oxidized hydrocarbons. This method not only reduces the concentration of CO_2 in the atmosphere, but also simultaneously produces renewable energy (synthesis gas), which is a key precursor for the production of higher hydrocarbon content fuels through Fischer-Tropsch synthesis. Therefore, utilization of CO_2 and CH_4 is also a promising approach to overcome the energy crisis due to increasing population over time [1]. Recent research on bimetallic catalysts has shown promising results both in terms of high activity and durability. Just like the active metal, the catalyst support plays an important role in the overall functioning of the catalyst. The catalyst carrier not only provides a large surface area, but is also responsible for uniform dispersion and effective fixation of the active metal for its stable operation [2].

In this work, we investigated the effect of modifying additives La_2O_3 and Ce_2O_3 on the activity of Ni-Co oxides in the process of carbon dioxide methane conversion (CCM). The catalysts were obtained by impregnating the carrier (granulated natural clinoptolite-23-3A) with aqueous solutions of metal salts according to the moisture capacity. Heat treatment of the samples was carried out in air at 300-500 ºC. Testing of the activity of the synthesized catalysts in the reaction under study was carried out on an automated laboratory flow-type installation. Process conditions: reaction temperature Tr = 500–850ºC, volumetric flow rate W = 1000 h^{-1}, CH_4/CO_2 ratio = 1:1. Using Khromos GH-1000, the initial model mixture, as well as the resulting reaction products, were analyzed. The study showed that on Ni-Co-Ce/23-3A and Ni-Co-La/23-3A catalysts, when the reaction temperature increases from 500 to 850°C, the performance indicators of the catalysts increase. The introduction of 1.5 wt.% La_2O_3 into the Ni-Co composition leads to an increase in the activity of the catalyst, the highest activity is achieved at T = 850°C, methane conversion 96%, carbon dioxide 96%, without losing its activity for 20 hours. Whereas when adding 1.5 wt.% Ce_2O_3 on the Ni- Co - Ce/23 – 3 A catalyst, methane conversion increases from 27 to 93%, carbon dioxide conversion – from 27 to 94%. Thus, it was determined that Ni-Co oxides modified with La_2O_3 have good activity and stability in the CCM process compared to the composition modified with Ce_2O_3.

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ESCS-P-03

COBALT-MANGANES- 4Co - Mn / Al – Ca- CATALYSTS FOR THE CONVERSION OF METHANE WITH CARBON DIOXIDE

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The results of studies on the development and study of the activity of a cobalt-manganese catalyst in the process of conversion of methane with carbon dioxide are analyzed [1] . Utilization of CO_2 and production of an H_2 -CO mixture suitable for the synthesis of liquid fuels and other technically valuable products is becoming increasingly important. Nickel is preferred as an active component to provide an effective catalyst in the process of conversion of Methane with carbon dioxide. The main task is to find ways to reduce coke formation on the nickel surface. From the analysis of published data it follows that Ca additions in the Ni/MgO catalyst can lead to a positive result. Nickel catalysts on a calcium aluminate carrier - $CaAl_2O_4$ - are more active and less susceptible to carbon deposition. The activity of Co-, Mn-containing catalysts supported on an Al-Ca-alumina-calcium support in the processes of oxidative conversion of methane with various oxidants (water vapor, air oxygen, CO2) has been studied. The most active systems were those containing 6-9% Co and 1.5-2.5% Mn, with a Co - Mn ratio of 4:1. A study of the activity of the - 4Co - Mn/Al - Ca catalyst in the process of methane conversion with carbon dioxide showed that at a ratio of $CH_4 : CO_2 = 1:1.3$, a temperature of 700-800 ºC and volumetric velocities of the gas mixture for methane - 2000-4000 h^{-1}, the selectivity for the formation of H_2 and CO is close to equilibrium. Thermal analyses of individual oxides of cobalt, manganese and their mixtures in a methane environment showed that the pyrolysis of methane is most likely catalysed by metallic cobalt at temperatures of 520-540 ºC. On samples containing Co – Mn mixtures, the soot formation temperature is slightly higher and amounts to 590-610 ºC. On samples containing only manganese oxides, the decomposition of methane in the temperature range studied (up to 700 ºC) was not observed. In a methane environment, the presence of manganese oxides increases the temperature at which soot formation begins.

Analysis of the results of the research showed that of the Co-, Mn-containing catalysts in the carbon dioxide conversion of methane, the most active and stable is the 4 Co-Mn catalyst supported on an aluminum-calcium carrier - Al - Ca. The use of manganese oxides as an active component and promoter gives the catalyst resistance to carbonization.

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ESCS-P-04

CONDUCTIVE POLYMER ASSISTED TRANSITION METAL BASED 3D ELECTRODES FOR POTENTIAL APPLICATION IN SUPERCAPACITIVE DEVICES

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To serve the increasing requirements of modern systems, such as hybrid electric vehicles, portable consumer electronics, or large-scale industrial power systems, the efficiency of electrochemical energy storage (EES) devices has to be substantially improved by developing new materials and a better understanding of the fundamental electrochemical processes at the charge storage interface. Due to their promise as electrical energy storage devices for high energy and power applications, electrochemical capacitors, also known as supercapacitors (SC), have drawn significant attention in recent years. [1] Making porous, high surface area transition metal oxide-based composite electrodes (therefore increasing the capacitance) can lead to better performance in supercapacitive devices. However, the poor electrical conductivity of metal oxides (MnO_2 in this case) limits their utilization as electrode materials for supercapacitors.[2,3] This problem can be overcome by creating composite structures with conductive polymers in connection with electrically conductive nanostructured carbon materials such as graphene which is regarded as next-generation electrode material for energy storage and conversion systems due to its unique properties, such as ultrahigh theoretical surface area, superior conductivity, and rich surface chemistry. In this work, we report on the fabrication of conductive polymer-facilitated composite 3D electrodes composed based on manganese oxide and graphene foam. Manganese oxide which serves as charge storage material and carbon flakes were obtained via electroexfoliation in one step electrochemical process applying chronoamperometry. The mixture was characterized by its composition content and magnetic properties. It was mixed with conductive polymer Poly (3,4-ethylene dioxythiophene) (PEDOT) and pasted on top of graphene foam (PDMS-based graphene). The capacitance of this electrode was studied by taking cyclic voltammetry and analyzing non-faradaic response in phosphate buffer solution. The composite with conductive polymer demonstrated increased capacitance compare to bare graphene foam.

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ESCS-P-05

EFFECTS OF CERIUM OXIDE ON THE ACTIVITY OF FeNi/Al_2O_3 CATALYST IN THE DECOMPOSITION OF METHANE

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The demand for hydrogen is constantly growing due to its use in chemical processing, electronics, food industry, production of metals and fuel cells [1]. Production of hydrogen, from water separation using sunlight or other renewable energy sources is not competitive from an economic point of view [2]. Therefore, in the near future hydrogen production will continue to depend on fossil fuels, natural gas [3].

Catalytic decomposition of methane (CDM) can be used to produce hydrogen without CO_x and has recently become a hot research topic [4]. It produces pure hydrogen and carbon, and there is no need to separate hydrogen from other gases, such as CO_x, in traditional processes. Ni-Fe containing catalysts show higher conversion at higher temperatures, but they are not very stable. However, the addition of other metals as promoters opens an interesting way to increase the hydrogen yield and stability at higher temperatures in the methane decomposition reaction [5].

In this work the influence of cerium oxide on the activity of Fe-Ni/γ-Al_2O_3 oxide catalyst in the reaction of methane decomposition to hydrogen and nanocarbon is shown. The synthesized catalysts were dried at 300 °C (2 hours) and calcined at 500 °C for three hours. The activity of the synthesized catalysts was tested in a laboratory flow-through unit. Methane decomposition reaction products were carried out on a chromatograph (Chromos-1000). It was determined that the introduction of cerium oxide into the composition of Fe-Ni/γ-Al_2O_3, leads to an increase in stability and activity of the catalyst at high temperatures. At 750 ºC, for 300 minutes the Fe-Ni-Ce/γ-Al_2O_3 catalyst remains stable, methane conversion is 96 %, hydrogen productivity is 2.8 mmol/g^{-1}.

According to XRD, SEM and Raman data, the decomposition of methane on the Fe-Ni/γ-Al_2O_3 catalyst forms a 1-2-layer graphene, the growth center of which may be aggregated particles of Fe or Ni oxides. Single-layer nanotubes are formed on the Fe-Ni-Ce/γ-Al_2O_3 catalyst. The introduction of cerium oxide into the composition of Fe-Ni/γ-Al_2O_3 promotes the dispersion of active phases, thereby creating conditions for the nucleation and growth of free carbon in the form of nanotubes, which positively affects the activity and stability of the catalyst system in methane decomposition.

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ESCS-P-06

THERMOELECTRIC PERFORMANCE OF $Bi_2Sr_2Co_2O_y$ LAYEREDCOBALTITE DOPED AND Co-DOPED WITH $Na_2B_4O_7$ AND $Pb(BO_2)_2$

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Thermoelectrics can generate clean energy by transforming waste heat directly into electrical power. The *p*-type layered cobaltites are attractive materials for possible application in thermoelectric devices because of their good thermal and chemical stability, availability, and inexpensive cost of raw materials. As a result, the cobalt oxides have attracted the interest of numerous research groups. However, their real-life use still presents a challenge due to relatively poor heat-to-electricity conversion efficiency when compared to conventional ones. A number of studies have proven that the incorporation of suitable dopants into the host lattice is a useful strategy to enhance the functional properties of thermoelectric materials. This work focuses on the structural, morphological, and thermoelectric properties of $Bi_2Sr_2Co_2O_y$ system doped and co-doped with borax — $Na_2B_4O_7$ and lead borate — $Pb(BO_2)_2$. $Bi_2Sr_2Co_2O_y$ (reference), $Bi_2Sr_{1.95}[Na_2B_4O_7]_{0.025}Co_2O_y$, $Bi_{1.9}[Pb(BO_2)_2]_{0.1}Sr_{1.95}[Na_2B_4O_7]_{0.025}Co_2O_y$, and $Bi_{1.95}[Na_2B_4O_7]_{0.025}Sr_2Co_2O_y$ thermoelectric materials were prepared by the solid-state reaction method. The apparent density of synthesized ceramics increased from 72% for the reference sample to over 90% of the theoretical value for doped samples, which is beneficial for charge carrier transport. Incorporation of $Na_2B_4O_7$ and $Pb(BO_2)_2$ into the $Bi_2Sr_2Co_2O_y$ leads to the 1.3÷2.1-fold decrease of electrical resistivity at 973 K. Seebeck coefficient values of investigated compositions raised with temperature increasing and were close to each other up to 773 K (~150μV/K). At higher temperatures Seebeck coefficient of doped samples are slightly lower than the reference one. Values of Power Factor (PF) increased from 59 $\mu W/m \cdot K^2$ for reference sample to 100 $\mu W/m \cdot K^2$ for $Na_2B_4O_7$-doped $Bi_2Sr_{1.95}[Na_2B_4O_7]_{0.025}Co_2O_y$ at 973K. Partial substitution of Sr and Bi sites with $Na_2B_4O_7$ and $Pb(BO_2)_2$ leads to the increase of thermal conductivity at 573 K from 0.71 W/m·K for reference sample up to 1.23 W/m·K for co-doped $Bi_{1.9}[Pb(BO_2)_2]_{0.1}Sr_{1.95}[Na_2B_4O_7]_{0.025}Co_2O_y$ composition. From the investigated materials, samples with partial substitution of Sr and Bi by $Na_2B_4O_7$ show the maximum ZT of about 0.030÷0.033 at 573 K, which is 32% higher than the reference value.

Acknowledgment

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [grant number AR-22-470/Borates-containing graphene/ceramic thermoelectric composites — a step toward commercialization].

ESCS-P-07

THE MECHANISM OF THE INTRODUCTION OF IRON INTO MANGANESE DIOXIDE DURING PREPARATION OF ITS FILM FOR A SUPERCAPACITOR

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Manganese Dioxide (MD) films on the surface of platinum were generated by the electrochemical method at room temperature in a solution of $2\cdot10^{-3}$M $MnSO_4$ + 0,195M Na_2SO_4 + $5\cdot10^{-3}$M H_2SO_4 with the addition of an appropriate concentration of iron (II) or (III) sulfate. The characteristics of the resulting films were examined using cyclic voltammetry in a 0.5M Na_2SO_4 solution. Film capacity was calculated using the following equation:

$$C = \frac{I\Delta t}{\Delta V m}$$

Where I – is the current, Δt - is the potential sweep time, ΔV - is the voltage interval, m is the mass of the film. $I\Delta t$ was determined from half of the area obtained from the cyclic voltammogram.

The addition of iron increased the film capacity, improved the shape of the cyclic voltametric curve, and enhanced the cycling efficiency. However, due to the fact that the current efficiency of the MD in the presence of iron ions is less than 100%, calculating the film mass based solely on the charge expended during its formation became problematic. To estimate the mass and thickness of the film, MD was completely dissolved electrochemically in the coulometric mode, and its approximate mass was determined based on the consumed charge. The calculations revealed that the current efficiency for the undoped product was 97%, while for MD doped with Fe(II) ions, it was 83%, and for MD doped with Fe(III) ions, it was 110%.

To understand the mechanism of iron incorporation into MD, the film obtained without iron was anodically polarized, which led to the oxidation of manganese ions of lower valence on the electrode surface to form MD. Subsequently, the Pt/MnO_2 electrode was immersed in solutions containing only Mn(II), Fe(II), or Fe(III), washed thoroughly with water, and recorded the anodic voltammetric curves in a 0.5M Na_2SO_4 solution. When the electrode was exposed to Mn(II) or Fe(II) solutions, anodic current peaks were observed in the region of MD electrodeposition potentials. This behavior was attributed to the chemisorption of Mn(II) ions on the MD surface in the initial stage of the process:

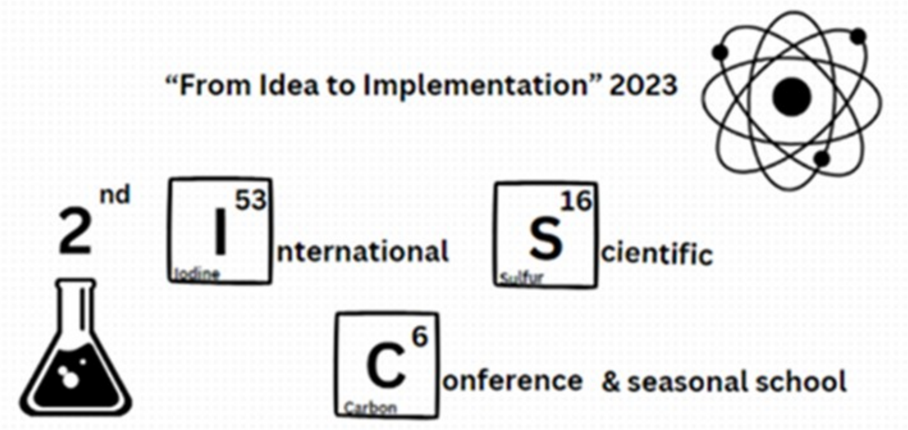
$$MnO_2 + [Mn(H_2O)_6]^{2+} \rightarrow MnOOH\cdot[Mn(H_2O)_5OH]^{2+}_{ads}.$$

Subsequently, the resulting species was electrochemically oxidized to form MD:

$$MnOOH\cdot[Mn(H_2O)_5OH]^{2+}_{ads} \rightarrow 2MnO_2 + 4\,H^+ + 4\,H_2O + 2e$$

When the electrode was immersed in a Fe(II) solution, a similar chemisorption of Fe(II) ions occurred, resulting in the formation of Fe(III) and Mn(III). In this case, the oxidation current of Mn(III) was observed on the voltammetric curve, albeit smaller, as Fe(II) ions produced only half as much Mn(III). Keeping the Pt/MnO_2 electrode in a Fe(III) solution did not lead to the formation of Mn(III), and therefore, no anodic peaks were observed on the polarization curve. However, Fe(III) ions were adsorbed on the MD surface and incorporated into its structure. This conclusion was supported by the calculation of the current efficiency of the MD, which was 110%. In this case, physical adsorption occurred without charge transfer, and the current during film formation was not consumed for the introduction of iron. During the electrochemical dissolution of the film, part of the charge was consumed in reducing Fe(III), resulting in the current efficiency of the MD film exceeding 100%. The capacitance of MD films was determined from the cyclic voltammetric curves, and the best results were obtained when the films were electrodeposited in the presence of Fe(III) ions, yielding a capacitance of 470 F/g.

PCSI
PROMOTION AND COMMERCIALIZATION OF SCIENTIFIC INNOVATIONS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PCSI-O-01

ACTIVITIES OF NATIONAL INTELLECTUAL PROPERTY CENTER OF GEORGIA “SAKPATENTI” SUPPORTING INNOVATION

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The National Intellectual Property Center of Georgia Sakpatenti is a government agency – a legal entity of public law. In accordance with the Georgian legislation, Sakpatenti determines the policy in the field of intellectual property. The core function of Sakpatenti is the legal protection of IP rights, examination of applications for intellectual property subject-matters, issuing titles of protection and keeping the register. In particular, Sakpatenti examines relevant applications and issues protective documents on industrial property objects such as patents, utility models, trademarks, designs, geographical indications and appellations of origin, new animal breeds and plant varieties as well as topographies of integrated circuits. For supporting patenting activity of universities and scientific-research institutions, since 2015 Sakpatenti has been introducing special measures, including establishing an Intellectual Property Training Center offering courses for wide target audience, providing consultations in IP matters, e.g. patent drafting, at the service center of Sakpatenti, introducing preliminary patent search service to assess patentability of outcomes of research projects, offering support for universities and scientific-research institutions in drafting Intellectual Property policy documents. The preliminary patent search service has been very actively used by Georgian Innovation and Technology Agency (GITA), Shota Rustaveli National Science Foundation of Georgia, universities, scientific-research institutions, individual inventors. Over 100 preliminary search requests are received annually. Universities and scientific-research institutions patenting activity has been at 15 patent applications and 5 utility model applications per year in the recent period.

PCSI-O-02

MATHEMATICS OF ARTIFICIAL INTELLIGENCE

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As suggested by the title, this talk is a short survey of mathematical branches used in AI problems. We also briefly present research, which is carried out at MICM in the fields of ML, DNN and NLP by the support of currently running HORIZON EUROPE project "GAIN".

PCSI-O-03

METODOLOGY FOR CREATING A SYSTEM OF MONITORING AND EVALUATING SCIENTIFIC AND TECHNICAL PROJECTS

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To solve the problems of monitoring and evaluating scientific and technical projects and making decisions at all stages of project development, it is necessary to create information systems that establish thematic relationships between science and technology.

In TECHINFORMI, such a system has been ~~is~~ created on the basis of a database of scientific projects and international databases of patent information.

For performance analysis using the SCOPUS system, SciVal is used, an online tool that offers access to research results using bibliometrics. It allows you to visualize research performance and analyze research trends.

SciVal uses the citation data in patent documents from scientific publications as well as other patent documents contained in the SCOPUS database. This allows you to establish certain links between scientific developments and patent research, which indicates the practical results of the use of scientific research.

Based on the extended databases of Clarivate Analytics, TECHINFORMI developed a methodology for analyzing the relevance of a research project: determining the relevant IPC (International Patent Classification) indices, as well as determining the most cited patent documents, which make it possible to determine promising continuations of research.

To determine the most pertinent IPC indices, the project explored the possibility of taking into account the average number of citations per document for different IPC headings and introducing an additional parameter of citation efficiency for IPC headings relevant to the search criteria.

The structure of the scientific project analysis procedure: At the first stage of the analysis, keywords are selected from the project abstract contained in the database of scientific and technical projects created in TECHINFORMI.

At the second stage, the selection of patent documents belonging to each separate IPC heading, established at the first stage, is carried out, and time series of distribution by years of relevant documents are determined for each IPC heading for the last 15 years. Citation data for each selected patent document is also stored.

Analyzing the time series, we can conclude that there is an increase or decrease trend in patent documents corresponding to the subject area of the researched scientific and technical project, and belonging to this IPC heading.

Depending on the results of the analysis, the project developers can be given information about the most priority technical areas for this scientific and technical subject. Of course, this information can only be of an advisory nature.

High-ranking documents and indices of the International Classification of Inventions, obtained as a result of the analysis are placed in the database of scientific and technical projects created in TECHINFORMI.

PCSI-O-04

GEO-ECOLOGICAL ASPECTS OF THE HARMONIZATION PROCESS IN THE ECONOMICS-ECOLOGY SYSTEM DURING THE ENERGY TRANSITION PERIOD

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The problem of managing processes and activities between the economy and ecology is particularly relevant today in connection with the restructuring of the economy in the context of changes in the ratio of the use of energy resources.When the goal is to find ways and trends in the economic development of countries, it is necessary to consider the tasks of integrating various types of capital. The main forms of capital to consider are: natural, intellectual, physical, human and financial. Energy transition regulatory mechanisms are energy production management, social, technical, technological and scientific mechanisms.

When balancing processes in the economy and ecology, it is imperative to take into account the distributional consequences of both a negative and positive nature.

How to balance development and look for ways to compromise, taking into account the peculiarities of the economy and environmental problems of a single country? Balancing between the economy and the environment can find a compromise path, which is expressed in the harmonization of environmental and economic development, control and management of environment damage through the environmental payments, pollution taxes, etc. This process can be based on the use of industrial, social and technical technologies, innovative decisions. For this, the better way to consider approaches at the level of administrative regulation, economic levers in conditions of market relations, taking into account the preservation and harmonious development of geo-ecological systems.

PCSI-O-05

DEVELOPMENT OF BIODIESEL PRODUCTION FROM WASTE BIOMASS IN GEORGIA

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Biodiesel, as one of the most effective clean, renewable, alternatives to common petroleum fuel, can reduce a great deal of exploitation of fossil fuels, curb greenhouse gas emissions, and mitigate global warming factors. The name Biodiesel generally refers to the mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats through the process of etherification.

Today biodiesel is used in any segment of the modern industry where petroleum-based (mineral) diesel is used, including the internal combustion engines. Biodiesel and its blends have the possibility to be more widely used as alternative, eco-friendly fuel in various types of internal combustion engines. For this purpose, it is important to strictly meet the quality demands and achieve the stable structural composition of functional groups of biodiesel fuel and its blends.

Georgia is the first country in the region of the South Caucasus which develop industrial-scale production of biodiesel from waste biomass. The production of biodiesel fuel in Georgia started in 2018 and since then it has been successfully developing.

The further scaling up production of biodiesel, however, is closely linked with the fuel quality and the strict demands of the Georgian national and EU standards. The quality of the fuel is especially important for the transport sector, where diesel-type internal combustion engines are widely used.

We have promoted a special nano-composition which improved the quality stability and storage capacity of biodiesel fuel. The nano-composition of biodiesel – the nano-biodiesel - was created on the basis of commercially produced biodiesel, or B100. The nano composition of biodiesel, while meeting the demands of EN 14214, ASTM D 6751, and EN 590 standards, significantly increased the long-term storage and quality stability of biodiesel.

The composition of the functional groups (group composition) of nano-biodiesel remained stable for three years and the nano-biodiesel fully maintained the group composition as well as the physical-chemical and technological properties of the fuel.

PCSI-O-06

TECHNOLOGY TRANSFER IN GEORGIA: CHALLENGES AND OPPORTUNITIES

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The process of technology transfer stands as a vital conduit between academic research and practical applications within the private sector. In this presentation, we delve into the details of technology transfer mechanisms and explore the challenges and opportunities prevalent in Georgia’s landscape.

Georgia, despite its increasing potential, grapples with a critical issue: the disconnection between academic institutions and the private sector. Universities and research organizations struggle to establish meaningful engagements with businesses, while the private sector remains largely unaware to the scientific advancements available within the academic sphere. This disproportion is multifaceted, rooted in both perceptual barriers and tangible realities.

Our focus is to dissect these challenges comprehensively, encompassing subjective perceptions and objective impediments. By identifying and understanding the factors hindering effective communication and collaboration, we aim to pave the way for plausible solutions that can bridge these existing gaps. The presentation aims to actively involve the audience in a practical discussion regarding crucial aspects of collaboration between academia and businesses. It emphasizes the importance of enhancing technology transfer to drive innovation, boost economic growth, and cultivate collaborative synergies specifically within Georgia.

With a strategic emphasis on highlighting hurdles hindering collaboration, this presentation will offer actionable insights and guidance for stakeholders. By navigating this intricate landscape and capitalizing on the untapped potential, stakeholders can leverage opportunities that lie at the intersection of academia and the private sector.

PCSI-O-07

MODELING THE RESULTS OF ECONOMIC ANALYSIS OF TECHNOLOGICAL PROCESSES IN THE FOOD INDUSTRY

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Citrus, namely grapefruit, unused by Georgian food industry enterprises was selected as the research object.

Grapefruit contains such chemical substances as: vitamins P and C, phenolic compounds

Due to such a chemical composition, they are recommended for use in: scurvy, osteoporosis, high blood pressure, cardiovascular disease, etc. during diseases. Fruits are used raw and processed.[1].

To achieve the set goal, we have selected the technology of grapefruit juice processing.

After processing the grapefruit into juice, the secondary raw material was subjected to grinding after drying. A product rich in pectin and vitamin P is obtained - flour.

The resulting ground mass can be used to enrich flour confectionery with biologically active substances

Each process described above is modeled by me in the financial analysis, in order to accurately determine the costs incurred for these processes. Accurate calculation of costs allows us to accurately determine the profitability of production.

Determining the profitability allows us to present a financial analysis of technological processes to a potential investor, so that he can determine whether it is worth investing in the project and making a profit as a result.

The financial analysis of the given processes will introduce the complete financial situation to the potential investor.

I hope that with the financial modeling of the technological process, I will contribute to the interest of investors in such necessary and useful products and their timely and long-term production.

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PCSI-P-01

PUBLIC-PRIVATE PARTNERSHIPS IN THE FIELD OF INNOVATION (Challenges of Georgia)

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Properly structuring PPPs in the field of innovation is a dynamic process that requires careful planning, effective governance and constant monitoring.[1] Private investment, bundling of contracts and transfer of risk to the private sector are seen as incentives for innovation.[2] By creating an environment conducive to innovation, PPPs can contribute to the development of new solutions to complex challenges, promote economic growth and societal progress.[3].

The problem is the lack of methodology for the characteristics of public-private partnership (PPP) impact on innovation and its proper structures.

On the example of "G 3" - "Green Cube" commissioned by the Institute of Inorganic Chemistry and Electrochemistry (Georgia) and a US private firm, which frees nature from tire waste, a model of how PPP features should be structured to enhance innovation has been developed. These characteristics are: allocation of resources; access to expertise; risk sharing; focus and task definition; flexibility and adaptability; the regulatory framework in which PPPs should facilitate innovation; intellectual property management; community involvement; monitoring and evaluation; Determination of long-term and short-term perspective.

The design, objectives and management of a PPP can have a significant impact on the extent and nature of innovation. A well-structured PPP that leverages the strengths of both the public and private sectors can create an enabling environment for fostering innovation and solving complex challenges.

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PCSI-P-02

ETHNO-CONFLICTS AND SOCIO-ECONOMIC ASPECTS OF SCIENCE
(Conflict transformation in Abkhazia)

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Ethno-conflicts' adverse effects have received relatively limited attention in the realm of scientific research. Typically, they are primarily examined from a socio-economic perspective. Nevertheless, it should be noted that ethno-conflicts affect the progress of science and the social status of researchers. By examining the Abkhazia conflict's outcomes, it is possible not only to analyze the social aspects of scientists, but also to determine the role of science in the transformation of the conflict.

In the period following the dissolution of the Soviet Union, prior to the onset of the ethno-political conflict, Abkhazia was home to several research institutions, including: The Institute of Subtropical Agriculture of Georgia; The Institute of Experimental Pathology and Therapy; The Black Sea Monitoring Institute; The Sukhumi Institute of Physics and Technology; The Scientific-Research Institute of Balneology and Non-Traditional Medicine, Agriculture and Botany; The Scientific Laboratory of Gerontology.

The armed conflict has, among its many severe consequences, led to the deterioration of fundamental science and the increased vulnerability of scientists. These are brain drain; job loss; decline of scientific culture; loss of specialized facilities; delays in the impact on other economic sectors; diversion of resources from research to defense; disruption of collaboration among researchers from diverse ethnic backgrounds; suppression of dissent; mobility barriers; loss of cultural and scientific heritage; destruction of scientific equipment; restricted access to necessary research tools and resources; psychological stress and diminished capacity for scientific focus; isolation of scientific exchange.

The European Union's policy is linked to both energy security and environmental protection. [1] In light of this, the effective management of science geared toward applied and interdisciplinary research plays an important role in the reconciliation efforts concerning the Abkhazia conflict. An example of this is the energy production project in Georgia during 2002-2003 [2], the restoration of which, through the Enguri hydroelectric plant, can establish a solid foundation for peace initiatives, involving both the public and private sectors in the region. Furthermore, research endeavors related to the Black Sea's resources, participation in a research consortium involving the six coastal countries of the Black Sea and the conflict parties, as well as the development of scientific collaborations in electronic management systems for agriculture and energy, will contribute significantly to the economic transformation of the conflict-affected region.

PCSI-P-03

REVIVAL OF THE DAIRY INDUSTRY IN GEORGIA, MILK PRODUCTIVITI FROM CATTLE ACOORDING TO VERTICAL ZONATION

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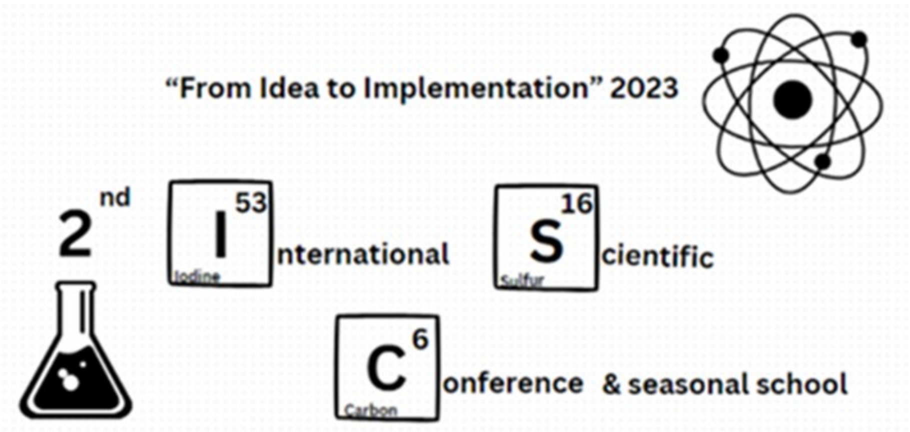
Different types of cattle are assimilated in our country according to vertical zonation: khevsureti –khevsuruli, guria, samegrelo– megrulitsiteli, the plateau of imereti – shvitsuri, samtskhe – kavkasiuritsabla. Depending on the nutritional ration (animal feed) and genetic factors, the milk obtained from the mentioned cattle is different. On the basis of microbiological analysis, has been ascertained, that obtained milk satisfied the requirements of milk properties. The analysis of the samples revealed, that it belongs to the first and the second quality milk according to the microbiological analysis. At the same time, it meets requirement of the ISO standard. Compare with the spring, there are the high level of proteins, fats and other parameters in the milk, during the period of the winter. It is important to note, Georgia has the potential to produce biologically fresh and ecologically full-fledged milk, which is useful for human's health.

Key words: cattle, verticalzonality, genetic factor, animal feed, milk, parameters of milk.

ADDITIONAL ABSTRACTS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A-A-01

PECULIARITIES OF GLAZE PRODUCTION USING TECHNOGENIC RAW MATERIALS

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The issue of using artificial raw materials in the production of various types of ceramic products, for example, glazes, is becoming increasingly relevant. This is due to the fact that quite expensive and scarce materials included in the final composition will be saved and by introducing technogenic materials into the final composition, the quality of the end product can be improved.

This work proposes a method for producing a low-melting glaze using residues of Chiatura manganese enrichment waste, a typical technogenic raw material, containting following oxides (wt.%): SiO_2-54,25; MnO_2 – 7,86; TiO_2-0,27; P_2O_5-0,35; Al_2O_3-7,73; Fe_2O_3-2,88; FeO-0,23; MnO-6,30; CaO-3,76; MgO-1,27; BaO-0,69; K_2O-1,82; Na_2O-1,02; CO_2-3,59; SO_3-0,63. Oxides in the raw materials are represented by quartz and hydrous SiO_2, anhydrous and hydrous aluminosilicates, complex and anhydrous manganese-containing oxides, carbonates and impurity minerals. The article also discusses the features of physical and chemical processes when cooking glaze.

The studies have shown that it is possible to obtain general purpose glazes with colour from black to brownish, various technological and operational properties for different application, and reduced preparation time.

A-A-02

PRODUCTION OF EXTRACT CONTAINING LIPOPHILIC FRACTION OF HOP CONES BY THE METHOD OF BISMACERATION

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The subject of the given research is the production of extractcontaining lipophilic fraction of the hop cones growing in the territory of Georgiaby the method of bismaceration. Oil produced from watermelon seed grown in Georgia was used as an extractant. The composition of natural and processed hop cones is rich in bioactive substances. That is why extract of hop seeds is widely used in folk and official medicine, therapeutic-prophylactic cosmetics [1- 4].

Extraction was performed in two stages. Both extracts were combined in one receiver. Standardization of oil extracts from hop cones was carried out according to a number of parameters - acid number, saponification number, essential and iodine number. Increase of the acid, saponification and iodine numbersindicates an increased content of free fatty acids, complex ethers and slightly unsaturated fatty acids in the oily extract. This is explained by the transition of substances from the lipophilic fraction of hop cones to the extract.

Qualitative reactions determined the presence of vitamins E and K1 in the oily extract obtained from the hop cones.Reaction with nitric acid and reaction with iron chloride were used to detect vitamin E. A reaction with an alkaline solution of cysteine was used to detect vitamin K.

The use of watermelon seed oil enriched with the components of the lipophilic fraction of the hop cones, is possible and recommended in various cosmetic compositions.

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A-A-03

SYNTHESIS OF DOUBLE COMPLEX COMPOUNDS OF COBALT (II) AND NICKEL (II) WITH ISONICOTINAMIDE AND PICOLINAMIDE

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Four new coordination compounds of cobalt (II) and nickel (II) with isonicotinamide, picolinamide and thiocyanate ion were synthesized: $\{[Ni(L)_2(H_2O)_2][Co(NCS)_4]\}n$ and $\{[Co(L)_2(H_2O)_2][Ni(NCS)_4]\}n$, where L is isonicotinamide, and $[Ni(L')_2(H_2O)_2][Co(NCS)_4]$and $[Co(L')_2(H_2O)_2][Ni(NCS)_4]$, where L′ is picolinamide.

Coordination compounds are isolated in a free state, stable in air. Their chemical composition was determined by the method of elemental analysis.

IR spectra of synthesized complexes were studied to determine the rules of coordination of organic ligands and acid groups. Based on the studied IR spectra of compounds, the structures of synthesized complexes are presented.

Based on studies, it was found that in the complex compound $\{[Ni(L)_2(H_2O)_2][Co(NCS)_4]\}n$, the coordination of the isonicotinamide molecule is carried out by means of the nitrogen atom of the heterocycle. By two chemical bonds, the nickel atom is connected to the cobalt atom by means of thiocyanate groups, which perform a bridging function.

The organic ligand acts as a monodentate ligand. The environment of the nickel atom has an octahedral shape. The cobalt atom is bound to four thiocyanate groups that perform a binding function.

The coordination isomer $\{[Co(L)_2(H_2O)_2][Ni(NCS)_4]\}n$ has a similar structure.

A complex compound of the cationic-anionic type $[Ni(L')_2(H_2O)_2][Co(NCS)_4]$, in which L′ - picolinamide is present, has been synthesized.

In the synthesized complex compound $[Ni(L')_2(H_2O)_2][Co(NCS)_4]$, the coordination of the organic ligand molecule - picolinamide with the nickel atom is carried out through the nitrogen atom of the heterocycle and the oxygen atom of the carbonyl group, and the organic molecule is a bidentate ligand.

In the complex compound $[Ni(L')_2(H_2O)_2][Co(NCS)_4]$, the structure of the complex anion is tetrahedral. Four isocyanate groups are connected to the cobalt atom via a nitrogen atom, i.e. the isothiocyanate structure of Ni←NCS is carried out.

The coordination isomer $[Co(L')_2(H_2O)_2][Ni(NCS)_4]$ has a similar structure.

A-A-04

STUDY OF ABSORPTION SPECTRA OF COORDINATION COMPOUNDS OF COBALT (II) AND NICKEL (II) WITH PARA-NITROPHENYLHYDRAZINE (PNPH-L)

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To determine the method of coordination of the organic ligand (PNPH-L) and H_2O molecules in coordination compounds of cobalt (II) and nickel (II) chlorides with para-nitrophenylhydrazine (PNPH-L), the ligand (PNPH-L) and absorption of spectra synthesized complex compounds ($CoCl_2{\bullet}L_2$ and $NiCl_2{\bullet}L_2$) .

The υ(NH) peak (3317.59 cm^{-1}) detected in the IR spectrum of the ligand (PNPH) is shifted to a higher frequency (3346.20 cm^{-1} in both compounds) due to its participation in complex compounds, indicating coordination of the nitrogen of the amino group with the metal atom [1].

The peak υ(NO_2) (1368.44 cm^{-1}), detected in the IR spectrum of the ligand, is shifted by ≈46 cm^{-1} (1331.67 and 1311.24 cm^{-1} and 1339.84 and 1307.15 cm^{-1} respectively), indicating the coordination of the ligands with nitro metal ions through both oxygen atoms of the group.

The frequency values υ(H_2O) (3534.17 and 3521.91 cm^{-1}) indicate the presence of water molecules in the inner sphere of the synthesized complex compounds.

In both synthesized complex compounds, one ligand is coordinated to the metal ion by the nitrogen atom of the amino group and acts as a monodentate ligand, the other ligand is coordinated by both oxygen atoms of the nitro group and acts as a bidentate ligand [2-3].

Based on all of the above, it can be assumed that the coordination compounds are cationic complexes with the composition: MeL_2Cl_2 – $[MeL_2(H_2O)_2Cl]Cl$ (where Me – Co(II) and Ni(II), L-PNPH). The approximate structure of coordination compounds is given in Figure 1.

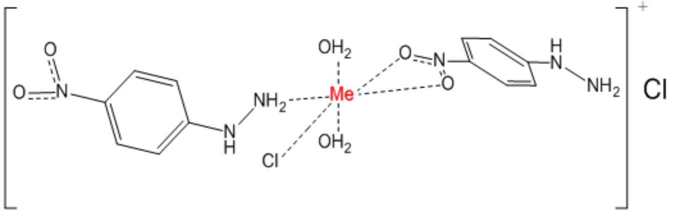

Figure 1. Approximate structure of $[MeL_2(H_2O)_2Cl]Cl$ coordination compounds (where, Me – Co(II) and Ni(II), L-PNPH)

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A-A-05

GEORGIAN QUINCE AND APPLE-AN ALTERNATIVE IN FUNCTIONAL NUTRITION

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The development of methodological approaches and recommendations provides a means to scientifically and rationally solve the problem of creating a product with a functional purpose - by reducing sugar and salt in food, by enriching products with vitamins, food fibers, micro and macro elements, vegetable proteins [1-2];
The aim of the research is to produce prophylactic, balanced and diabetic food preserves using local raw materials.
For this purpose, local, available raw materials rich in chemical composition for human nutrition were used - quince and apple fruits;
Apple contains: water, sugar, cellulose, pectin, organic acids (apple, wine, lemon), carotenoids, vitamin C, chlorogenic acid, catechins, flavonoids, anthocyanins, essential oils, iron, phosphorus. organic compounds, tanning substances;
Pumpkin is rich in minerals, vitamins and antioxidants, carbohydrates, its chemical composition includes: water, proteins, fat, a large amount of mono and disaccharides, saturated fatty acids, sodium, magnesium, calcium, potassium, phosphorus, manganese, copper, selenium, zinc, iron.
jams were obtained using the canning processing processes of apple and quince coupage, based on the research, we determined the recipe for the production of each product and the technological mode of process management;
Based on the research, we determined the % content of sugar, vitamins (B, C, A, PP) and ash in the obtained samples; A product of a new composition was created - in the direction of functional nutrition, with a low % amount of sugars, an increased % amount of vitamins and mineral substances.

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A-A-06

DETERMINING THE ACCURACY OF THE EXPERIMENT AND DISCUSSING RESEARCH METHODS

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Studying any physico-chemical process, it is important to measure the required characteristic data accurately. For this, it is necessary to check and clarify the reliability of the recorded experimental data by means of certain methods. It is in this work that the experimental data accuracy conversion method proposed and developed by us is applicable.

During the course of the experiment, the devices used to stabilize the accuracy of the data description of the research should be divided into two parts. The first is the equipment, through which we deliver a high-precision electrical signal to the measuring instruments participating in the experiment, and the second, the measuring instruments themselves, which record the experimental data with certain errors in Excel files. In our case, PP-63-"0.05" is the high-precision device, and the signal receiving devices include multimeters AXIO-MET AX-18B (3 pieces) and TEKPOWER TP9605BT (1 piece).

The obtained experimental information is written in an Excel file and stored in the computer. After that, it is processed by a program named “Minitab 17 statistical Software”, which allows us to obtain a descriptive mathematical model (formula) of the said experiment. Later, the mentioned mathematical formula will be written in the Excel workspace, where the process will automatically convert the descriptive numerical data of the experiment received from the measuring devices (AXIO-MET AX-18B, TEKPOWER TP9605BT) into the accuracy data of PP-63-"0.05" level.

Such a method of conversion of experimental data measurement accuracy gains great importance in increasing the reliability of the data obtained from the conducted research works and intensification of the research itself.

LIST OF ABSTRACTS

NPN
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ESCS

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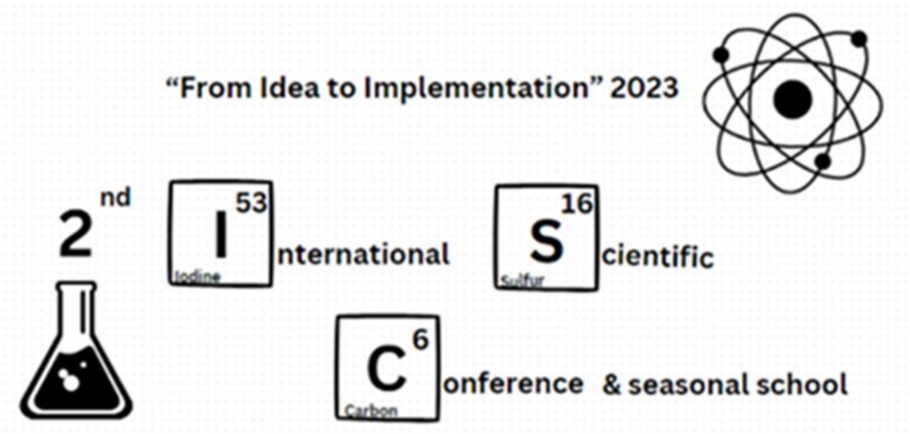
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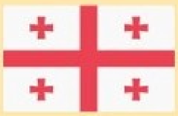

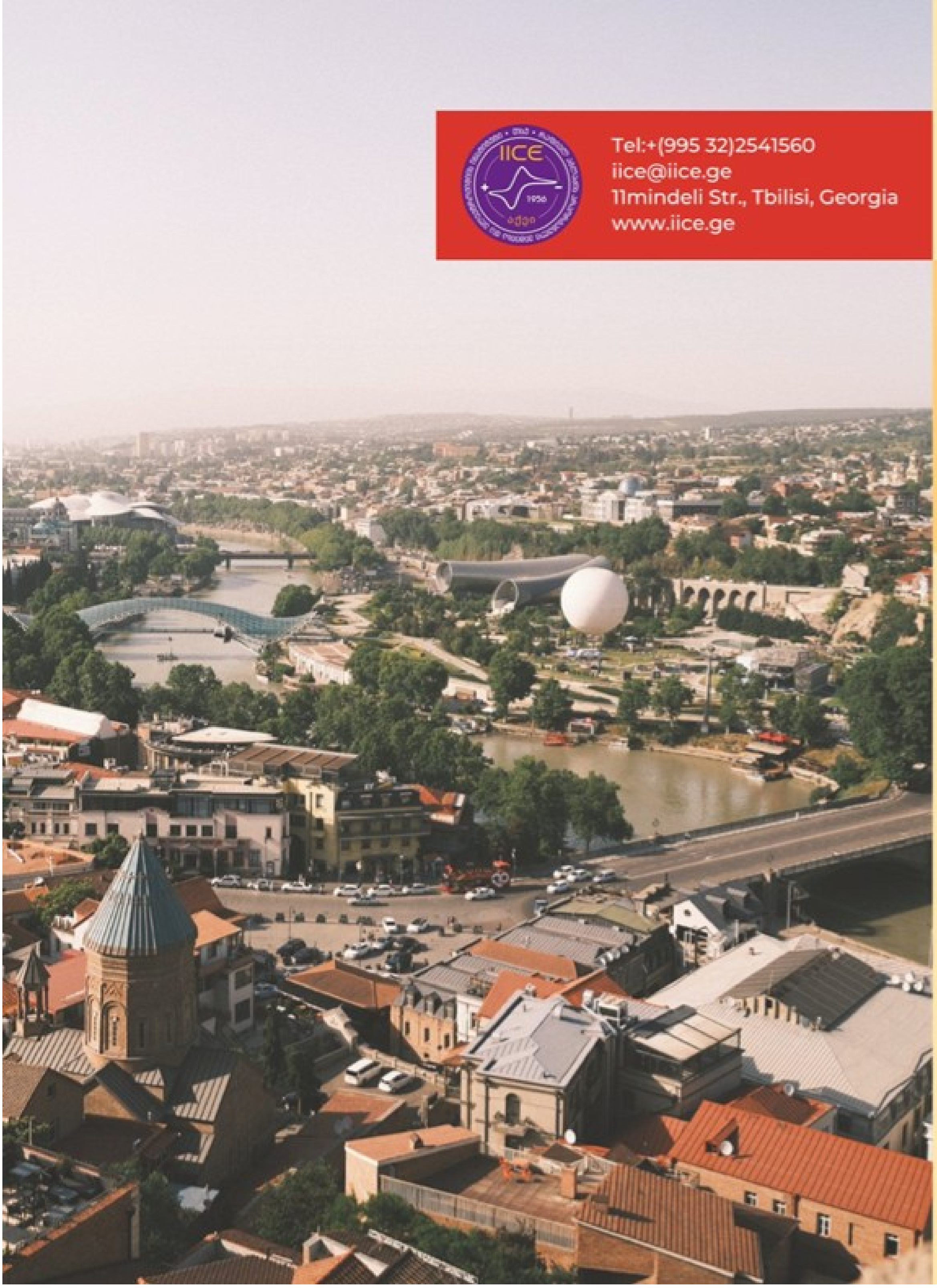

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