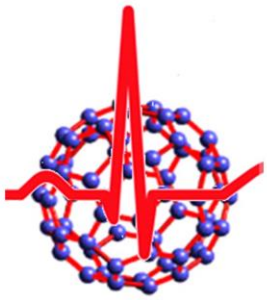
6th INTERNATIONAL CONFERENCE
on Nanotechnologies and Biomedical Engineering

September 20-23, 2023, Chisinau, Republic of Moldova

Abstract Book



ICNBME - 2023

6th INTERNATIONAL CONFERENCE on Nanotechnologies and Biomedical Engineering

Organized by:
Moldavian Society of Biomedical Engineering
Technical University of Moldova

In collaboration with:
Nicolae Testemitanu State Medical and Pharmaceutical University
International Federation for Medical and Biological Engineering
European Alliance for Medical and Biological Engineering & Science
Academy of Sciences of Moldova

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Information Note

ICNBME-2023 continues the series of International Conferences in the field of nanotechnologies and biomedical engineering. The conference aims at bringing together scientists and engineers dealing with fundamental and applied research for reporting on the latest theoretical developments and applications in the fields involved.

The Conference details are available through the website https://icnbme.sibm.md/

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Organizing Committee

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- **Technical University of Moldova**
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PREFACE

It is our great pleasure to welcome all of you at the 6th International Conference on Nanotechnologies and Biomedical Engineering (ICNBME), to be held on September 20–23, 2023, in Chisinau, Republic of Moldova. ICNBME-2023 continues the series of international conferences in the field of nanotechnologies and biomedical engineering with the main goal focused at bringing together scientists and engineers dealing with fundamental and applied research for reporting on the latest theoretical developments and applications in the fields involved.

The conference covers a wide range of subjects of primary importance for research and development such as nanotechnologies and nanomaterials; bio-micro/nano technologies and devices, biomaterials for medical applications, biosensors and bioinstrumentation, biomedical signal and image processing, bioinformatics and computational biology, medical physics and biophysics, molecular, cellular and tissue engineering, clinical engineering, health technology management and assessment, innovation, development and interdisciplinary research, nuclear and radiation safety and security, medical physics and radiation protection, new technologies for diagnosis, treatment and rehabilitation, personalized approaches in medicine.

The contributions of the Conference reflect the results of multidisciplinary research undertaken by about one hundred of groups worldwide. Special attention is paid to the development of novel nanotechnologies and nanomaterials, in particular of bio-nanotechnologies and bio-nanomaterials. New biocompatible materials are proposed for use in regenerative medicine, cellular and tissue engineering. Interesting data on novel chemical and biosensors are reported which are based on nanostructured metal oxides and hybrid nanocomposite materials. A wide range of new technologies for diagnosis, treatment and rehabilitation, personalized approaches in medicine are also presented.

Considerable progress has been achieved at the intersection of nanotechnologies, information technologies and biomedicine as, for example, in health informatics, e-health, telemedicine, biomedical instrumentation and signal processing. New theoretical and experimental results are highlighted in such fields as metamaterials, aeromaterials, micro-opto-electronic and photonic materials, photovoltaic structures, quantum dots, one- and two-dimensional nanomaterials, 3D nanoarchitectures, multifunctional hybrid materials like sandwich and core–shell structures, etc. The papers reflect the state of the art in controlling the properties of several classes of nanocomposite materials for important future applications in various fields.

We hope that the papers scheduled to be presented at the Conference will be of interest for established researchers working in multidisciplinary fields of science and technology, young scientists, students and broad community wishing to get up-to-date information on progress in the fast-developing areas of nanotechnology and biomedical engineering.

Prof. Victor SONTEA, Acad. Prof. Ion TIGINYANU
Chairmen

Chisinau, Republic of Moldova, September 2023

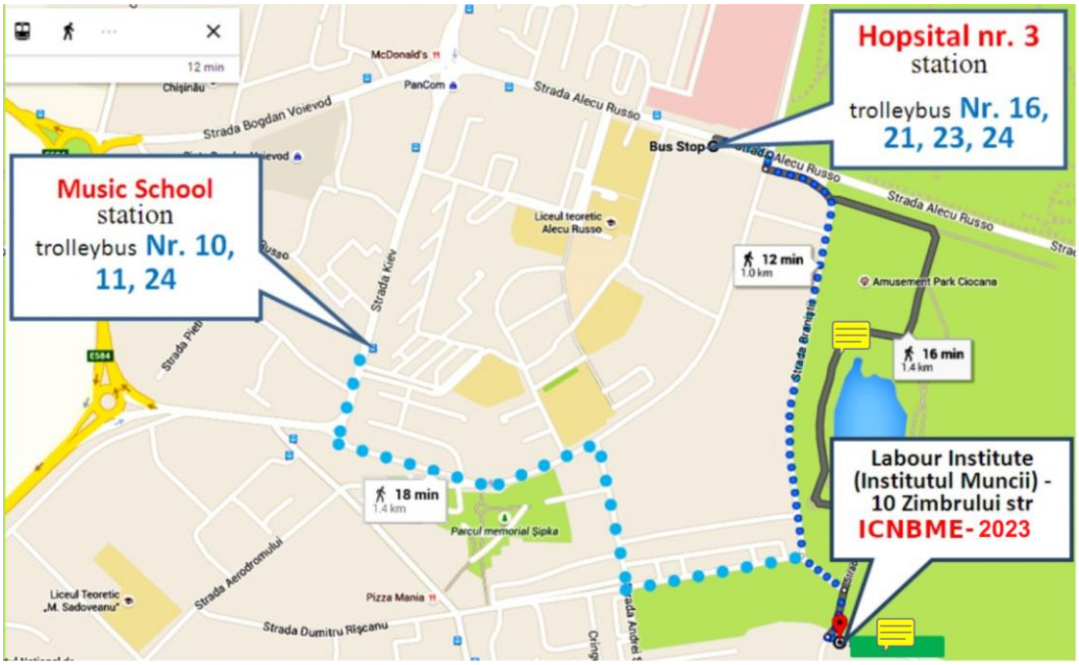
The Conference will take place at the Labour Institute located at 10 Zimbrului street, Chisinau, Moldova. The building is located in the park area between two city districts: Rishkanovka and Chekani.

Participants registration will take place in the building of the Labour Institute, 10 Zimbrului street, Chisinau, Moldova on September 19th from 10.00 to 22.00 and September 20th from 8.30 to 16.00.

The conference will open at 9.30, September 20th, 2023.

Language

The official language of the Conference is **English.**



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PRESENTING AUTHORS INSTRUCTIONS

Oral Presentations:

1. Please make your presence known to one of the chairmen 5 minutes before your session starts and be present during the entire session in which your presentation is scheduled. Time slot for plenary sessions is up to 90 minutes.
2. Time slots for oral sessions are 90 minutes. Number of papers in each session is up to 6 meaning that 15 minutes is allocated for each presentation (20 minutes for invited presentations). However, there are exceptions to this rule; therefore, please refer to the final program for actual duration of your presentation.
3. Authors and Speakers must report to the Speakers Area in order to preview and upload their presentations. Files must be handed-in a minimum of 2 hours prior to the start of their session (for morning sessions starting at 9.00 h, please upload it the day before). We recommend that you take advantage of the early file uploading opportunity. More details are available at the conference web site https://icnbme.sibm.md/.
4. All session rooms will be equipped with a data projector and a computer. You do not need to bring your own laptop to the lecture room. Please prepare your presentations for display with aspect ratio 4:3.
5. When building your presentation, use standard fonts (e.g., Times New Roman, Arial, etc.). Basic fonts are included on the session room computers, but if an unusual font is used it may not display well.
6. Even if you have submitted your presentation files in advance, please plan to bring the latest version of your presentation to the session on a Windows-readable USB flash Drive or CD-ROM.
7. Computers in conference rooms are equipped with Windows 7, Microsoft Office 2010 package. Apple Mac computers will not be provided in any of the session rooms. If you are using Mac, please check compatibility with Microsoft Office 2010 package or use your own Mac computer if your presentation is created in Apple's "Keynote" presentation application. Videos handed in as an independent file must be coded under standard codec. Users are recommended to preview them in standard universal software, such as VLC Player or Quicktime.

Posters:

Poster sessions are a valuable method for authors to present papers and meet with interested attendees for in-depth technical discussions. Therefore, it is important that you display your results clearly to attract people who are interested in your work and your paper. Your poster should cover the KEY POINTS of your work. The ideal poster is designed to: attract attention; provide a brief overview of your work; initiate discussion and questions.

Use colors to highlight and make your poster more attractive, by using pictures, diagrams, cartoons, figures, etc., rather than only text wherever possible. There is however no specific template for the poster: font size and text are free.

Maximum outside dimensions of each poster, including the title, must not exceed 60 cm width x 84 cm height (A1 sheet).

SET UP AND DISMANTLING TIMES:

A poster number display will be placed at the top corner of the board. Double sided tape will be supplied at each poster board.

Poster sessions will be held on Thursday 21 according to the program.

Poster set up time: 12.00-13.00 h. Authors are requested to be next to their posters during poster session: 13.00-17.00 h.

Conference Sections

S1 - Nanotechnologies and Nanomaterials

S2 - New Technologies for Diagnosis, Treatment, and Rehabilitation, Personalized Approaches in Medicine

S3 - Clinical Engineering and Bioinstrumentation

S4 - Biomaterials for Medical Applications

S5 - Innovation, Development, and Interdisciplinary Research

S6 - Bioinformatics, Biomedical Signal and Image Processing

YIC - YOUNG INVESTIGATORS COMPETITION - Nanotechnologies and Biomedical Engineering

CONTENTS

Plenary speakers abstracts

PL-1.1

Genes, Cells and Discovery in Basic Science and Disease

Randy Schekman
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Our understanding of the basic processes of life at the cellular and molecular level has substantially changed the outlook for the treatment of the greatest diseases of mankind.

As a result of the development of tools to explore genes and chromosomes and the protein molecules they encode, therapies to treat heart disease and cancer have been designed with a level of precision that has saved countless lives. Beginning with the discovery of the structure of DNA and continuing with the elucidation of the path taken to express the genes in our genome, we are now able to modify genes that show promise of curing genetic diseases such as sickle cell anemia. These breakthroughs will surely lead to treatments for cancers and neurodegenerative diseases where heritable mutations are the source of illness.

My interest began with a toy microscope that I received as a gift which stimulated a fascination with the microbial world. That interest matured at University and in my PhD work where I learned the powerful tools of biochemistry from Arthur Kornberg, a Nobelist who discovered an enzyme that copies DNA stands. For my independent career, I took the lessons from Kornberg and from broader readings on modern approaches to the elucidation of complex cellular processes and applied them to a molecular genetic dissection of the process of protein secretion in a simple eukaryotic organism, Baker's yeast. Using simple genetics to discover essential genes required for protein secretion, my research team elucidated a pathway similar to that discovered in pancreatic tissue by the great Romanian Nobelist, George Palade.

The genes we discovered are evolutionarily conserved and employed in mammals to execute the diverse processes in secretion essential to normal physiology. This conservation allowed the biotechnology industry to harness yeast cells as a secretion platform for the production of clinically important proteins such as human recombinant insulin.

Following on the genetics, we developed biochemical approaches to identify the functions of a number of the secretion genes in yeast and their equivalents in human cells. Several of the genes encode subunits of the channel in the endoplasmic reticulum (ER) membrane responsible for the first step in the transfer of newly-synthesized secretory proteins from their site of synthesis on ribosomes in the cytoplasm across the ER membrane into the interior luminal space. Another set of the genes encode subunits of a coat protein complex that pinches transport vesicles carrying secretory cargo proteins for traffic from the ER to the Golgi apparatus. Some of these genes have been found to be the basis of human genetic diseases of protein secretion. Knowledge of these precise mechanisms contributes directly to the development of novel therapeutic interventions.

PL-1.2

New Areas of Research and Applications for GaN

Ion M. Tiginyanu and Tudor Braniste
Academy of Sciences and Technical University of Moldova, Chisinau, Republic of Moldova
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The properties of semiconductor materials can be modified in a controlled fashion or even new characteristics may be brought to light by building hybrid 3D nanoarchitectures. The goal of this presentation is to review the research efforts undertaken over the last years to develop novel bio-inspired hybrid 3D nanoarchitectures based on binary compounds such as GaN, ZnS, ZnO, TiO_2 etc. One of the most promising 3D nanoarchitectures proves to be the so-called aero-GaN or Aerogalnite, which represents the first artificial material exhibiting dual hydrophobic-hydrophilic behaviour, its characteristics being close to those inherent to a biological cell membrane. The Aerogalnite consists of gallium nitride hollow micro-tetrapodal structures with nanoscopic thin walls, the inner surface being covered by an ultrathin film of zinc oxide [1]. The lateral faces of GaN tetrapods were found to show hydrophobic properties, while the free end of the arms – hydrophilic ones. This new result was achieved in close collaboration with other research groups (see [1] and https://physicsworld.com/a/hydrophobic-or-hydrophilic-aero-gallium-nitride-is-both/).

Approaching each other hollow GaN tetrapods floating on the water surface leads to the formation of waterproof rafts showing impressive stretching and cargo performances. The interaction between tetrapods resembles the interaction of fire ants forming live rafts on the water surface which enable the insects to survive during floods [2, 3].

The elasticity and stretching performances of self-assembled aero-GaN membranes were studied using communicating vessels. It was found that the aerotetrapods of gallium nitride interact with each other on the water surface until a consolidated membrane forms. The membrane is elastic and can be used as a separation barrier between liquids, avoiding direct contact and mixing, but keeping the gas exchange due to a very high degree of porosity. We found that the membranes can withstand liquid droplets hundreds of times heavier than the membrane [1].

It was found that aero-GaN platelets with the thickness of 1-2 millimeters exhibit impressive shielding capabilities against electromagnetic radiation in a wide range of frequencies including Gigahertz and Terahertz ones [4, 5]. The shielding effectiveness in the frequency range from 0.25 to 1.37 THz exceeds 40 dB, which places Aerogalnite among the known best Terahertz shields.

We succeeded in preparing liquid marbles using GaN aero-tetrapods. In order to explore the aero-GaN liquid marble properties, different deviations from the spherical symmetry were induced during the fabrication process. It was found that aero-GaN based liquid marbles exhibit energy-efficient long-term translational movement for several hours and fast velocity of rotation up to 750 rpm [1]. The rotation speed and the time decay of spinning liquid marbles are highly dependent on their weight. The lighter liquid marbles show higher rotation speed, while the heavier ones are characterized by a much higher inertia keeping the spinning for a longer time [6]. The rotation of liquid marbles is highly dependent on the specific architecture of the enveloping shell consisting of GaN hollow microtetrapods with dual hydrophilic – hydrophobic properties and the deviations from the spherical shape leads to behavioral changes of the marbles. It was found that elongated liquid marbles exhibit pulsed rotation, attaining the same maximum speed of rotation at each pulse, after which the speed of rotation drops down sharply. This phenomenon was described by using a simple analytical model which takes into account the uplift of the marble and formation of water columns underneath during the spinning process. When the rotation speed increases the marble tends to detach from the water surface, which leads to interruption of the propulsion mechanism and consequently the marble drops on the water surface and continues the rotation at much lower speed [6].

In the plenary report, results of investigation of architectures based on Ga_2O_3, ZnS, TiO_2 will be presented as well and the areas of possible applications of these aero-materials will be discussed.

The research was funded by National Agency for Research and Development of Moldova under the Grant #20.80009.5007.20 „Nanoarhitecturi în bază de GaN și matrici tridimensionale din materiale biologice pentru aplicații în microfluidică și inginerie tisulară” and by the European Commission under the Grant #810652 "NanoMedTwin".

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PL-1.3

Rehabilitation Using a Data Glove for Moving the Paralyzed Fingers

Hidenori Mimura, Soich Takigawa, Katsunori Suzuki, Kamen Kanev, Toru Aoki and Masakazu Kimura
Research Institute of Electronics, Shizuoka University, Japan

We have synthesized spinnable carbon nanotube (CNT) [1] and have developed the CNT strain sensors as components of a textile based, wearable sensing system for real-time motion detection [2]. Well-aligned CNT sheets are fabricated by stacking and shrinking the CNT webs. Experimental CNT strain sensors are manufactured by placing the CNT sheet on a flat and smooth substrate in a direction parallel to the stretching direction and impregnating it with elastomeric resin. The sensor resistance is proportional to the applied tensile strain that increases with the applied force. The temporal strain changes are closely followed by the variation of the strain sensor resistance that can exceed 200 %.

We have developed a data glove using the CNT strain sensors [2]. The data glove is a wearable device with incorporated the strain sensors that allow for motion and posture tracking of the user's hands and fingers. Since direct sensing is employed, there are no environment restrictions and timely, highly reliable data can be collected. Motion interactions are then implemented through real-time analysis and recognition of the user's hand and finger posture and gesture.

In this study, we have applied the data glove to functional electrical stimulation (FES) training [3]. FES is used to restore motor function in paralyzed patients because of stroke or spinal injury. In FES, electrical stimulations activate nerve tissue connected to muscle groups to contract muscles to induce movement of the hands. Its restoration improves the quality of life of a paralyzed patient, because hand function is crucial in daily life. We have proposed an FES training method triggered by motions of the opposite hand. Symmetrical motions in the target hand are triggered by the response to multiple motions of the opposite hand. The posture of the opposite hand is recognized by a data glove, and the electrical stimulation points of the multi-pad electrodes of the target hand are dynamically selected on the basis of the recognized posture. The patient can make the target hand produce postures symmetrical to the multiple grasping postures of the opposite hand without being aware of a special device. Electrical stimulation points that elicit the desired grasping motions are explored in advance with reference to the postures of the opposite hand. The proposed method can be applied to contralaterally controlled functional electrical stimulation (CCFES) and a combined method of mirror therapy and FES to train paralyzed patients to recover their grasping function more effectively.

Figure 1 shows the experimental flow (upper) and the target grasping postures and a relaxed open posture recorded with the opposite hand (lower). The experiment was conducted as follows: In step 1, multiple grasping postures were recorded with the subject's opposite (right) hand using the data glove to create a data table for identifying hand posture. In step 2, the stimulation electrodes of the subject's target hand were scanned, and the optimal stimulation electrodes to produce the pre-recorded target grasping posture were determined by detecting the evoked postures with the data glove . In step 3, symmetrical postures were produced in the target (left) hand. Specifically, the grasping posture of the opposite hand was detected with the data glove. Then the optimal electrical stimulation pattern identified in the search was applied to the target hand according to the discriminated grasping posture. This procedure produced symmetrical postures in the target hand in response to the grasping postures of the opposite hand.

In summary, we have developed a system that combines multichannel FES and a data glove with CNT strain sensors. Experiments on four healthy subjects demonstrated that the system selectively activates the muscles of the target hand in response to the grasping postures of the opposite hand. Additionally, the method produces postures symmetrical to those of the opposite hand. By this method, patients can intuitively train multiple grasping motions using FES without operating special

instruments. Applying this method to CCFES or its combination with mirror therapy should improve the efficacy of training with FES.

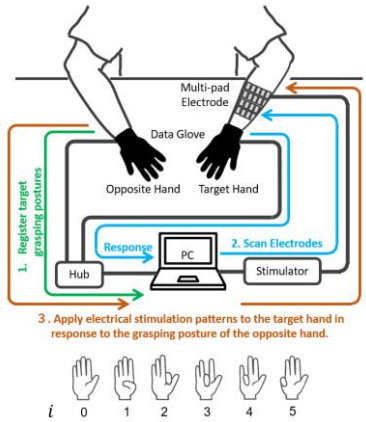

Fig. 1. Flow of the three steps of the experiment (upper) and target grasping postures and a relaxed open posture recorded with the opposite hand (lower).

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PL-1.4

Importance of Training Health Care Professionals in Medical Technology

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The progress of medical technology during the past 60 years is the driving force of the radical change in the way health care is delivered nowadays. Many simple devices like syringes, needles, personal protection and many other sterilizable products in the 1950's have been replaced by single use devices that are produced in quantities of tens of billion items each year with an accelerated pace. Implantable devices, like knee and hip prostheses or dental implants, are common practice with a huge variety of products on the market. The same holds for active implantable medical devices (AIMDs) like pacemakers, defibrillators, or infusion pumps. The progress in the In Vitro Diagnostics (IVDs) is also impressive with thousands of tests available today. It is estimated that over a million products available on the world market today are classified as Medical Devices.

A clear indicator of this progress is the number of patents released every year for medical devices. Just as an example, according to MedTech Europe, more than 15,000 patents applications are deposited at the European patent office (EPO), that represents 41% of the worldwide total medical technology patent applications. The medical device sector together with Digital communication are top of the list overpassing all other sectors, like Pharmaceuticals or Computer technology in this aspect.

In response to these developments and to assure the quality and safety of the product that are reaching the market, in most countries there have been established regulatory mechanisms for medical devices approval before been placed on the market. In the EU for instance after the introduction of the Medical Devices Directives (MDDs) for AIMDs (90/385/EEC), MDs 93/42/EEC and IVDs 98/79/EC. These directives have been accompanied by several guidelines on classification, nomenclature, and vigilance, just to name some. A certification system has been established through the involvement of Notified Bodies assigned for this task by the Competent Authorities of each member stage, or other linked non-EU countries to this system. Hundreds of harmonized technical standards or European norms (EN) have been and are continuously developed and updated by CEN/CENELEC to face the needs. These directives of the 1990's have been replaced in 2017 by two regulations: One for IVDs (2017/746) and one (2017/745), for all other MDs including AIMDs. These regulations are stricter than the previous directives aiming to improve safety and better protect the patients, in a balanced way to avoid big obstacles for innovation. Therefore, control of the EU market seems well regulated, and it is similar in other parts of the world.

Additionally, the regulatory frameworks for MDs over the world contain a provision of a vigilance system, that follows them after they have entered the market with an associated adverse event reporting system and in some cases an obligatory parallel post-market surveillance system. These systems aim to increase patient safety by preventing the recurrence of adverse events, like already reported ones. This is achieved by mandating users and manufacturers of medical devices to report to the health authorities, incidents where a medical device has potentially contributed in death or injury of a patient or user, and where appropriate, dissemination of information, which could be used to prevent such repetitions, or to alleviate the consequences of such incidents.

Health technology assessment (HTA) for medical devices has also attracted the interest of regulators and a new Regulation (EU) 2021/2282, has been voted recently aiming to coordinate the way assessment is done for medicines and certain medical devices groups, by the respective national HTA agencies. This regulation is planned to be applied by January 2025. For medical devices it also is recently recognized that they need a different approach of assessment, considering their big differences with medicines, in their way of application, action and use.

It is therefore clear that both placing MDs on the market and their assessment are well regulated. However, the third pilar of medical technology safety, that is management of MDs during use, remains nonregulated. In fact, the way the medical devices are maintained, repaired, and used is left to the healthcare units they belong. Quality control, preventive maintenance, repair or withdraw, do not necessarily imply certified involved parties or users. This last issue is very critical, since correct application of medical technology, as intended by the manufacturer, is of prime importance for diagnosis, treatment, and overall safety of the patients.

According to data extracted by the Manufacturer and User Facility Device Experience (MAUDE) database, of the US Food and Drug Administration (FDA), almost 3 million adverse event reports, involving MDs, are submitted each year. A large proportion of them are due with use errors.

There are several reasons behind the large increase in the number of adverse events attributed to non-appropriate use of medical devices. The variety of devices available today, their non uniform instructions for use, the non-self-evident user interfaces of the medical equipment that are often computer driven, etc. For instance, in a medium sized modern hospital of less than one thousand beds, one could find more than 15 different types/models of infusion pumps, 17 different types/models of portable ventilators, 10 different types/models of ICU ventilators, 20 different types/models of multiple vital physiological parameters monitoring systems and 35 different types/models of bedside monitoring systems. This situation creates a burden for the medical and paramedical staff that must pass from one device to the next, with completely different user handling requirements, thus increasing the risks for an adverse event due to use error.

Therefore, it is very important to establish regular and continuous user training programs to maintain the knowledge and skills of medical and paramedical personnel, in the principles of operation and the practical use of medical devices. There are various ways to implement such programs nowadays. Apart for the traditional face to face or distance learning courses, there are numerous alternatives for synchronous or asynchronous teaching approaches that have been developed to respond on the needs imposed by the covid-19 pandemic. Additionally, new simulation means are available for virtual training and finally, the use of AI is expected to greatly increase the way courses will be prepare and presented in the future.

PL-1.5

Tetrapods and Aeromaterials for Antiviral and Antibacterial Treatment and Therapy

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This talk will give an overview of recent advances in the field of antiviral and antibacterial treatments either for personal therapy or in air filtration systems from the functional nanomaterials group at Kiel University. In contrast to molecular drugs or similar medical agents, the main effect here is on the physical interaction or interaction with a nanostructured surface and not on a chemical effect influenced, for example, by the solubility of a drug. The entire system, i.e. in the case of a technical system its entire environment or in the case of personal therapy not only the disease, but also the surrounding network such as the immune system is exploited. Two main examples are followed: Tetrapodal microcrystals of zinc oxide and the graphene-based aeromaterials created from them by a templating process. While the pharmaceutical effects of zinc oxide nanoparticles, which are simply based on an excess of nanoparticles, have been widely used for a long time in various products such as creams and ointments due to their weak antiseptic and drying effect, e.g. to support the healing of herpes blisters, tetrapodal zinc oxide, which actually showed a curative effect based on an immunization only in 2016 [1] in animal models, has only recently been translated from the research group into the pharmaceutical market (see figure 1). For this purpose, the tetrapodal zinc oxide enables the immune system to detect the virus at an early stage via the CD4 CD 8 signaling pathway with the help of antigen presenting cells, which can easily internalize the virus enabled by an immobilization on specially adjusted nanoscale surface structures on the zinc oxide crystal. Besides the first product experiences of "Afinovir", a creme that contains GMP certified tetrapodal zinc oxide in herpes therapy, further antibacterial effects are now in focus. These might be utilized in 3D printed skin patches y their specific antibacterial effects and their ability to deliver proteins, like the VEGF for wound healing assistance, as shown by Leonard Siebert [2].

Compared to the effects in personal therapeutic medicine, the effects of sterilization provided by the Aeromaterials in air filtration systems are much less sophisticated. The combination of the structural features of Aeromaterials, the interconnected large free volume and the low weight are employed for a pyrolysis [3] of pathogens. Low mass means low heat capacity, which results in reaching high temperatures with relative low power. High free volume in connection with a hierarchical micro nanostructure means high filter efficiency. However, the example given in the framework of the Graphene Spearhead Project AEROGrAFT, a passenger jet air filter system is developed together with the aviation company Lufthansa Technik. It will be shown and discussed that beside technological obstacles the aviation certification procedure provides a similar challenge.

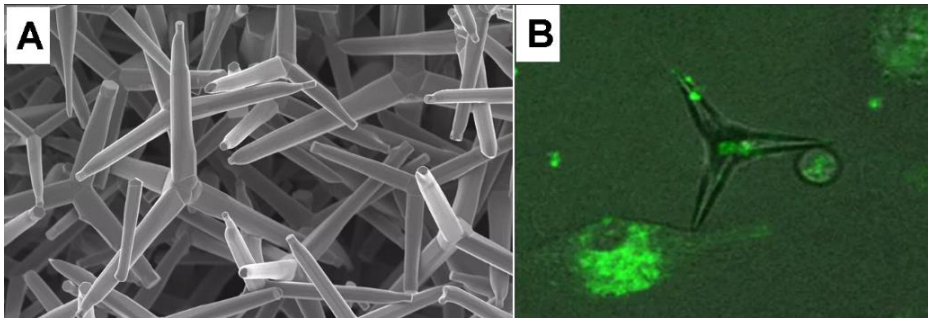

Fig. 1. Micrographs of tetrapodal Zink Oxide. A. Scanning electron microscopy image, the arm diameters of the ZnO microcrystals are in the order of ~1-3µm SEM. B. Fluorescence microscopy of a tetrapod with GFP labeled herpes virus bound to a tetrapod

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PL-2.1

Nanocomposites and Polymer Thin Films: from Gas Phase Synthesis to Functional Applications

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Among the functional nanocomposites, our group has focused on highly filled particulate metal-dielectric nanocomposites films due to their unique functional properties with hosts of applications. To explore collective interactions between the particles, we control the particle separation on the nanoscale by employing vapor phase deposition, which is a scalable approach permitting, inter alia, excellent control of the filling factor.

For deposition of functional polymer thin films, we have recently used initiated chemical vapor deposition (iCVD) to avoid decomposition of the functional groups [1]. Examples include highly stable electrets for electret microphones and magnetoelectric sensors [2], 3D superhydrophobic coatings [3], nanoscale gradient copolymers, and strain-invariant conductors for soft robotics [4]. For the fabrication of the nanocomposites, the nanoparticles can form during gas phase co-deposition via self-organization or by means of high-rate gas aggregation cluster sources, which provide independent control of filling factor and size as well as in situ monitoring and control of the composition of alloy nanoparticles. Recent examples of nanocomposites range from plasmonic meta-materials through photoswitchable [5] molecular plasmonic systems to memristors and memsensors for neuromorphic electronics [6]. We also explored nanoscale synergetic effects of plasmonics and photocatalysis [7], e.g. for photoinduced enhanced Raman spectroscopy (PIERS) [8].

In cooperation with the group of Oleg Lupan, we have also used alloy nanoparticles with tailored composition to enhance the sensitivity and selectivity of chemical sensors made up of micro and nanostructured wide-bandgap semiconductors [9]. Cross-sensitivity against moisture could be successfully eliminated with fluoropolymer coatings deposited by iCVD [10].

In addition to particulate nanocomposites, we are also concerned with multilayer nanocomposites. Here, emphasis is put on magnetoelectric sensors consisting of magnetostrictive and piezoelectric components on a vibrating beam. We also use electrets for readout and for obtaining a well-defined nonlinear restoring force [11].

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PL-2.2
Single Crystal Diamond Radiation Detector

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We have reported on the growth of single-crystal diamond and its application to radiation detectors. This time, we report on the measurement of an imager with a photon-charge counting read out integrated circuit (ROIC) connected to a single-crystal diamond. The single crystal diamond was 3.0 x 3.0mm x 0.5mm thick. The bump connection area of our test ROIC is a 3.2mm x 3.2mm area with 40 x 40 pixels pads with 80μm pitch. Silver-based bumps were formed on short-crystal diamond using a super inkjet printer and bumped to the ROIC using flip chip bonders. The imaging experiment was conducted by irradiating X-rays at 90 kV and 0.2 mA at 30cm distance. The results showed that the X-ray transmission image with a clear contrast between the area shielded by 2 mm thick lead and the unshielded area was captured, demonstrating a prototype single-crystal diamond-type X-ray imager.

CVD growth single-crystal diamond was used for the semiconductor detector. The crystal was 3 mm x 3 mm x 0.5 mm in size. The plate electrode was formed by sputtering a thin indium film. The other side had no electrode formed before stacking, but was connected to the ROIC by contact with the silver paste formed on the ROIC side during stacking. 40 × 40 electrodes were arranged at a pitch of 80 μm for the ROIC, and the maximum crystal size was 3.2 mm × 3.2 mm. However, due to the small crystal size, the detection area is 3.0 mm x 3.0 mm and 38 x 38 pixels. For the connection to the crystal, silver paste bumps were formed on the electrodes of the ROIC using a SIJ-S050 super inkjet printer manufactured by SIJ-Technology, Inc. The readout architecture of the ROIC was designed by our group [3],[4] and the transistor-level circuitry was designed by designed by Brookman Technology, Inc. (now TOPPAN Inc.) and fabricated in a TSMC (Taiwan Semiconductor Manu- fracturing Company Limited) 0.13-μm standard CMOS process. Figure 1 shows the assembled diamond imager and its stacked structure.

The ROIC was operated in electron collection mode. A bias voltage of -500 V was applied to the plate electrodes. the frame rate of the ROIC was 200 Hz. 10 seconds (2,000 frames) were taken and the counts were summed to obtain one image. an x-ray tube with a tube voltage of 100 kV was used as the x-ray source. the distance from the tube to the detector was 20 cm. A 3 mm x 3 mm lead plate with a thickness of 1 mm was used as the X-ray shield. The shielding body was shaped like a Japanese character. The shielding was placed between the X-ray tube and the detector, 5 mm away from the detector.

It was confirmed that X-rays were detected as expected when X-rays were irradiated with and without the shielding. Next, a shielding was placed in front of the detector and the shielding was imaged. As shown in Figure 2, the shape of the shielding was obtained as an image.

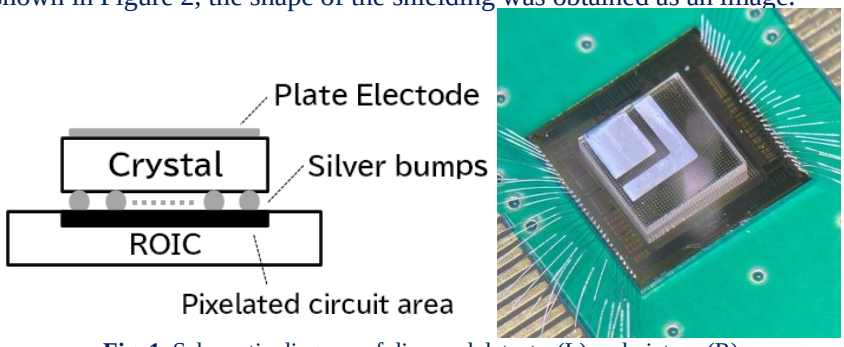

Fig. 1. Schematic diagram of diamond detector(L) and picture (R).

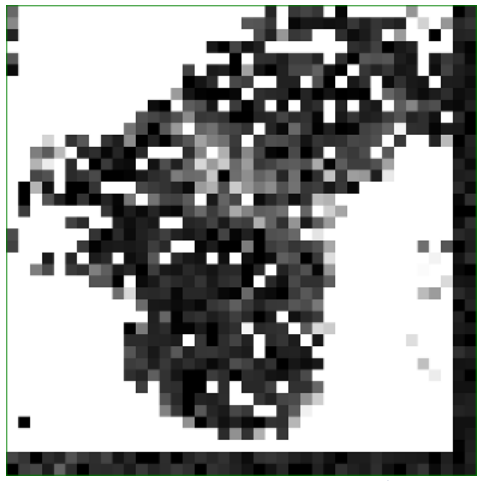

Fig. 2. X-ray imaging result with a lead-object of イ (Japanese character)

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PL-2.3

Strategic Integration of Electrospinning and Additive Processing for Smart and Sustainable Nanostructures

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Electrospinning is an effective and versatile technique applied to fabricate porous structures ranging from submicron to nanometer dimensions. Using a variety of high-performance polymers and blends, several porous structure configurations have become possible for applications in tactile sensing, energy harvesting, filtration, and biomedical applications, however, the structures lack mechanical complexity, conformity, and desired three-dimensional single/multi-material constructs necessary to mimic desired structures. A simple, yet versatile, strategy is through employing digitally controlled fabrication of shape-morphing by combining two promising technologies, viz., combinatorial electrospinning and 3D printing/additive processing. Using synergistic integration of configurations, elaborate shapes, and patterns are printed with mesostructured stimuli-responsive electrospun membranes, allowing for in-plane-modulations, and internal interlayer stresses induced by swelling/shrinkage or mismatch, thus guiding morphing behaviors of electrospun membranes to adapt to changes of the environment. Recent progress in 3D/4D printing/additive processing includes materials and scaffold constructs for tactile and wearable sensors, filtration structures, sensors for structural health monitoring, biomedical scaffolds, tissue engineering, and optical patterning, among many other applications to support the vision of synthetically prepared smart material designs that mimic the structural aspects with digital precision. A novel technology called 3D jet writing was recently reported that propels electrospinning to adaptive technologies for the manufacturing of scaffolds according to user-defined specifications of the shape and size of both the pores and the overall geometric footprint. This presentation reviews the hierarchical synergy between electrospinning and 3D printing as part of the precision and rapid prototyping of smart, sustainable, and biomedical structures that are likely to evolve next-generation structures into reality.

PL-2.4

Brain like Artificial Neural Network Based on Superconducting Neurons and Synapses

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Energy efficiency and the radically reduction of the power consumption level becomes a crucial parameter constraining the advance of supercomputers. The most promising solution is design and development of the Brain-like systems with non-von Neumann architectures, first of all – the Artificial Neural Networks (ANN) based on superconducting elements. Superconducting ANN needs elaboration of two main elements – nonlinear switch, neuron [1] and linear connecting element, synapse [2]. We present results of our design and investigation of artificial neurons, based on superconducting spin valves – S/F/S Josephson Junctions with weak link F fabricated from magnetic material (Ni or alloy CuNi), and superconducting synapse based on layered hybrid structures superconductor-ferromagnet.

We obtained and analyzed results of experimental study of the proximity effect in a stack-like superconductor/ferromagnet (S/F) superlattices Nb/Co with F = Co ferromagnetic layers of different thicknesses and coercive fields, and S= Nb superconducting layers of constant thickness equal to coherence length of niobium which can serve as an artificial synapse.

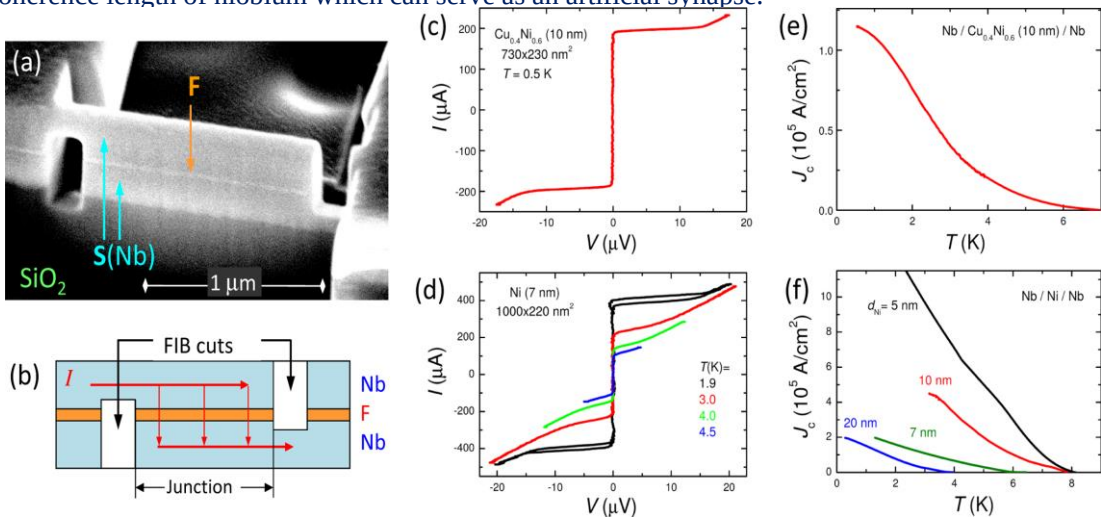

Fig.1. a) TEM image of the artificial neuron – Nb/F/Nb Josephson Junction, b) sketch of the Nb/F/N Josephson Junction with F - magnetic material (Ni, or CuNi) , c) I-V switching curve of the Nb/CuNi/Nb Josephson Junction at fixed temperature T=0,5 K, d) c) I-V switching curves of the Nb/Ni/Nb Josephson Junction at number of fixed temperatures listed in the inset, e) Temperature dependence of the critical current of Nb/CuNi/Nb Josephson Junction, f) Temperature dependence of the critical current of the set of Nb/Ni/Nb Josephson Junctions with various thickness of the Ni layer.

The superlattices Nb/Co demonstrate change of the superconducting order parameter in thin niobium films due to switching from the parallel to the antiparallel alignment of neighboring ferromagnetic layers magnetization. We argue that such superlattices can be used as tunable kinetic inductors for ANN synapses engineering. As the result of design of the ANN using that two elaborated base elements, artificial neurons and artificial synapses, allows construction of the computer with 6-7 orders of magnitude lower energy consumption in comparison with the traditional computer designed from semiconducting base elements.

The study was supported by the Grant RSF No. 22-79-10018 “Controlled kinetic inductance based on superconducting hybrid structures with magnetic materials” (theory development, samples measurements, results evaluation), and by the Moldova State Program Project «Functional nanostructures and nanomaterials for industry and agriculture» no. 20.80009.5007.11 (samples fabrication and characterization).

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PL-2.5

Engineering Heterostructured Nanomaterials for Nanoelectronic and Biomedical Applications

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Engineering heterostructured nanomaterials for nanoelectronics, as well as for biomedical applications have attracted huge attention in the past decade. It is because heterostructured nanomaterials are constructed by two or more single-component nanoparticles with certain structure, order of nanolayers and synergistically enhanced functional properties.

Heterostructures made of nanoparticles and nanostructured thin films or metal-organic frameworks are integrating advantages of porosity, nanosize, structure, optical and electrical performances. Recently, diverse nano-heterostructured materials are engineered and grown through various approaches and strategies and have proved promising potential for applications in battery safety sensors (BAS), gas, vapor and UV sensors, as well as biosensensors for biomedical applications [1-7].

Novel two-in-one battery safety sensors have been developed based on the CuO/Cu_2O and $TiO_2/CuO/Cu_2O$ heterostructures, as an example of real application [1-4]. These sensors enable early detection of solvents or the vapors of their degassing products, which are produced by Li-Ion batteries at the onset of runaway [1-5]. Coating ZnO nanocolumns using Al_2O_3 and thermally annealing offers the resulting Al_2O_3/ZnO heterostructure that enhances the gas sensing properties towards the detection of the components in the electrolytes of the lithium-ion batteries. Columnar films of Al_2O_3/ZnO with a thickness of 10 nm for the top-coating layer exhibit the highest sensitivity and selectivity towards the vapors of $C_3H_4O_{10}$. Experimental and computed results indicate that relative humidity will not affect the sensing properties of the such heterostructures towards the volatile organic compounds (VOCs) and degassing products used in the electrolytes of lithium-ion batteries [1-6].

As well as, new 2-in-1 sensor for NH_3 and H_2 detection is discussed, which ensure stable, precise and very selective characteristics for the tracking of these vapors at low concentrations. The fabricated TiO_2 layers, which were annealed at 610 °C formed two crystal phases, anatase and rutile, and after coverage with a thin PV4D4 polymer nanolayer via initiated chemical vapor deposition (iCVD), show response to ammonia at room temperature and exclusive hydrogen detection at elevated operating temperatures. These results open new possibilities for applications, e.g. like biomedical diagnosis, biosensors, and the development of non-invasive technology [7]. Compared to unprotected $CuO/Cu_2O/ZnO$:Fe the coated $CuO/Cu_2O/ZnO$:Fe exhibit a much better sensing performance at higher relative humidity and tunability of the gas selectivity [3].

The higher responses to specific volatile organic compounds, VOCs, are controlled and tailored for the samples synergistically enhanced with dopants and nanoparticles simultaneously. In addition, the recovery times are reduced for the developed nanocolumnar layers for a range of operating temperatures. The response of the synergistically enhanced sensors to gas molecules containing certain functional groups is in excellent agreement with density functional theory calculations performed in our work too [8].

This new fabrication strategy can underpin the next generation of advanced materials for photocatalytic, VOC, and gas sensing applications and prevent levels that are hazardous to human health and can cause environmental damage. As well as, it can be used for detecting gases used as traces for specific molecules, that act as biomarkers in exhaled breath or outgassing VOCs of various biological systems.

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PL-2.6

Superconducting Order Parameter in Inhomogeneous Superconductors

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Superconductivity is the state of matter in which the electronic wave function spontaneously takes on a definite complex phase. The most fundamental ingredient in the theoretical description of this phenomenon is the superconducting order parameter. Modern computational methods and the corresponding computer codes allow the quantitative predictions of superconducting properties for realistic experimental settings involving not only bulk superconductors but also heterostructures. One major consequence is that it enables the accurate calculation of the superconducting order parameter in inhomogeneous systems, which has been limited so far due to the lack of an appropriate theoretical tool set, even though the superconducting order parameter is one of the central quantity of superconductivity. This is because the BCS theory of superconductivity, in its original formulation, is not easily generalized for heterostructures, especially in the relativistic domain

In this talk we attempt to provide a quantitative theory that takes into account the ab-initio band structure with its full microscopic complexity together with magnetism, effects from relativity, spatial inhomogeneity of the lattice and different orbital symmetries on the same footing. This can be achieved within the framework of Multiple Scattering Theory (MST), this time combined with the Bogolubov-deGennes (BdG) reformulation of the BCS theory. Similarly to the normal state, the central quantity of such an MST is the quasiparticle Green's function, which now carries information about the scattering of quasiparticles [1]. The main extra ingredient of such scattering events compared to the normal state Korringa-Kohn-Rostoker (KKR) formalism is the so called Andreev reflection. It occurs when an electron, with energy lying in the superconducting gap, arriving from the normal metal to the superconductor - normal metal (S/N) interface is retro-reflected as a hole and a Cooper pair is formed in the superconductor. This formalism allows vast applications and we shall focus on the behavior of superconducting order parameter revealing its complexity and physical meaning in realistic systems. As an example, I will revisit the well known proximity effect, which is part of the standard textbook physics vocabulary and it is mostly understood within the quasiclassical picture. However, the real microscopic mechanism behind the proximity effect is the Andreev reflection. If one considers this microscopic picture for some artificial materials, often referred to as heterostructures it reveals the difference in important concepts, like the superconducting order parameter, pairing potential, superconducting gap, which are not well separated in the conventional BCS theory of bulk superconductors. We will use the example of Nb/Au heterostructures in the talk.

Then we will apply the approach to the complimentary problem, namely when a superconducting impurity cluster is embedded into a non-superconducting material. By doing so, we shed light on the build-up of the superconducting phase and its connection to the order parameter. As a testbed for our calculations, we consider superconducting Nb atoms surrounded by non-superconducting bulk Nb [2]. For a relatively small cluster of material with nonzero pair interaction parameter embedded in a normal metal, the superconductivity will be suppressed and the superconducting gap will be forced to close. However, the interesting question is what happens when the size of the cluster reaches the same order as the corresponding superconducting coherence length. Here one should remember that the Cooper pairs are extended in real space, since Cooper pairs are formed in momentum space and not in real space. In fact our local pairing model is the analog of conventional BCS theory, where Cooper pairs are formed by electrons with different quantum numbers $\mathbf{k},\uparrow$ and $-\mathbf{k},\downarrow$ in which states

from the region of the gap around the Fermi level are mixed. The coherence length is the extension of these wave packets in real space given by the BCS theory.

When a magnetic impurity or a cluster of magnetic impurities is introduced into a singlet *s*-wave time-reversal invariant superconductor, there is a pair-breaking effect due to the spin-dependent scattering, and the superconducting transition temperature decreases as the impurity concentration increases. Yu, Shiba and Rusinov revealed that local states (referred as YSR states) appear within the BCS energy gap due to multiple scattering between conduction electrons and magnetic impurities. Later, it was realized theoretically that one can engineer nanostructures, where hybridized YSR states form a topological fully gapped quasiparticle spectrum. For magnetic impurities an especially rich internal structure of the superconducting order parameter can be calculated from the local Green's function as non-zero elements in the electron-hole off-diagonal block. It will be demonstrated, that the complexity of the ab-initio electronic structure allows the appearance of an exotic local triplet state in magnetic ***s***-wave time-reversal symmetry breaking superconductors. Furthermore, we also show how topological superconductivity is manifested in the structure of the superconducting order parameter.

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PL-3.1

3D Nanoarchitectures – a Novel Class of Materials: Perspective for Sustainable Development

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Extending nanostructures into the third dimension has become a vibrant research avenue in condensed-matter physics, because of geometry- and topology-induced phenomena. Modern advances of high-tech fabrication techniques have allowed for generating geometrically and topologically nontrivial manifolds at the nanoscale, which determine novel, sometimes counterintuitive, electronic, magnetic, optical and transport properties of such objects and unprecedented potentialities for design, functionalization and integration of nanodevices due to their complex geometry and non-trivial topology [1]. I will focus on three directions of key importance for sustainable development of technologies.

Firstly, recently suggested Möbius-strip microcavities [2] as integrable and Berry-phase-programmable optical systems are of great interest in topological physics and emerging classical and quantum photonic applications. For photons resonating in a Möbius-strip cavity, the occurrence of an extra phase—known as the Berry phase—with purely topological origin is expected due to its non-trivial evolution in parameter space. However, despite numerous theoretical investigations, characterizing the optical Berry phase in a Möbius-strip cavity has remained elusive. Here we report the experimental observation of the Berry phase generated in optical Möbius-strip microcavities. In contrast to theoretical predictions in optical, electronic and magnetic Möbius-topology systems where only Berry phase π occurs, we demonstrate that a variable Berry phase smaller than π can be acquired by generating elliptical polarization of resonating light.

Secondly, an efficient tailoring of acoustic phonon energy spectrum in rolled-up multi-shell tubular structures [3] opens up prospective applications in microelectronics, in cases when low heat conduction is required. The phonon energy spectra in the Si/SiO_2 multishell nanotubes are obtained using the atomistic lattice dynamics approach. Thermal conductivity is calculated using the Boltzmann transport equation within the relaxation time approximation. Redistribution of the vibrational spectra in multishell nanotubes leads to a decrease of the phonon group velocity and the thermal conductivity as compared to homogeneous Si nanowires. Phonon scattering on the Si/SiO_2 interfaces is another key factor of strong reduction of the thermal conductivity in these structures (down to 0.2 $Wm^{-1}K^{-1}$ at room temperature). We demonstrate that phonon thermal transport in Si/SiO_2 nanotubes can be efficiently suppressed by a proper choice of nanotube geometrical parameters: lateral cross section, thickness and number of shells.

Thirdly, prospect directions and challenges in the domain of superconductivity and vortex matter in curved 3D nanoarchitectures and their great potential for magnetic field sensing, bolometry, and information technology have been demonstrated [4]. A topological transition between the vortices and phase slips under a strong transport current is found in open superconductor Nb nanotubes with a submicron-scale inhomogeneity of the normal-to-the-surface component of the applied magnetic field [5]. This transition determines the magnetic-field–voltage and current–voltage characteristics, which imply a possibility to efficiently tailor the superconducting properties of nanostructured materials by inducing a nontrivial topology of superconducting screening currents. A transition between the vortex and phase-slip regimes depends on the magnetic field only weakly if the magnetic field and/or transport current are switched on gradually. In the case of an abrupt switch-on of the magnetic field or transport current, the system can be triggered to the stable phase-slip regime within a certain window of parameters. A hysteresis effect in the current-voltage characteristics is predicted in superconductor open nanotubes [6]. Dynamic topological transitions in open superconductor nanotubes occur under a combined dc+ac transport current [7]. The key effect is a

transition between two regimes of superconducting dynamics. The first regime is characterized by a pronounced first harmonic in the Fast Fourier Transform (FFT) spectrum of the induced voltage at the ac frequency. It is typical of two cases, when the dominant area of the open tube is superconducting at relatively low magnetic fields and/or weak dc currents or normal at relatively high magnetic fields and/or strong dc currents. The second regime is represented by a rich FFT spectrum of the induced voltage with pronounced low-frequency components due to an interplay between the dynamics of superconducting vortices or phase slips and those driven by the ac.

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PL-3.2

Evaluation of Health Technology in Republic Moldova

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Medical devices (MD) are indispensable in performing the medical act, and their importance has become a priority at the medical institution level as well as at the national level. To ensure the efficient functioning of a health system, it is necessary to equip it with medical devices, in accordance with the progress of medical technologies. However, the use of quality, safe and effective medical devices also requires qualified human resources, as well as the implementation of an effective management of medical devices [1].

The degree of endowment with high-performance medical devices and ensuring an appropriate level of professionalism of the medical staff are the key tools in ensuring the good functioning of the health system and exert a direct impact on the functional effectiveness of the system, on the quality of the service and the degree of satisfaction of the beneficiary .The effective use of them presupposes, as a matter of priority, the increase in the number of cost-effective and qualitative investigations and treatment. For these reasons, the WHO recommends and it is essential to have a policy at the national level regarding the Management of Medical Devices (MMD), which includes the provision of DM, ensuring the maintenance, verification and correct use of medical technologies, the training of specialists in the field and the creation of a system of their continuous training, etc.

In the Republic of Moldova, Law no. 102 of June 9, 2017 regarding medical devices with the aim of adjusting the legal framework of the Republic of Moldova to the Community acquis for the implementation of European technical regulations in the field of MD and consumer protection of medical services, offered through the application of MD. The signed law stipulates the definitions according to the European Directives with application to DM and establishes that they can be introduced on the market, put into operation or used only if they are certified and registered, so that they do not affect the safety and health of patients, users and other people and the environment.

With the support of the Swiss Development and Cooperation Agency through the PERINAT and REPEMOL projects, all existing procedures related to MDD at the hospital level were analyzed, the necessary set of procedures was defined and the model of MD management and administration procedures was developed, which were initially implemented in five medical institutions and was developed with the support of JICA, the Guide regarding the establishment criteria, roles and responsibilities of biomedical engineering Departments/Sections within medical institutions.

The results of the MDM evaluation at the medical institution level demonstrated the positive impact in the efficient use of the DM, the reduction of the maintenance expenses of the DM, through appropriate internal services in a timely manner, the increase in the cost-efficiency and safety of the medical act.*

In the same context, the "Management of Medical Technologies" Pilot Center was established, at the base of the Mother and Child Institute jointly with the Technical University of Moldova, which aims to develop procedure models for MMD to European and international standards, the development of procedures for maintenance, diagnosis and repair of medical devices, with the support of JICA, 5 departments of Biomedical Engineering were organized.

According to the Statistical Yearbook of the Republic of Moldova for 2020, 12,552 doctors and 23,584 medical personnel worked in the health system, of which 18,514 were nurses - all users of medical devices.

One of the most important roles in the management of medical devices belongs, of course, to the personnel responsible for the maintenance of medical devices (medical bioengineers, technical engineers, technicians, mechanics, etc.).

Starting from 2016 and until now, annual evaluations have been carried out regarding the endowment of the health system with human resources (medical bioengineers, engineers and

technicians). Recent evaluations have shown that their total number is about 150, of which 50 are medical bioengineers. At the same time, the real need of the health system, being over 300 medical bioengineers.

For this purpose, the National Biomedical Engineering Center within the Technical University of Moldova [2], authorized by law with such functions, plays a special role in the periodic training and improvement of staff.

The expected result following the implementation of the MMD in is ensuring the quality of medical devices and optimizing the use of public financial means through a proposed rational and efficient management.

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PL-3.3

Manifestations of Unconventional Pairing Symmetry in Superconducting Hybrids

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Superconducting states with broken time-reversal symmetry may arise in structures with nontrivial topological properties and are currently of high interest from fundamental and applied points of view. We will discuss theoretical basis for the description of interfaces between unconventional superconductors (S) and normal metals (N). We will present the results for electronic and spin transport in multiterminal S/N hybrid structures [1-3]. Technically, the derivation of boundary condition for the Nambu-Keldysh quasiclassical Green's functions at the S-N interfaces will be outlined. Of particular interest is application to superconductors with mixed s + p-wave superconducting pairing symmetry, including the cases of chiral and helical p-wave state in two dimensions, as well as the so-called Balian-Werthamer state in three dimensions. The local density of states, charge and spin conductance will be discussed. The cases will be identified when the proximity induced pairing in N has odd-frequency spin-triplet s-wave symmetry. This state is characterized by the existence of a robust zero energy Andreev bound state.

Within the developed approach, three- and four-terminal S/N structures are investigated where the superconducting potential is a mixture between s-wave and p-wave potentials. The ways are proposed to determine whether S has a mixed pair potential and to distinguish between chiral and helical p-wave superconductivity. In this case a difference in conductance for electrons with opposite spins arises if both an s-wave and a p-wave components are present, even in the absence of a magnetic field. It is shown that a setup containing two SN junctions provides a clear difference in spin conductance between the s + chiral p-wave and s + helical p-wave symmetries. Further, we propose new approach to distinguish p-wave from s-wave symmetry by measuring conductance a four terminal junction consisting of S and N terminals. The N-terminals are used to manipulate the energy distribution functions of electrons in the junction in order to control the charge transport. It is shown that the differential conductance of junctions containing p-wave and s-wave superconductors is distinctly different, thus providing experimental test to detect potential p-wave superconductivity.

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SECTION S1
Nanotechnologies and Nanomaterials

S1-1.1

Tunable Properties of Vacuum-Evaporated $CH_3NH_3PbCl_{3-x}I_x$ Perovskite Layers

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Perovskite layers as a photo absorber material are widely used in single-junction and tandem solar cells. The characteristics of these solar cells have been greatly improved in recent years. This study prepared the $CH_3NH_3PbI_{3-x}Cl_x$ metal halide perovskite layers on glass substrates covered with a thin indium tin oxide film by vacuum thermal evaporation method. Inorganic lead iodide (PbI_2) and organic methylammonium chloride (CH_3NH_3Cl) were used as precursors. The layers were characterized by scanning electron microscope, x-ray diffraction, and *C–V* measurements. The transmission and absorption of the obtained layers were studied within the wavelength range of 400 to 1100 nm. It was found that the structural and optoelectronic properties of sequentially (layer-by-layer) evaporated (after annealing at the temperature of 100°C for 30 min) and co-evaporated (jointly) perovskite layers are similar. The perovskite layers had a tetragonal crystal structure. They densely, without pinholes and cracks covered the surface of the substrates. The layers show a favorable band gap of 1.57 eV. The low-temperature optical studies were carried out to reveal the temperature dependence of the band gap energy. The possibility of increasing the layers' thermal stability by adding 2.3 % cesium iodide to the PbI_2 precursor during the evaporation process. was also shown.

S1-1.2

Gamma Radiation Sensitization of ZnO/Al_2O_3 Sensors Based on Nanoheterostructures

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Reliable detection of dangerous gases by using devices based on semiconductor materials in environments, with different influencing factors, such as gamma radiation, is a challenge for a medical facility or space program. A study of the influence of gamma radiation on the electrical and sensing properties of ZnO/Al_2O_3 core@shell heterostructure has been carried out in this work. Using as radiation source Cs-137, a low level of ionizing radiation was applied. It was observed that gamma irradiation did not affect the electrical resistance in real time measurements, but changes have been observed once comparing I-V characteristics before and after measurements. Initial gas tests showed that ZnO/Al_2O_3 heterostructure does not detect volatile organic compounds (VOC) gases in the operating temperature range between 150-200 °C and gas concentration up to 100 ppm. Further gas sensing tests, after irradiation, showed that the experimental results are of interest for the gas sensors development based on the ZnO/Al_2O_3 heterostructure, showing an increase in response value by more than 100% and 200% for 100 ppm 2-propanol and n-butanol VOC gases at operating temperature of 200 and 250 °C, respectively. These findings can be used for further development of gas sensors in environments with gamma radiation field and for biomedical applications too.

S1-1.3

Functional Capabilities of Two-barrier Semiconductor Structures

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Two-barrier semiconductor structures with a high-resistance sublayer and longitudinal illumination, using certain design and technological parameters, have several unique functionalities, such as injection amplification of the photocurrent, and spectral selective sensitivity. This investigation considers the possibility of creating highly sensitive devices in the optical (CdTe, Si) and X-ray (CdTe) ranges of electromagnetic waves. The process of mutual compensation of photocurrents arising in opposite potential barriers overlapping the sublayer, with longitudinal absorption of radiation, leads to pronounced short-wavelength and long-wavelength maxima in the spectral distribution of intensity or photocurrent. Using structures based on cadmium and silicon telluride, as examples, the phenomenon of the sign reversal of the spectral photocurrent and the possibilities of measuring wavelengths are demonstrated. To study the photoelectronic processes occurring in these structures, the obtained mathematical expressions are used, which relate the parameters of the structure and optical radiation. The algorithm developed using these expressions is based on a new spectral analysis mechanism, which makes it possible to implement it as affordable, small-sized, low-material, and low-power devices. All this is considered in the context of solving urgent problems of quantitative remote identification of the components of an optically transparent medium suitable for solving environmental issues.

S1-1.4

Electrical Properties of the (Copper, Dysprosium)-Containing Complex Compound

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A new semiconductor material tetrakis-μ3-(methoxy)(methanol)-pentakis(acetylacetonato) (tricopper(II), dysprosium(III)) (I) was synthesized, with the following composition: $[Cu_3Dy(AA)_5(OCH3)_4CH_3OH]$, where HAA = $H_3C–C(O)–CH_2–C(O)–CH_3$. By data of the elemental analysis and physic-chemical research methods, the obtained complex compound (I) was established to contain atoms of copper (II) and dysprosium (III) in a ratio Cu : Dy = 3 : 1, and its composition was established to correspond to a gross formula: $Cu_3DyO_{15}C_{30}H_{51}$. The electrical conductivity of the obtained material was measured in compressed form. The following parameters were calculated for the complex compound (I): the number of valence electrons in one molecule was 276; the mass of one molecule was $166.777 \cdot 10^{-20}$ kg; the total number of molecules in a cylindrical sample with a 0.138 g mass and a $19.72 \cdot 10^{-9}$ m^3 volume was $8.274 \cdot 10^{13}$ molecules. The resistivity of the pressed sample decreases from $9 \cdot 10^{10}$ to $7 \cdot 10^4$ Ohm·cm in a 303 ~ 413 K temperature range. This confirms that the synthesized compound is a semiconductor with a bandgap of 1.38 eV. The conductive properties of the complex compound as a heat-sensitive element were studied. An experimental sample of compressed material with geometric sizes of $1 \cdot 10^{-3}$m×$0.5 \cdot 10^{-3}$m×$0.5 \cdot 10^{-3}$m was employed for investigations.

S1-1.5

Morphological and Sensing Properties of the ZnO - Zn_2SnO_4 Ternary Phase Nanorod Arrays

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In this paper, the morphological and sensing properties of the Sn-doped ZnO-Zn_2SnO_4 nanorods obtained by the hydrothermal method are presented. The developed methodology exhibits high levels of efficiency and cost-effectiveness, making it particularly suitable for implementation in the field of nanoelectronics and biomedical applications. Scanning electron microscopy was used to analyze the morphology of the Sn-doped ZnO-Zn_2SnO_4 nanostructures showing nanorod arrays formation. Energy dispersive X-ray spectroscopy was involved to determine the chemical composition and shows uniform distribution of Sn. Structural analysis by X-ray diffraction shows high crystallinity of Sn-doped ZnO-Zn_2SnO_4 samples with (0002) main orientation and formation of a ternary phase Zn_2SnO_4. These nanostructures obtained by the hydrothermal method were tested as sensor materials for ethanol and carbon dioxide. A high response of about 130 % to 100 ppm ethanol vapor with a very fast response time of 1s at an operating temperature of 250 °C was observed. This factor is very important for the detection of harmful or explosive gases. Sn-doping in ZnO and the formation of Zn_2SnO_4 is considered to be the key factor that changes the morphological and sensing properties for application use in miniaturized photodetectors, light emitting diodes, laser light source, and gas sensors.

S1-1.6

Nanocomposite Films Based on Photosensitive Azopolymer with Gold Nanoparticles: Synthesis, Film Deposition, Diffractive Optical Elements Recording and Characterization

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In the present study, the photosensitive nanocomposite was fabricated based on azopolymer and Au nanoparticles (Azo-Au NPs). For the first time, the synthesized polymeric poly-N-(2,3-epoxypropyl) carbazole with azo dye SY 3 (PEPC-co-SY 3) was the basis of the nanocomposite. As a medium for polarization holographic recording, thin films of a nanocomposite a number of concentrations deposited on a glass slide by the rod coating method were studied. Diffraction gratings were recorded on films by direct and single-stage polarization holography. For recording, the polarization states of the beams were P-P, S-S, and ±45 º and left-right circular. In nanocomposites, the optical path of the beam is defined by the summary changes in surface topography and refractive index. The periodically modulated polarization/amplitude interference patterns produced by the gratings were investigated by in situ measurements of the diffraction efficiency (DE) kinetics in the first diffraction order when the DE saturation value was reached. A maximum DE value of 35% was obtained for the nanocomposite PEPC-co-SY3 with 0.0006mg/ml of Au NPs. The gratings were studied using a polarization-sensitive digital holographic microscope to reveal their optical phase features using the full-field method. The surface relief was measured by AFM. A comparison of the behavior of azopolymer films during the recording of surface relief gratings with and without Au NPs was carried out. The results of diffraction gratings recording by the polarization holography method are presented, confirming the possibility of recording not only amplitude and phase of light, as in scalar holography, but also polarization states.

S1-1.7

MOF-coated 3D-printed ZnO Tetrapods as a Two-in-one Sensor for H_2 Sensing and UV Detection

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As the world rapidly transitions towards renewable energy sources, the use of hydrogen (H_2) as a green energy carrier has become increasingly important. The various applications of hydrogen in the energy sector require sensor materials that can efficiently detect small amounts of H_2 in gas mixtures. One solution is the use of a Metal-organic Framework (MOF)-functionalized oxide gas sensor, specifically a MOF-functionalized ZnO sensor. The sensor is composed of tetrapodal ZnO microparticles coated with a thin layer of MOF, which results in a core@shell composite structure. Prior to the conversion to MOF, these microparticles are 3D printed to create macroscopic sensor circuitry. The sensor demonstrated selectivity and sensitivity to 100 ppm H_2 in air at an operating temperature of 250 °C. The sensor is based on crystalline t-ZnO as a core which is partially converted to ZIF-8 (zinc dimethylimidazolate, $Zn(MeIM)_2$). MOF are a class of porous materials composed of metal ions or clusters connected by organic ligands. They have a high surface area and can be tailored to exhibit specific properties, such as selective adsorption of gases. The sensor also reliably detected H_2 gas in air and is selective versus methane, acetone, butanol, and propanol. Such a selectivity is important for determining the H_2 dilution level in natural gas pipelines. Analysis was performed using X-ray diffraction, SEM, UV radiation, and gas sensing measurements. This innovative two-in-one sensor for UV radiation and H_2 gas has significant implications for the energy sector's transition to renewable energy sources.

S1-1.8

Organic Nanostructured Crystals for Thermoelectric Cooling in Medical Applications

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In this study we performed theoretical calculations and numerical modeling of a thermoelectric *p-n* pair composed of organic nanostructured crystals. Specifically, we focus on two highly promising materials: TTT_2I_3 and $TTT(TNCQ)_2$ crystals, which exhibit promising thermoelectric properties attributed to their unique molecular arrangements and electron-phonon interaction mechanisms. Our theoretical investigations demonstrate that tuning the concentration of charge carriers can significantly enhance the thermopower and electrical conductivity of these materials. However, such manipulations can also introduce impurities and lattice dislocations that affect the thermoelectric properties. Through detailed numerical calculations, we explored the thermoelectric characteristics of these crystals within specific temperature ranges, charge carrier concentrations, and impurity scattering parameters. Numerical calculations reveal that, within a certain range of temperature, charge carrier concentration, and impurity scattering parameters, these crystals exhibit highly promising thermoelectric characteristics. Building on these findings, we investigate the cooling properties of a thermoelectric device composed of these materials, with potential applications as local cooling systems for medical use or accurate temperature controllers for biomedical laboratories. Our results demonstrate the potential of these organic nanostructured crystals as small-scale, efficient, reliable, and environmentally friendly cooling devices. Moreover, their non-toxic nature makes them particularly suitable for diverse medical and biomedical applications, such as localized cooling systems and precise temperature controllers.

S1-1.9

General Nature of Serration Effect in Crystals and Other Materials Under Indentation

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The nature of the manifestation of the "serration effect" (SE) during nano-microindentation of materials of various types was studied in this work: ionic and covalent crystals (LiF, MgO, Si), coated systems (CSs) of the film/substrate type, metals (Cu, austenitic steel AISI 316L) and laser phosphate glasses doped with rare earth elements (SP-R). The serration effect on the nano-microindentation $P(h)$ curves was revealed both at the loading and unloading stages. It has been established that serration effect is a property of all studied materials. General regularities were revealed: SE is most pronounced in single crystals and CSs, less in metals, and the weakest in glasses. With an increase in the load on the indenter and an increase in the loading rate, the amplitude and step of oscillations decrease. The characteristic dependences obtained in the paper correlate with the literature data, which also confirm the wavelike nature of indentation for various materials. It has been suggested that the effect may be associated with the elastic-plastic recovery (relaxation) of the material, which takes place throughout the entire indentation process. The fluctuations revealed on the load-displacement curves may indicate the wave nature of the indentation process and the universal character of the oscillatory effect in the process of depth-sensing indentation.

S1-1.10

Optical and Photoelectric Properties of Cadmium Diarsenide and Surface-barrier Structures Based on it

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The optical properties of CdAs2 single crystals are studied in polarized light. The features of the fundamental absorption edge and the splitting of bands in the field of the crystal lattice are studied. Birefringence indices in the wavelength range from 3 μm to the absorption edge were determined by the method of interference of polarized beams. The necessity of taking into account the complex nature of the dielectric functions of a crystal when calculating birefringence in the near-edge region of intrinsic absorption is shown. A technology has been developed for obtaining ohmic and rectifying contacts on CdAs2 crystals. The electric and photoelectric properties of surface-barrier structures based on CdAs2 have been studied. The determining influence of deep levels and the ratio of deep to shallow levels on the properties and parameters of the contact barrier is found. The optimal properties of the semiconductor and metal are determined to obtain the most pronounced photoelectric effect. It has been established that the photocurrent spectrum has features of the band structure of the crystal, an indirect-gap extreme fundamental development with a band gap of ~ 1 eV, and optical transitions in the deep zone. Impurity absorption bands are found, one of which is adjacent directly to the absorption edge and has a significant effect on the photoelectric effect boundary. The dependence of the height of the potential barrier of metal contact with cadmium diarsenide on the work function of the metal has been established. In addition, a significant decrease in the barrier in the near-contact region was found, which has a significant or decisive effect on the spectral distribution of the photocurrent, depending on the electrical properties of the semiconductor. For example, the Fowler electron emission photocurrent is detected only when the barrier is reverse-biased, while in the short-wavelength region of fundamental absorption, the photocurrent is suppressed or reverses its sign. The presented studies show the potential possibilities of using CdAs2 to create active structures and the need to improve the technology for obtaining crystals with desired properties.

S1-1.11

Preliminary Study on Silver Nanoparticle Synthesis Through Chemical and Biological Methods

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This research was focused on the synthesis and characterization of silver nanoparticles, known for their various utilizations in the people daily life. Aiming the promotion of eco-friendly nanoproducts, we present a comparison between the properties of silver nanoparticles synthesized by chemical reduction method and biological method based on the reduction with antioxidants from plant extract. The formation of colloidal silver nanoparticles was evidenced by the recordings of the characteristic spectral band (due to the phenomenon of localized surface plasmon resonance) in the UV-Vis range for both types of samples. The citrate-AgNP suspension, synthesized by reduction with trisodium citrate reagent, was characterized by relatively broad band with maximum at 425 nm while green tea-AgNP suspension, synthesized with green tea leaf extract, presented the characteristic band with maximum at about 445 nm. Highest intensity of LSPR band was noticed for the AgNPs synthesized by the eco-friendly method denoting remarkably better efficiency of the biological reducers. The good granularity in the nanometric domain was revealed by Scanning Electron Microscopy for both samples while the elemental composition was confirmed by Energy Dispersive Spectroscopy. The optimization of the biological synthesis with green tea extract is designed to efficiently provide silver nanoparticles for biomedical applications that are more friendly with the environment.

S1-1.12

Advanced Nanotechnology-based Approaches to Waste Water Purification from Organic Pollutants

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Advanced nanotechnology-based approaches to waste water purification is attracting more and more attention at the present time. Among several types of advanced oxidation processes (AOPs), heterogeneous photocatalytic decomposition using a solid semiconductor photocatalyst and UV radiation of low concentrated, hihgly toxic, hardly decomposable impurities should be distinguished. One such organic substance that requires wastewater treatment before being discharged into the aquatic system is phenol and its derivatives, which are known to be endocrine disruptors. Heterogeneous photocatalysis using titanium dioxide and ultraviolet radiation has been successfully used in suspended slurry photoreactors.

A photocatalyst (NTD) based on nanosized anatase and diatomite as a substrate has been synthesized in an electrolyzer and applied for the photodecomposition of phenol in a slurry-type photoreactor.

The parameters affecting the adsorption and the degree of photodecomposition were determined: the initial phenol concentration, pH of the solution, dose of the photocatalyst, and duration of UV irradiation.

It is shown that photocatalysis with NTD under UV radiation makes it possible to achieve the degree of purification of the aqueous phenol solution up to the MAC (maximum allowable concentration) level for wastewater (5 mg/l) at an initial phenol concentration of 11 mg/l, a catalyst dose of 2 g/l, pH = 4.5 during 32 minutes of the process.

S1-1.13
Micro-Raman Analysis of Some As-S-Sb-Te Nanostructured Semiconductors

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In the present work some nanostructured chalcogenides of the As-S-Sb-Te system have been investigated by non-contact Micro-Raman spectroscopy which is a powerful technique for obtaining information on the local structure of the crystalline as well as disordered materials, especially when the composition and structure is varied.. In this paper we report micro-Raman spectra of $As_{1.17}S_{2.7}Sb_{0.83}Te_{0.40}$, $As_{1.04}S_{2.4}Sb_{0.96}Te_{0.60}$, $As_{0.63}S_{2.7}Sb_{1.37}Te_{0.30}$, and $As_{0.56}S_{2.4}Sb_{1.44}Te_{0.60}$, of bulk semiconductor compounds and thin films. These semiconductor alloys are interesting and important from the point of view of assessing their physical properties, primarily the structure, as well as for determining the scope of technical application. It was established that the Raman spectra of light scattering of bulk samples differs from the spectra of thin films with a higher As content and a low Sb content, but samples prepared as bulk and powder exhibit the same behavior. All spectra have characteristic intense bands which are assigned to the Te-Te (ν = 119 cm^{-1}), As-As (ν = 234 cm^{-1}), $AsS_{3/2}$ (ν = 345 cm^{-1}), As_4S_4 (ν=495, 236, 223, 189, 168 cm^{-1}), As_4S_3 (270–273 cm^{-1}), S_8 rings (ν = 146, 220 cm^{-1}) and SbO (ν = 255 cm^{-1}) structural units. It was also found that the sample $As_{0.63}S_{2.7}Sb_{1.37}Te_{0.30}$ have a more amorphous phase, while $As_{0.56}S_{2.4}Sb_{1.44}Te_{0.}60$, $As1_{.17}S_{2.7}Sb_{0.83}Te_{0.40}$ and $As_{1.04}S_{2.4}Sb_{0.96}Te_{0.60}$ samples are more polycrystalline.

S1-1.14
Ground and Excited States of Excitons in GaSe Single Crystals

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Gallium selenide is a layered crystal with outstanding nonlinear optical properties. Due to layered structure and weak van der Waals bonds it is perspective as two dimension material. GaSe possesses two-phonon absorption and can be uses in THz diapason. Investigation of optical properties is important for further development of optoelectronic devices on its base. In this work photoluminescence, reflection and absorption spectra of GaSe single crystals were studied in a wide temperature range (10 – 300 K). The presence of series of excitonic levels in the region $E > E_g$ was shown. At excitation by 448 nm laser of GaSe crystal electrons were resonantly excited from $V_1(\Gamma_1)$ band to $C_1(\Gamma_6)$ and $C_2(\Gamma_5)$ bands. The luminescence from excitonic levels (n_A = 1, 2 … 5) of conduction band $C_1(\Gamma_6)$ to valence band $V_1(\Gamma_1)$ was observed. Recombination from excitonic level of $C_1(\Gamma_6)$ band to V_2 and V_3 bands (maxima n^B = 1 - 2.1751 eV and n^B = 2 - 2.2222 eV) and to V_4 and V_5 bands (maxima n^C = 1 – 2.311 eV and n^C = 2 - 2.350 eV) was observed. Luminescence maxima n^D = 1 (2.399 eV) and n^D = 2 (2.434 eV) attributed to transitions between C_1 – V_6, V_7 bands and E_3 maximum caused by recombination C_2 – V_1 were found out. A model of energy bands responsible for observed transitions was suggested.

S1-2.1
New Characteristics of Blue Self-pulsating InGaN Lasers

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In this paper, we present results of numerical calculations on the influence of blue light laser parameters on self-pulsation regimes. The adopted Yamada model to InGaN laser is used for numerical calculations. We start our investigations presenting the dependence of output power on the injected current. A threshold current of 90mA is obtained. We use the bifurcation analysis to plot the lines of Hopf - bifurcation in the plane of different parameters. The region of self-pulsation in the plane differential amplification coefficient injected current is obtained. The region of self-pulsation is wide and appears for large values of injected current. We studied also the influence of the thickness of the saturation absorber, the length of the laser, as well as the lifetime of the charge carriers on the self-pulsation region in terms of several parameters. The region of self-pulsations for different values of the reflection coefficient of the back facet of the laser is obtained. The higher reflectivity implies the wide self-pulsation region. Finally, we calculated the lines of the same frequency in the plane of laser length – injected current. We also report the regions of pulsations with higher frequency.

S1-2.2
Parametric Anomaly of the Phonon Spectrum of a Thin Free-Standing Membrane

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We consider modification of the acoustic Rayleigh-Lamb phonon spectrum in a thin homogeneous membrane upon variation of parameters characterizing the medium. It is emphasized that single-valued parametric dependence of the frequency-wavenumber spectrum is related to the performance of acoustic sensing applications and a single layer membrane has been known to fully support this requirement. To capture the behavior in the full three-dimensional parametric space of the considered basic structure we analyze the solutions in terms of variables scaled with material parameters. The main finding is that not all the branches of the spectrum demonstrate the regular monotonic evolution in the parametric space (e.g., an increase of the bulk velocity is associated with an increase of the phonon eigenfrequencies). Thus, the resonance frequencies of a whole range of phonon modes are shown to *decrease* if the bulk velocity of the propagation medium is increased. It is noteworthy that the respective anomalous branches, S1 and A2, are the ones which show the strongest dispersion anomalies, like zero group velocity and backward wave propagation. However, the anomalous parametric variation of the spectrum is located in the region of shorter wavelengths than the dispersion anomaly of the same branches. So that the “abnormal” parametric behavior is observed for the modes on the S1 and A2 branches which a have a “normal”, i.e., positive group velocity.

S1-2.3

Photoluminescence and Cathodoluminescence of Layered $ZnIn_2S_4$ and $Zn_2In_2S_5$ Compounds Thermally Processed in Sulfur Vapor and Vacuum

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The phenomena of nonradiative recombination have been investigated for various semiconductors of the family of $Zn_xIn_2S_{3+x}$ (x=1, 2, 3) compounds that exhibit photoluminescence in a wide energy range. These properties are promising for a vast range of applications in various branches of engineering. The luminescent properties of the layered compounds were investigated under the action of accelerated electrons – cathodoluminescence - and X-ray radiation. The experimental results of investigations conducted on the luminescent properties of layered compounds $ZnIn_2S_4$ (three-packet polytype III), $Zn_2In_2S_6$ (III), and $Zn_3In_2S_6$ (I) are presented. Processing of layered compounds of the $Zn_xIn_2S_{3+x}$ (x=1, 2, 3) family in sulfur vapor leads to the displacement of the photoluminescence emission maximum to the low energy region, and the thermal processing in vacuum shifts it towards the high energy range. The obtained results show that it is possible to change the limits of the spectral range of light radiation from 1.36 to 2.71 eV. The calculation of the excitation rate on the material's surface and in its volume (R_s and R_v) under the action of accelerated electrons and X-ray radiation, a high level of excitation energies and excitation current allow one to specify the structure and nature of the energy levels in the forbidden energy band. The basic bands in the luminescent emission spectrum of zinc and indium bisulfides $Zn_xIn_2S_{3+x}$ (x=1, 2, 3): a red band with the maximum at 1.79 eV, an orange band with the maximum of 2.08 eV, and a yellow-green band with a maximum at 2.34 eV were identified.

S1-2.4

Synthesis Technology for CdSe/CdTe Heterojunctions and Characterization of their Photoelectric Properties

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This paper presents the results of studying the photoelectric properties of CdSe/CdTe heterojunctions synthesized by the hot-wall epitaxy method. The CdSe/CdTe heterojunctions were manufactured by consecutive growth of CdSe and CdTe layers on a conductive ITO/glass substrate purchased from Solaronix Swiss. As ohmic contact for CdTe, Ni was deposited by thermal evaporation. The CdSe layer thickness (1–3 μm) was controlled according to the time of deposition of the layer. The temperature of the substrate and the source for CdTe growing were 400 °C and 520 °C, respectively and reached the thickness 15 μm. The synthesis process for heterojunctions with CdTe layers includes the treatment of the entire structure in a $CdCl_2$ solution, followed by annealing in air at a temperature of 450 °C for 30 min. Upon the deposition of CdTe layer, due to the diffusion of Se into the growing CdTe film, a transition layer of the $CdSe_xTe_{1-x}$ solid solution is formed at the interface, evidenced by the spectral dependence of the photocurrent. The investigation of the current-voltage characteristics at different intensity of illuminations shown that nonideality factor *n* has a value of 1.7- 2.0, which indicate a generation-recombination mechanism of current in the CdSe/CdTe heterojunctions. The best photovoltaic parameters for CdSe/CdTe heterojunctions were achieved for structures with thicker CdSe layer and are as follows: J_{SC} = 24.6 mA/cm^2, U_{OC} = 730 mV, FF = 0.5, η = 7.6%.

S1-2.5

ZnO Microtetrapods Covered by Au Nanodots as a Platform for the Preparation of Complex Micro-nano-structures

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We propose to use hybrid networks of ZnO microtetrapods produced by flame transport synthesis and Au nanodots deposited by pulsed electroplating, for the preparation of more complex 3D micro-nano-structures via Au catalyst-assisted vapor-liquid-solid growth of semiconductor nanowires on the surface of ZnO microtetrapod arms. The pulsed electrochemical deposition of Au nanodots with optimized pulse parameters was realized in pressed pellets containing the ZnO tetrapods with the density 1 g cm^{-3}. The mechanical stability was increased by means of thermal treatment of pressed hybrid networks of ZnO microtetrapods at 950 °C for 1 h. The morphology of the ZnO microtetrapod networks and the density of the deposited Au nanodots were investigated by scanning electron microscopy. The deposition of Au nanodots with various densities and of monolayers of self-assembled nanodots was demonstrated on ZnO microtetrapods possessing different conductivities. The optical quality of the ZnO microtetrapods was investigated by photoluminescence (PL) spectroscopy in the temperature interval from 10 to 300 K. PL bands related to neutral donor bound excitons D^0X and donor–acceptor pairs (DAP) recombination were observed at low temperature. We assume that the presence in the spectrum of PL bands related to excitonic radiation is indicative of a high enough quality of the investigated ZnO microtetrapods for various optoelectronic and photonic applications.

S1-2.6

Illumination-Dependent Photovoltaic Parameters of CdS/ZnTe Solar Cells

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This paper focuses on the influence of the illumination of CdS/ZnTe solar cells with different ZnTe thin film thicknesses. The devices were analyzed through current-voltage measurements. The values of the open circuit voltage (V_{OC}) and the short circuit current density (J_{SC}) depend on the substrate and source temperatures. The J_{SC} is observed to decrease from 224 μA/cm2 to 95 μA/cm^2 with increasing the source temperature from 560 °C to 600 °C, while the V_{OC} increases from 0.41 V to 0.54 V, respectively. The value of V_{OC} increasing from 0.68 V to 0.76 V, but J_{SC} decreasing from 760 μA/cm^2 to 500 μA/cm^2, when ZnTe thin film thickness increasing. Besides, the impact of the light intensity on the photovoltaic parameters of the CdS/ZnTe solar cells with different ZnTe thin film thicknesses was analyzed. The increasing in the light intensity from 20 mW/cm^2 to 100 mW/cm^2 rise the V_{OC} from 0.67 V to 0.76 V tending further to saturation. Regardless of ZnTe thin film thickness, η increases logarithmically with the light intensity, but for the *Jsc* is observed linear dependence. The R_s increases with the increasing ZnTe thin film thickness, but decreases with the increasing of light intensity. Also, the R_{sh}, changes under changing the ZnTe thickness and the light intensity.

S1-2.7

Fine Dispersion and Intensification of Heat Transfer at Boiling in Electric Field on the Modified Surfaces

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The research tasks were formulated on the basis of scientific and applied aspects of engineering thermophysics and bioengineering. In the first part of the work the results of experimental study of heat transfer at boiling of a dielectric liquid in electric field on the modified surfaces are presented The surfaces are received using the electric spark alloying. The experimental conditions and the results of investigation of the influence of field strength, interelectrode distance and the specifics of heat supply are described. The maximum influence of the field is observed for an underdeveloped boiling regime, where the relative heat transfer coefficient increases with increasing of field strength and decreases with increasing of heat flux density. The optimal interelectrode distance is determined, at which the effects of heat transfer intensification under the influence of the field are most pronounced. The heat exchange has been intensified up to 6 times, compared with boiling in the absence of a field. In the area of developed bubble boiling, the field effect weakens and, depending on the experimental conditions, may even become negative. The influence of the electric field on the hydrodynamics of the vaporization process is discussed. In the second part of the work, on the basis of visual observations and high-speed filming, the features of generating of steam bubbles and the mechanism of microdispersion of a dielectric liquid under the influence of an electric field are analyzed. The regime parameters have been established at which the splitting of steam jets, the formation of a cloud of finely dispersed charged bubbles, and the behavior of micro– and nanofilms on the heat exchange surface are observed. The importance of determining of the number of vaporization centers, tear-off diameters and the frequency of bubble separation, the possibility of using microbial bio-coatings for the degree of cooling and thermostating under controlled exposure to an electric field is emphasized. The obtained results can be used in calculations of the intensity of electroconvective heat exchange during boiling of weakly conducting heat carriers.

S1-2.8

The Water-Soluble Zinc Phthalocyanine Substituted with Sulfur-Containing Groups

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In this paper we describe [phthalocyaninato]zinc octakis (methylene isothiuronium) chloride and [phthalocyannato]zinc octamethanethiol having as the starting substance octakis(cloromethyl) phthalocyanine zinc obtained by chloromethylation reaction of zinc phthalocyanine. The structures of the synthesized compounds were characterized by elemental analysis, FTIR and ^{1}H-NMR spectroscopies. The UV–Vis spectra of mentioned compounds depend on its concentration and generally present, a wavelength region with – the *B* band situated at approx. 300–400 nm and the *Q* band at approx. 600–800 nm. The UV–Vis spectra of [phthalocyaninato]zinc oktakis (methylene isothiuronium) chloride presented a broader *Q*-band in water solution with a shoulder on the red side. It is noticeable, the disappearance of *Q* peak splitting, with a slight hypsochromic shift at 639 nm, characteristic of the α-form of aggregation. Laser flash photolysis has been used to characterize the triplet state of [phthalocyaninato]zinc oktakis (methylene isothiuronium) chloride compound in dilute DMSO: H_2O, NVP: H_2O and H_2O solutions. The fluorescence decay curves for [phthalocyaninato]zinc oktakis (methylene isothiuronium) chloride at the interval of excitation wavelengths (λ_{exc}= 341…703 nm) show a biexponential behavior with lifetime values being yielded 2.31 μs and 1.23 μs in DMSO: H_2O, 1.22 μs and 9.22 μs in NVP: $9H_2O$ solvents. The decay curve of

phosphorescence of [phthalocyaninato]zinc oktakis (methylene isothiuronium) chloride in H_2O are multi-exponential and are represented by the relatively long triplet lifetimes of 1.09 μs, 4.96 μs and 15.23 μs. The triplet lifetime and triplet quantum yield values of [phthalocyannato]zinc octamethanethiol in DMSO: H_2O are lower than of [phthalocyaninato]zinc octakis (methylene isothiuronium) chloride compound.

S1-2.9

Patterning Nanoelectronic Devices using Field Emission Scanning Electron Microscope

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Many advances in fabrication processes at micro and nanoscale in the past two decades were possible due to scanning electron microscopy, which is now an indispensable tool for analyzing and fabricating new nanostructures and nanomaterials. The development of very efficient in-lens detectors for SEM and the capability to use low energy electron probes are the gateway to the revelation of new features and new properties of nanomaterials that have been hidden by the use of high accelerating voltages and large interaction of volume, in the high-resolution SEM. Electron beams have been used for lithography for decades and pattern generators can be fitted to all modern SEMs, converting them in very powerful nanolithographic tools, without degrading or limiting their imaging capabilities. The SEM became a very versatile tool for micro and nanofabrication, the same equipment used for fabrication being used to view the resulting nanostructures.

Electron Beam Lithography (EBL) is one of the highest resolution lithographic technologies and a key technique for fabrication of nanoelectronic devices, allowing direct patterning of structures with critical dimensions down to 10nm [1]. Apart of resolution, a very important point of EBL is that it can be easily implemented in a research laboratory by converting a scanning electron microscope (SEM) for lithography with an external pattern generator. To illustrate the patterning capabilities of electron microscopy, in this review we describe the EBL based fabrication processes of some nano-devices like field effect transistors on graphene and other 2D materials.

S1-2.10

Quantum Oscillations in Topological Insulator Bi_2Te_2Se Microwires Contacted with Superconducting In_2Bi Leads

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We studied the magnetoresistance (MR) of polycrystal Bi_2Te_2Se topological insulator (TI) microwires contacted with superconducting In_2Bi leads. Bi_2Te_2Se has a simple band structure with a single Dirac cone on the surface and a large non-trivial bulk gap of 300 meV. To study the TI/SC interface, the Bi_2Te_2Se glass-coated microwire with a diameter of d = 17 μm was connected to copper leads on one side using superconducting alloy In_2Bi (T_c=5.6 K), and on the other side using gallium. The topologically nontrivial 3D superconductor (SC) In_2Bi has proximity-induced superconductivity of topological surface states. To eliminate conventional contribution to superconductivity from the bulk, the resulting edge states of the TI/SC contact area were studied in magnetic fields above H_{c2} in In_2Bi. The *h/2e* oscillations of magnetoresistance (MR) in longitudinal and transverse magnetic fields (up to 1 T) at the TI/SC interface were observed at various temperatures (4.2 k–1.5 K). To explain the observed oscillations, we used magnetic flux quantization, which requires a multiply connected geometry where flux can penetrate into normal regions surrounded by a superconductor. The effective width of the closed superconducting area of the TI/SC interface is determined to be 15 nm from an analysis of FFT spectra and the beats of the MR oscillations for two different directions of magnetic field.

YIC-2.S1

Characterization of Films Prepared by Aerosol Spray Deposition in the $(MgO)_x(In_2O_3)_{(1-x)}$ System

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In this paper nanostructured thin films with thickness of 150 nm have been prepared by aerosol deposition method on p-Si in the system $(MgO)_x(In_2O_3)_{(1-x)}$ with the composition range x = 0.2, 0.4 and 0.6, using indium chloride and magnesium chloride as precursors. The produced films were investigated by scanning electron microscopy (SEM) and atomic force microscopy (AFM) to determine the morphology and roughness, energy dispersive X-ray (EDX) analysis for the chemical composition estimation, and X-ray diffraction (XRD) for establishing the structural and crystallographic phases. It was found that the nano-crystallites sizes grow with increasing the Mg content, therefore influencing the roughness of the films. The film surface roughness calculated from topographic AFM images is in the RMS range from 5.7 to 7.5 nm with increasing Mg concentration, but the value of the Coefficient of Kurtosis parameter is from 0.18 to 0.64. The evolution of the crystalline phases content with increasing the x value from 0.2 to 0.6 was established. The electrical and photoelectrical properties were studied by I-V characterization under the illumination with the light with the wavelength of 365 nm. It was shown that the films are sensitive to this radiation with the ratio of the photocurrent to the dark current from 5 to 7 at the excitation density of 2.4 mW/cm^{-2}.

YIC-3.S1

A Nanosized Heteronuclear $\{Fe_{18}Tb_6\}$ Coordination Wheel Based on Pivalate and Triethanolamine Ligands

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Ring-like systems assembled from metal ions and organic ligands attract attention due to variety of their useful properties and aesthetic beauty of their structure. A new nanosized heteronuclear $[Fe_{18}Tb_6(piv)_{12}(tea)_6(Htea)_{18}(N_3)_6] \cdot n$(solvent) (**1**) (where Hpiv = pivalic acid) wheel-shaped cluster was synthesized by reacting of oxo-linked trinuclear Fe(III) pivalate precursors and terbium(III) nitrate with triethanolamine (H_3tea) and sodium azide in the mixture of ethanol and acetonitrile under ultrasonic irradiation. Cluster **1** was characterized by elemental analysis and IR-spectroscopy. Single-crystal X-ray diffraction analysis shows that 18 iron(III) and 6 terbium(III) ions in **1** define a ring and are linked by 6 bridging pivalate and 24 triethanolamine ligands. Additionally, six pivalates and six azides completed the coordination sphere of the metal atoms in **1**. In the resulting wheel core, three iron(III) and one terbium(III) ions generate six repeated $\{Fe_3Tb\}$ sequential fragments along the ring. The outer diameter of the $\{Fe_{18}Tb_6\}$ wheel is ca. 3.5 nm, the inner diameter is ca. 1.0 nm, and the thickness of this molecular wheel is ca. 1.3 nm. In the crystal structure, the packing of bulky wheel-shaped clusters results in the formation of infinite channels fulfil with solvent molecules. Upon removal of solvent molecules this structure reveals a huge total potential solvent accessible volume of ca. 26% per unit cell volume.

YIC-12.S1

Photodetector Based on β-Ga_2O_3 Nanowires on GaS_xSe_{1-X} Solid Solution Substrate

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The detection of radiation in the ultraviolet C (UVC) region (100-280 nm) is of great importance for numerous technical applications, such as fire detection in security devices, tracking astronomical missile trajectories, chemical-biological analyses, and medicinal applications. Wide bandgap semiconductors have emerged as ideal materials for electronic devices operating in this spectral range. Among the various promising materials, β-Ga_2O_3, a gallium oxide with a monoclinic crystal lattice, has garnered significant attention along with $Al_xGa_{1-x}N$, AlN, and BN. While thin layers of $Al_xGa_{1-x}N$ suffer from structural instability, AlN exhibits photosensitivity to radiation with wavelengths shorter than 215 nm. On the other hand, cubic BN possesses an absorption band fundamental in the UV-vacuum region ($\lambda \leq 195$ nm). Notably, β-Ga_2O_3, with its direct *n*-type energy bands and a bandgap of 4.5-4.9 eV, demonstrates high photosensitivity in the UVC range, making it an excellent material for photoreceptors in the 220-280 nm range. In this study, we investigate the elemental chemical composition, absorption band edge, vibrational and photoresponsive properties of β-Ga_2O_3 nano-wire/nano-ribbon assemblies on a substrate of monocrystalline lamellae from GaS_xSe_{1-x} solid solutions (x=0.17). The nano-wire assemblies were grown using thermal oxidation of gallium compound semiconductors at temperatures ranging from 750 to 950 °C in an oxygen or water vapor-enriched atmosphere. Our findings provide valuable insights into the potential of β-Ga_2O_3 nanostructures as efficient photoreceptors for UVC radiation detection.

S1-P1

Trends in Evolution of the Energy Band Structure of Chalcopyrite $CuB^{III}X^{VI}_2$ Compounds with Variation of the B and X Compositions

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Bulk and nanostructured $A^IB^{III}X^{VI}_2$ chalcopyrite materials, including quantum dots on their basis, are widely used in the development of optical filters, solar cells, optoelectronic devices and photocatalysis. Physical properties of both bulk and nanostructured chalcopyrite compounds are determined by their energy band structure. The optical spectroscopy is one of the powerful and nondestructive method for determination of physical properties. This paper presents results of investigation of optical reflectance spectra of $CuB^{III}X^{VI}_2$ compounds with B = Al, Ga, and In, and X = S and Se, performed in a wide spectral range from 1.7 eV to 7.5 eV. The measured spectral position of peaks in the reflectance spectra are assigned to electronic transitions in different points of the Brillouin zone, on the basis of the electronic band structures of these materials deduced from theoretical calculation performed in previous works. Trends in the evolution of the energy band structure with changing the composition of materials have been revealed, which are important for practical applications. Apart from that, the observed trends in the evolution of the energy band structure of chalcopyrite $CuB^{III}X^{VI}_2$ compounds with variation of their composition are helpful for a right assignment of the observed peaks in the reflectance spectra to respective electronic transitions in various points of the Brillouin zone.

S1-P2

Flexible Cellulosic Matrices for Proton Exchange Membranes Fabrication

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Fuel cells are the subject of a global research due to the increasing demand for energy supplies, they enabling direct conversion of chemical energy into electrical energy with high efficiencies and low emissions. The proton exchange membrane (PEM) is a crucial component for fuel cell performance, and Nafion is most used PEM. Even Nafion is chemically and mechanically stable, it is expensive and is only effective (high proton conductivity) in conditions of high humidity and temperature bellow 90 °C. Researchers are concentrating on the development of novel conducting materials that can operate at temperatures exceeding 100 °C under low humidity. To achieve this objective, novel strategies have been implemented: *i)* substitution of Nafion with a natural, renewable, and pervasive polymer – cellulose; and *ii)* substitution of water with heterocyclic compounds (imidazole, 1-hydroxybenzotriazole) as conductive dopants, which assures high conductivity at temperatures >100 °C. Among cellulose derivatives, cellulose acetate is one of the most handy and cheap derivatives and offers an easy possibility of regenerating cellulose by alkaline hydrolysis. In this study, our aim is to have a complete picture of the proton conductivity of three types of cellulose matrices, in the form of films (cellulose acetate, regenerated cellulose and TEMPO-oxidized cellulose) doped with different amounts of 1-hydroxybenzotriazole, in correlation with the specific surface morphology (AFM, SEM) crystallinity and structural changes (FTIR, XRD) of the films.

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S1-P3

Optical Properties and Photoinduced Anisotropy of PEPC-*co*-SY3 Nanocomposite

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In the present work, the optical properties of the PEPC-*co*-SY3 nanocomposite doped with gold nanoparticles are brought to light. The samples were prepared with 3 different concentrations of Au as well as a control sample of undoped azopolymer. Thin films were studied with UV/Vis and polarimetric spectroscopy. The paper' results show bandgap shifts depending on the concentration of gold nanoparticles.

At the same time, the analysis of the spectral dependence of the transmittance, the reflectance, the absorption coefficient as well as the refractive index, indicates a proportional dependence of these parameters on the nanoparticle concentration. It was found that the band gap narrows with increasing concentration of nanoparticles, it decrease from E*g* = 2.38 eV for undoped azopolymer to 2.3 eV for azopolymer with a concentration of nanoparticles C = 0.001 mg/ml.The angular dependences of the azimuth and ellipticity of probe beam are also analyzed, which indicates the appearance of the polymer chirality change. Also, from the study of the spectral properties of azopolymer films and azopolymer nanocomposites, a change in the values of the spectral dependence of the refractive index was revealed, which was calculated taking into account the reflection spectrum, which has more pronounced interference peaks which leaves its mark on the refractive index spectra, and the dependence refractive index on the concentration of nanoparticles.

S1-P4

Synthesis and Physicochemical Characterization of Surface-functionalized ZnO Nanoparticles

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Environmental pollution is one of the biggest issues facing society today. For the removal of harmful pollutants various methods have been proposed, among which heterogeneous photocatalysis is recognised as an effective methods for removing contaminants because it allows for the mineralization of pollutants to CO_2 and H_2O, prevents secondary pollution, and operates in mild ambient conditions. Furthermore, the method's advantages are enhanced if visible light from the solar spectrum is used in the oxidation of organic contaminants. Literature data report numerous photocatalyst from metal-oxide semiconductors category (TiO_2, ZnO, CeO_2) appreciated for their low cost and easy availability, among which ZnO nanomaterials demonstrated exceptional chemical and physical properties, including chemical and thermal stability, nontoxicity, and cost effectiveness.

The effect of synthesis parameters on the dimensions and morphology of ZnO NPs will be studied in this work, together with their methodical characterization for the assessment of their structural, morphological and optical characteristics. Zinc oxide nanoparticles were synthesized via chemical precipitation method by employing different reaction precursors and experimental conditions, in order to conveniently tune the band gap energy values of the prepared samples. Further, the as-prepared nanoparticles will be surface modified with silane derivatives for subsequent integration in polymeric supports, with the goal of avoiding nanoparticles agglomeration, translating photocatalytic activity towards visible light, and facilitating catalyst reusability/recovery after photocatalytic cycles.

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S1-P5

Effect of Particle Size and Roughness on Contact Angle of ZnTe Thin Films

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Zinc telluride (ZnTe) thin films were prepared by close space sublimation method, and their detailed structural properties and wettability characterization were performed. The XRD analysis of all ZnTe thin films revealed the cubic structure, F-43m space group, regardless of the substrate and source temperatures. The vary of the substrate temperature with 10 °C in the interval (320-360) °C, lead to insignificant changes in the value of the crystallite size, from 32 nm to 27 nm. The same trend is also kept by changing the source temperature. The SEM analysis showed changes in the particle size that is directly related to the substrate/source temperatures. The tendency of the contact angle to increase with the increasing in the substrate and source temperatures of the ZnTe was also observed. The same behavior was revealed for the roughness deducted from the AFM measurements and shown that increasing RMS roughness enlarges the surface area, potentially enhancing the hydrophobicity of ZnTe thin films. The contact angle method shows that hydrophobicity of ZnTe thin films is well tailored by changing the substrate and the source temperatures. The increasing of the hydrophobic properties may lead to the increase of the self-cleaning properties of the solar cells elaborated on the basis of ZnTe thin films.

S1-P6

Controlling Hydrophobic/Hydrophilic Properties of ZnO Microtetrapods Structures by Means of Thermal Treatment

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We report on possibilities to convert, by means of thermal treatment, the wettability properties of networks consisting of ZnO microtetrapods from hydrophobic to super-hydrophilic. The ZnO microtetrapods were produced by flame transport synthesis. The ZnO powder containing the ZnO tetrapods were pressed in pellets with the density of 1 g cm^{-3} using a compression mold. The comparative study was performed on two set of samples, and namely: the as-grown ZnO tetrapods pressed in pellets and the annealed pellets. The wettability conversion proved to be an irreversible process for a long period. As a result, the thermal treatment process not only increase the mechanical stability of the ZnO pellets but also essentially increase the hydrophilic behavior of ZnO tetrapods, which is a very important issue for further chemical or electrochemical functionalization. Apart from wettability characteristics investigated by Water Contact Angle (WCA) measurements, the structural and optical properties were investigated by X-ray diffraction (XRD) and photoluminescence (PL) techniques, respectively. The XRD patterns revealed the hexagonal wurtzite structure and a high structural quality of both as-grown samples and annealed networks of microtetrapods at 950 °C. Their high quality was also confirmed by the presence of PL bands related to exciton recombination in the emission spectrum. The possible nature of other PL bands, especially green emission band attributed to specific recombination channels and their evolution with thermal treatment are discussed.

S1-P7

Technological Features of Creating Hole Structures on The Base of MoS_2 and The Electrochemical Behavior of MXene/Holey MoS_2 Hybrids in Oxygen Reduction Reactions

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High-performance noble metal-free two-dimensional (2D) electrochemical catalysts have gained great importance to replace the Pt-based catalysts in oxygen reduction reactions (ORR) to reduce not only the cost of the fuel cells but also enhance the energy efficiency. Herein, we designed a novel ORR catalyst by forming MXene/holey MoS_2 hybrids. The holes were created on the basal plane of MoS_2 both to create electroactive defective regions and enhance the diffusion of the reactants in the catalyst layer. Holey 2D MoS_2 layers were characterized using transmission electron microscopy (TEM), UV-ViS spectroscopy, scanning electron microscope (SEM), and Raman spectroscopy. The TEM images indicated the formation of nano-holes on the basal plane of MoS_2. The increased defect concentration was revealed from the Raman spectra of the samples. The successful synthesis of the V_2C MXene layers was confirmed using SEM and EDS results. The holes created on the basal plane of 2D MoS_2 boosted the electrochemical ORR performance compared to the pristine 2D counterparts, which is attributed to the defect-rich active sites on the edge of the holes and enhanced diffusion of the reactants. In conclusion, our designed MXene/holey MoS_2 hybrid catalyst exhibits superior electrochemical performance in ORR, offering a promising approach for the development of cost-effective and efficient catalysts for fuel cell applications.

SECTION S2
New Technologies for Diagnosis, Treatment, and Rehabilitation, Personalized Approaches in Medicine

S2-1.1

Role of Botulinum Toxin a Injections as a Salvage Therapy for Refractory Overactive Bladder: Insights from Urodynamic Studies

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The aim of study was to establish the role of botulinum toxin A (BTX-A) in the treatment of refractory idiopathic overactive bladder (OAB) patients and to find out if urodynamic values could predict the positive third line treatment response. Many clinicians use UDS to diagnose DO before detrusor injection treatment. According to NICE Guide it is mandatory to investigate „urodynamics” to confirm the diagnosis of DO before performing minimally invasive treatment such as BTX-A injections. Was obtained clinical data based on the necessity of performing urodynamic tests before BTX-A injection, at patients with idiopathic refractory OAB, ensuring effectiveness and long-lasting treatment, as well as providing predictive parameters for potential postoperative complications. A retrospective study was performed on 30 patients with OAB symptoms who followed first line therapy for 4 months, without any positive results. The study was performed during 2021-2022, at the Department of Urology, ”Nicolae Testemitanu” USMF, Republic of Moldova. After 6 weeks of intravesical BTX-A injection, was demonstrated significant reductions in frequency, nocturia and quality of life compared to baseline. This study identified several urodynamic variables that are directly associated with clinical data, influencing the severity of symptoms in patients with refractory idiopathic OAB and the effectiveness of BTX-A injection as a treatment option, especially when it is a urodynamic confirmation of DO. The administration of 100 U of BTX-A through detrusor injection has been shown to be efficacious in the management of OAB with DO confirmed on urodynamic, in patients that are unresponsive to second line therapy.

S2-1.2

Assessing the Impact of Parental Labor Migration on Children's Health

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In the Republic of Moldova, the phenomenon of children separated from one or both parents who went abroad to work has reached one of the highest levels in Europe. A total of 36,817 children were affected by parental labor migration in 2019, and 29,186 children in 2020. In order to define the quality of life of migrants' children, there were researched different aspects of their lives. As the instrument for given research there was used the Pediatric Quality of Life Inventory (PedsQL™4.0) questionnaire. The research sample comprised 280 people, which was divided into 4 groups: group I-70 children affected by parental labor migration, group II-70 children without parental labor migration experience, group III-70 parents/guardians of children affected by parental labor migration, group IV-70 parents/guardians of children without parental labor migration experience. Scientific arguments were made in the study supporting an innovative methodology for assessing children's quality of life - the Pediatric Quality of Life Inventory (PedsQL™ 4.0) questionnaire, which facilitated the assessment of patients' health affected by parental labor migration. The study showed that the Total Score of the Quality of Life of the patients ranged from 56.01 ± 12.75 points at the age of 5-7 years and 46.77 ± 11.09 points in adolescents aged 13-18 years, the figures being significantly lower compared to patients not affected by migration ($p = 0.000$).

S2-1.3

The Implementation of Personalized Medicine in the Republic of Moldova: Challenges and Opportunities in Cardiology

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Implementing Personalized Medicine in the operational and functional context of a healthcare system is a complex challenge for most countries. Pharmacogenetics represents the application domain of individual genetic profile testing for drug prescription purposes. Health insurance systems are the mechanism by which drug treatment expenses can be covered. Doctors prescribe treatments based on a patient's clinical evaluation, according to the results of clinical studies that demonstrated the efficacy and low risk of adverse reactions of a particular drug tested on a clearly defined group of patients. Historically, most of these studies missed the assessment of individual capacity to metabolize drugs through xenobiotic transformation pathways. Proteins involved in transforming drug's chemical forms have yet to be well known, and studying their activity mechanisms is complex from a methodological point of view. Structural changes in the genes coding these proteins demonstrated an association with drug metabolism capacity, as revealed by GWAS studies for some populations. Inequality in sample collection and access limited the representativeness of many populations, with statistical significance levels being reached only for some of them. Validation of GWAS associations would allow their application in pharmacogenetic testing services in an evidence-based manner. This study represents a survey of the current opportunities to implement recommended genetic testing for the drugs used in CVD treatment compensated for the population by the National Health Insurance Company in the Republic of Moldova.

S2-1.4

Non Conventional Methods in Visual Function Training for Children with Sight Disabilities

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The paper presents a new unconventional method, complementary to the classic ones, by which, through the tablet or laptop, children with different visual impairments can be assisted in the recovery process through assisted visual training. It consists in the repeated testing, through virtual and alternative games, of several aspects - key specific to the visual function, aspects correlated with the main types of pathologies that can occur during childhood. In the first part, the development is presented, through the design, programming and testing of a software interface that was the basis for the development of training through an alternative virtual game. There are presented several steps for the software interface designing and programming. After that, the researches focused on software interface testing, meaning verifying the correct score reported to the test solving and also improving the necessary time required for tests solving.

In the second part, it is exemplified how the visual training procedure through the virtual game was applied in complementarity with other classical and non-conventional training procedures, for some concrete cases. As a conclusion, it was found that the method, an accessible one, was, on the one hand, accepted by children, parents, optometrists and educators. On the other hand, the proposed method proved quite effective for the period when the alternative training procedure was applied for the children in question, the test results continuously improving. In the paper is presented just the first step in terms of applying the developed method for visual screening or training activities.

S2-1.5

Thiol-Disulfide Homeostasis in Kidney Tumors in Children

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Renal tumors in children occupy the 4th place, succumbing to hemoblastomas, tumors of the central nervous system and lymphomas, and constitute 5.5 – 7.0% of all malignant tumors in children. Emphasis on the severity of renal tumors and identification of the most appropriate means of diagnosis and treatment of children`s kidney tumors. The study was conducted on a group of 11 patients, aged between 2 and 10 years, with renal tumors treated in Natalia Gheorghiu Institute of Mother and Child, National Scientific-practical center of Pediatric Surgery, urology department and IMSP Oncology Institute, oncopediatrics Department. The clinical examination attested paleness and dark shade of the integuments, asymmetry of the abdomen with enlargement in the hypochondrium and the respective flank - tumor formation with lumbar contact. Ultrasound of the urinary system indicated renal tumors in all 11 patients, being confirmed by computed tomography and magnetic-nuclear resonance. In six patients, the tumor was large and required first polychemotherapy treatment, then surgical treatment to remove the renal tumor. After a preoperative preparation with hemostatic preparations, surgical intervention was used to remove the affected kidney on the left in 10 patients. A biopsy of the left kidney tumor was performed in a child with bilateral renal tumor process. Screening of children in the risk group managed by the family doctor would allow early diagnosis in time and in detail to appreciate any pathological changes.

S2-1.6

Modern Methods for Identification and Reduction of Visual Problems in Children

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The paper presents a stage of research done in order to help optometrists in the pediatric field. This stage of the research focused in particular on the development of a new solution regarding, first of all, the screening identification of certain visual problems among preschool children. The method proposed for the visual screening is an unconventional and up-to-date one, taking into account the great attraction of the little ones for tablet or mobile phone games. For this purpose, the paper presents how a software interface dedicated to a practical and rapid assessment of visual function in children in screening activities in kindergartens was designed, programmed, tested and used. The software application was designed to be flexible, useful for optometrists or ophthalmologists, as well as for school or preschool children. Concretely, with this method it was proposed that, through a virtual game, the visual function of children can be tested objectively and efficiently, by evaluating the recognition of the size, shape and color of attractive graphic entities. The evaluation procedure specific to the developed interface refers primarily to fundamental aspects related to the visual function, namely the recognition of shape, colors and the appreciation of sizes. The proposed method could be successfully applied in a rapid screening procedure in a group of 10 children, from a kindergarten group, whose parents gave their consent for the testing of their children.

S2-1.7

Method for Increasing the Production or Activity of Catalase in the Body

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The aim of this study is to develop a new, more sensitive and accurate method for the induction and/or activation of catalase (CAT) in the body. The proposed goal is achieved by using bromo-2-{[2-(prop-2-en-1-ylcarbamothioyl)-hydrazinylidene]methyl}phenolatocopper – a coordinating compound from the class of thiosemicarbazidates of transition metals, which expands the arsenal of synthetic compounds with high CAT induction and/or activation activity. The synthesis method of this compound and its structural formula are described. It was established that this compound exhibits the highest induction and/or activation of catalase, which exceeded 2.7 the values of the control group and 1.8 the values produced by vitamin D3 (prototype). This indicates the existence of an excessive synthesis of catalase after exposure to this compound, a particularly important fact established by us for the first time.

This compound can be used in medicine as a therapeutic agent, which, by activating the important production of catalase in the body, can prevent and/or reduce the occurrence of neurodegenerative, renal, cardiovascular pathologies, atherosclerosis and carcinogenesis, inflammatory processes, the development of cellular and tissue damage, associated with excessive accumulation of hydrogen peroxide.

The obtained data mark a beginning that opens the perspectives of developments, which will diversify the arsenal of effective tools to combat various severe pathological processes.

S2-1.8

Diagnosing Pulmonary Embolism with Computed Tomography Pulmonary Angiography

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Pulmonary embolism (PE) is the third most common cause of cardiovascular mortality after myocardial infarction and stroke. Incidence rates range from 53 to 162 per 100 000 inhabitants. The CTPA is reported as the standard of care for the evaluation of patients with suspected pulmonary embolism. The aim of study was to assess the diagnostic performance of CTPA for finding of PE on contrast-enhanced chest CT investigations. We included in the study 70 patients (mean age 63.2 ± 14.5 years; 18 women, 35 men) with a high clinical probability of PE, who were hospitalized in „Sfinta Treime" Hospital an subjected to the investigation of CTPA with contrast Ultravist 370. The diagnosis of PE was based on National clinical protocol criteria and was confirmed in 55 (79%). The clinical presentation of patients ranged from sudden breathlessness (98,18%) to sudden cardiac arrest in 3 cases and the most frequent symptoms was pleuritic chest pain (76.36%) and less – hemoptysis (23.46%). The filling defects were determined on CTPA at the level of the: pulmonary trunk– in 7.2%, bilateral left main pulmonary artery (PA) and right main PA – in 36,3 %, left main PA – in 16.3%, right PA (mainly in the lumen of the distal portion) – in 32.7%, left PA (distal portion) – in 20.0%, bilateral at the level of lobar/segmental/subsegmental PA – in 89.0%, right PA increased diameter - in 76.4%. Conclusion: computed tomography pulmonary angiography diagnostic performance in pulmonary embolism is high and useful in cases of suspected PE, because it can confirm the diagnosis and reveal findings consistent with differential diagnosis.

S2-1.9

Improvement of Cardiovascular System Diseases Diagnostics by Using Multiparametric Data

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The most common cause of death among humans is cardiovascular disease. An effective way to detect early signs of cardiovascular disease is to constantly monitor the patient's critical physiological parameters during their daily activities using a wearable device. Most of these wearable devices available on the market can only register one or two types of biosignals, which are processed independently. On the one hand, these data obtained in this way are sufficient to see some changes in the cardiovascular system, but on the other hand, this type of device is bulky and uncomfortable to wear for a long time. One of the most promising methods for studying the cardiovascular system today is the use of multiparametric data, namely the combination of ECG and PPG data. Multivariable data is already used today for continuous non-invasive (cuffless) blood pressure measurement. However, the use of this type of data for a more complete analysis of the cardiovascular system is possible only at the initial stage of the study. The authors proposed a method that allows, due to the continuous processing of EGC and PPG data strictly synchronized in time, obtained from a wearable device, to assess the general state of the cardiovascular system and the risk of its disorders. Physionet data were used for verification. As part of the implementation of the device, a prototype of a wearable analyzer of the cardiovascular system was created and the first results were obtained.

S2-1.10

Combined and Complex Treatment-optimal Therapies in Rectal Cancer

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Despite advances in medicine and national screening there is a continuous increase in the incidence of rectal cancer. Surgical treatment remained the mainstay of treatment, but neoadjuvant therapy has demonstrated in recent years favorable results to obtain R0 resection margins and 70% remission of rectal cancer at 5 years. Oligosymptomatic oncet, varied spectrum, and specific character of clinical manifestations of rectal cancer determine the adoption of a prudent and scrupulous tactic. Preoperative chemotherapy and radiotherapy are well tolerated but together with surgical intervention it ensures a better control of the appearance of distant metastases. Although 5-year survival rates are equivalent to postoperative chemotherapy and radiotherapy, is currently recommended by most authors for all patients with T3 or T4 rectal cancer, and tends to become a new standard in rectal cancer. Complex treatment has demonstrated its role in reducing morbidity and mortality in rectal cancer, but also in improving long-term survival. The multidisciplinary approach is of major importance both preoperatively and postoperatively, surgical treatment has remained the main treatment modality and is standardized, but there are still controversies in the timing and establishment of useful times of the other therapeutic means. Future trials will refine strategies to identify optimal treatment protocols.

S2-1.11

The Peculiarities of Circadian Rhythms and their Implications on Parkinson's Disease

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Unsettling epidemiological data suggest Parkinson's disease as the second most common neurodegenerative disorder worldwide. The worries persist as there is a demographic tendency towards the ageing of the population as the life expectancy rises. Simultaneously, circadian rhythm disruptions become more frequent as artificial life sources multiply in our daily lives. Thus, the interest of this study resides in determining the traits the endogenous clock has in the context of Parkinson's. In order to reach this aim, a case control approach was selected which helped identify the associations between altered sleep quality and the disease (p=0.007) along with the worsening of the motor dysfunctions (p=0.029). Additionally, chronotype based variances in symptomatology's severity was observed – worst outcomes remarked in morning individuals. Furthermore, the effect light, as main zeitgeber, exerts in diagnosed subjects was assessed and completed with from complementary studies evaluating its uses as a therapeutic tool. The end point of this paper was to attract attention upon an insufficiently researched topic, as are circadian rhythms disruptions in Parkinson's disease, since they only recently acquired a diagnostical relevance as prodromal non-motor symptoms. Correspondingly, we wanted to incite researchers from different fields to study ways of using the biological clock's peculiarities to enhance diagnosed patients' lives through a transdisciplinary approach.

S2-1.12

Updates on the Use of Ozone Therapy in Patients with COVID-19. A Review

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To date, there are no specific antiviral treatment strategies for COVID-19 patients. Empiric approaches used for other viral infections wasn't effective against SARS-CoV-2. Thus, some urgent therapeutic alternatives are still required. Ozone therapy could be favorable due to its effects. Therefore, authors conducted a comprehensive review to reassess the reported adjuvant clinical potency and the last medical approaches towards patients with SARS-CoV-2 virus or COVID-19. Relevant articles were searched in PubMed, Hinari and SpringerLink, National Center of Biotechnology Information, and Medline using keywords "COVID-19", "SARS-CoV-2", "ozone therapy", "mechanisms of ozone", and "biological effects of ozone", as well as their combinations. A total of 475 publications found were compared to exclude duplicates. The collection was reviewed and articles were filtered by title and abstract content. The remaining articles were assessed in full to exclude case-control studies or articles without relevant conclusions. Finally, 49 relevant sources were selected as representative. Ozone therapy has shown various beneficial properties: antiviral, immunomodulatory, antioxidant, anti-inflammatory, and cytoprotective effects, that can be useful in managing tissue damage occurring in many inflammatory illnesses, including viral infections like SARS-CoV-2. It can enhance the respiratory parameters, blood gas indicators, overall health condition, leading to a faster patient recovery.

Despite encouraging preliminary data from ongoing clinical trials, as well as expert opinion, there is still not enough evidence to confirm that it is a viable treatment for patients with COVID-19.

S2-1.13

The Prevalence of Allele Frequencies of CYP2C19 Polymorphisms of Clinically Important Drug-metabolizing Enzymes CYP2C19 in Moldova Healthy Population

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Genetic polymorphisms of drug-metabolizing enzymes, such as cytochrome P450 oxidases, can alter the pharmacokinetic properties of administered drugs, leading to variability in drug responses. Prior knowledge of allele frequencies of cytochrome P450 polymorphisms in a population is crucial. In the current study, the frequency of the CYP2C19*2, CYP2C19*3, CYP2C19*17 alleles, genotypes and phenotype in healthy population of Republic of Moldova was examined. Tests for polymorphisms of CYP2C19 was performed using method TaqMan® SNP Genotyping Assays in 430 healthy subjects, assessing the phenotypes, which included normal metabolizer (NM), intermediate metabolizer (IM), poor metabolizer (PM), rapid metabolizers (RM) and ultrarapid metabolizer (UM). 112 individuals (26.2%) were CYP2C19*1/*2 heterozygotes, 7 (1.6%) were CYP2C19*2/*2 homozygotes, 119 subjects (28.4%) were CYP2C19*1/*17 heterozygotes and 31 subjects (7.4%) were CYP2C19*17/*17 homozygotes, while 1 individual (0.2%) was a CYP2C19*1/*3 compound heterozygote. Therefore, 7 individuals CYP2C19*2/*2 homozygotes (1.6%) are predicted to be CYP2C19 PM. The allele frequencies for CYP2C19*2, *3 and *17 was 14.7%, 0.1% and 21.6%, respectively. The results of this study provide important information about the distribution of CYP2C19 genetic variants in the healthy population of the Republic of Moldova. These findings may have implications for understanding population differences in drug responses, and they support the potential application of genetic testing in medical practice to guide personalized treatment approaches.

S2-1.14

Prospectiv, Descriptive Study of Rotaviral Infection in Vaccinated and Non-vaccinated Infants from Republic of Moldova

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Acute diarrheal disease is one of the most current health problems of the baby. Rotaviral infection is the most common cause of dehydration in infants and young children. The implementation of the sentinel surveillance of rotaviral infection in infants from 2008 in the Republic of Moldova demonstrated the high rate of this infection (40.0%), being an argument in recommending the antirotaviral immunization in children within the National Immunization Program. The study enrolled children with acute diarrheal disease, included in the sentinel supervision (2012-2016) and treated in the Unit of acute diarrheal dis-eases of Clinical Children's Hospital no. 1. Were assessed 193 patients with acute diarrheal disease, according with a standard clinical approach. The biological material was examined by serological enzyme-linked immunosorbent assay (ELISA) and genotyping revealed by polymerase chain reaction (PCR). The rotaviral infection was confirmed in 193 infants, of which 121 children were not vaccinated against rotaviral infection, and 72 were immunized. Depending on the genotypes encountered before and after vaccination, it was found that G9P[8], G3P[8], G4P[8] was detected before vaccination, but post-vaccine prevailed G2P[4], G4P[8], also the incidence of rotaviral infection is decreasing, and the evolution of the disease is much easier. This article reflects the evolution of the genotypic properties of rotaviruses and the clinical-paraclinical particularities of rotaviral infection in infants, with a major importance in the context of the implementation of antirota-viral immunization in children within the National Immunization Program in the Republic of Moldova.

S2-2.1

Personalised Medicine Implementation in Low- and Middle-income Countries

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The potential of Personalised Medicine makes it attractive to health systems, and personalised approaches are being applied in practice in highly developed countries. However, the implementation of personalised medicine in low- and middle-income countries (LMICs) faces a number of barriers. In this group of countries, where resources allocated for health are limited, innovation is often not a priority. Methods: database search was used to identify publication that describes barriers and prerequisites for the implementation of personalised medicine in LMICs. Results. Insufficient regulation, lack of necessary infrastructure, high costs, lack of training of healthcare providers, low awareness of policy makers and population about benefits are barriers to the implementation of personalised medicine. Strengthening research in the field of personalised medicine, aligned with international standards, on a continuous basis, generating evidence on the long-term benefits of personalised medicine is a prerequisite for the implementation of personalised medicine in LMICs. The collaboration between researchers, information exchange and knowledge transfer between different actors of the health system is an essential element to overcome barriers to the implementation of personalised medicine. Ensuring access to personalised medicine services by identifying solutions to reduce health inequalities is a priority for implementing personalised approaches in health systems in LMICS. Conclusion. Prioritization of personalised medicine at the national level will ensure the strengthening of research, financing and the creation of infrastructure necessary for implementation. Consolidated efforts of all actors involved: health system actors, decision makers, citizens are needed to develop and implement personalised medicine in low- and middle-income countries.

S2-2.2

In vivo Evaluation of PMMA Antiglaucoma Shunt's Biocompatibility

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The histocompatibility of traditional trabeculectomy in comparison to PMMA antiglaucoma shunt with valve implant in the rabbit's eyes. The preclinical research included the implantation of the newly designed PMMA antiglaucoma shunt with a silicone valve into 5 New Zealand rabbits (Group A). The shunt was implanted into the anterior chamber under a scleral flap, after steroid-induced ocular hypertension. As a control group serves Group B which undergoes trabeculectomy. The follow-up of the operated eye from each group was observed by a certified ophthalmologist using the biomicroscope. It was evaluated histopathologically following rabbits' euthanasia on days 90 after antiglaucoma surgery. Hematoxylin and eosin staining, and trichrome staining were performed in both groups. In Group A the foreign body reaction consisted of the formation of a fibrotic capsule, with an amount of fibroblasts compared with the control one. The samples were devoid of inflammatory cells, such as macrophages and lymphocytes. The lumen of the antiglaucoma shunt was free of inflammatory exudates or other obstructions in all specimens examined. No adverse reactions were registered in Group A for up to 90 days. The data obtained from the histopathologic examination reveals the good tolerability and safety of the antiglaucoma shunt with valve, with no adverse effects and inflammatory response. The device can be an alternative to trabeculectomy.

S2-2.3

The Role of Molecular-genetic Assays in Diagnosis of Pulmonary Tuberculosis in the Republic of Moldova

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The culture with the drug susceptibility testing are the gold standard in diagnosis of tuberculosis (TB). However the use of the new molecular genetic test for identification of *Mycobacterial tuberculosis* DNA based on polymerase chain reaction contributed to earlier diagnosis of TB, prompt start of the treatment according to the drug resistance profile and improvement of the clinical case-management. The aim of the study was to assess the role of molecular genetic tests in diagnosis of pulmonary TB in the Republic of Moldova. A selective, prospective and case-control study on 673 new cases diagnosed with pulmonary TB in 2022 was conducted. The patients were distributed in the main study group, which included 431 patients with positive molecular genetic test GeneXpert MTB/Rif (Xpert) assay, from which 304 were sensible and 127 resistant to Rifampicin, which were compared with the control group composed of 242 patients with negative Xpert assay. Based on the collected data the predictors for positive molecular genetic assays were extensive and severe forms of pulmonary TB, high expressiveness of the clinical complains and associated disease. The risk factors for acquiring the drug-resistance were TB contact, the history on incarceration and the comorbid state. Due to precocious diagnosis of the drug-resistance and adaption of the TB treatment to the drug-resistance results, the unfavorable treatment outcomes were in a significant lower proportion in patients diagnosed through the Xpert compared with those diagnosed through the conventional culture methods. In conclusion, the molecular genetic assays improved the TB case-management due to precocious diagnosis and adequate therapeutic approach.

S2-2.4

The Relationship Between Dental Caries Damage, Tooth Enamel Hypoplasia and the Particularities of Calcium Homeostasis in Children

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The aim of the present research was to study the relationship between dental caries (DC), enamel hypoplasia (EH) and markers of calcium homeostasis in children. The level of vitamin D, parathyroid hormone (PTH), calcium (Ca) and phosphates (Pi) in blood serum and oral fluid (OF) was studied in a sample of 246 children aged between 1 and 18 years. Depending on the state of oral health, the children were divided into 3 identical groups according to structure. The research group L_1 consisted of 82 children with EH, the research group L_2 included 82 children with DC, and the control group L_0 – 82 conventionally healthy children, free of caries and without clinical manifestations of EH. As a result of the study, vitamin D deficiency, increased PTH level in blood serum and decreased Ca/Pi ratio in OF were established. Conclusions: vitamin D_3 deficiency and increased PTH production can be used as markers of EH formation, increased susceptibility to DC and rampant DC development. The decrease of the Ca/Pi ratio in OF below 1:1.2 is a prognostic factor of the very rapid evolution of DC, caused by the disturbance of the tooth enamel remineralization process. The detection of some important risk factors for EH and the rampant evolution of DC requires the performance of interdisciplinary studies and the complex approach in planning measures to prevent DC and EH, which should include, in addition to local methods of prophylaxis, the administration of medication to balance Ca homeostasis at the local level and systemic.

S2-2.5

Impact of Tumor Necrosis Factor Alfa on Dental Caries Development in Children with Severe SNC Disorders

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The aim of the present study was to perform a comparative evaluation of TNF-α level in saliva and blood serum at children with severe disorders of the central nervous system (CNS) and conventionally healthy children in order to highlight the role of TNF-α in the initiation and development of dental caries. To assess the degree of the dental caries (DC) development were clinically examined 1272 children aged between 1 and 18 years. The study included 636 children with severe CNS disorders, which constituted the research group (L_1) and 636 conditionally healthy children formed the control group (L_0). The concentration of TNF-α in the oral fluid (OF) and blood serum was estimated in 212 children randomly selected from both groups. In children with severe CNS diseases TNF-α concentration in saliva is 5.53 times higher, and in blood serum it is 10.19 times higher compared to healthy children. In children with severe CNS diseases there was revealed a strong inverse relationship between TNF-α concentration in saliva and blood serum and the chances of avoiding new caries development, as opposed to the inverse average relationship estimated in healthy children. Excess TNF-α production, both locally and systemically influenced increased caries risk and dental caries morbidity in children with severe CNS diseases, which is necessary to consider when planning individualized prevention measures.

S2-2.6

ECMO Experience in Post-cardiotomy Cardiogenic Shock. Case Presentation

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Post-cardiotomy cardiogenic shock (PCCS) presents a paramount challenge, with severe and potentially fatal implications, significantly impacting myocardial contractility and peripheral tissue perfusion due to reduced cardiac output. The following report chronicles a clinical case of a patient diagnosed with rheumatic valvulopathy, severe mitral and tricuspid regurgitation, concomitant pump dysfunction of the heart, severe pulmonary hypertension, heart failure, persistent atrial fibrillation, and congestive hepatopathy, among other comorbidities. The case emphasizes the importance of timely diagnosis, intervention, and continued management in patients with complex cardiovascular pathology. The perioperative decision for ECMO support in PCCS remains complex, relying on scientific data as well as individual considerations. ECMO is associated with high mortality and morbidity, reflecting the severity of the underlying disease, and the imperfections of the method, which can lead to hemorrhagic complications, ischemic or thromboembolic events, and multi-organ failure. The purpose of implementing post-cardiotomy ECMO (ECMO-PC) is to maintain systemic oxygen delivery (DO_2) three times higher than oxygen consumption (VO_2) (DO_2:VO_2 ratio >3), with the norm being 5, and shock state assessment at 2. Managing a patient on post-cardiotomy ECMO (ECMO-PC) support necessitates heightened attention to the hemostatic system, as both bleeding and thrombosis remain common complications during ECMO.

S2-2.7

Clinical and Cost Effectiveness of Telerehabilitation System in Balance Disorder Patients

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Balance disorders are a very common consequence of brain damage. Most of these conditions have a chronic nature and require long-term rehabilitation care. Telerehabilitation using the Homebalance system is a suitable alternative or complement to standard rehabilitation. The aim of this study is to evaluate the clinical and cost effectiveness of the Homebalance system in telerehabilitation. The study involved 33 patients who were randomly divided into two groups. The intervention group underwent a 4-week telerehabilitation therapy using the Homebalance system. The comparison group received standard in-person rehabilitation care of the same length. Clinical effectiveness was assessed using the standardized Berg Balance scale test. Quality of life was measured using the EQ-5D-5L questionnaire. The cost part of the study was evaluated from a healthcare payer perspective. Clinical effectiveness of the telerehabilitation was demonstrated by difference in the pre-post BBS scores ($p < 0{,}001$), which was comparable to the effectiveness of standard therapy ($p = 0{,}52$). No significant changes were observed in the patient's quality of life during the therapy. The costs of the experimental intervention were estimated at CZK 7,152, while the costs of the comparator were estimated at CZK 9,424. Telerehabilitation brings many benefits for patients allowing to undergo therapy from the comfort of their homes. The results of this study have shown that telerehabilitation using the Homebalance system is clinically effective, and also cost-effective.

YIC-4.S2

Hemodynamic Protective Assessment of BurnNavi-guided Fluid Management in Burned Patients: Pilot Study

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Burn injuries remain a leading cause of mortality and morbidity worldwide. Many formulas have been described for burn resuscitation using various combinations, but there is still no consensus on the most effective method. The aim of our study was to evaluate the effectiveness of Burn Navigator (BN) as an effective clinical tool for fluid management under non-invasive assessment of cardiac output (CO). The study included 34 patients who were hospitalized at Vinnytsia Burn Care Center. The patients were divided into 2 groups: a group with 16 cases (14 males and 2 females, aged (44.6 ± 12.4) years) who had followed the BN (FBN) and a routine monitoring group with 18 cases (15 males and 3 females, aged (41.8 ± 14.8) years) who had not followed the BN (NFBN). The hemodynamic effects of different fluid management strategies were assessed by continuous measurement of non-invasive cardiac output (esCCO). The results of our study showed a significant difference in fluid volumes infused between the two groups in favor of the FBN group (155.87±82.7 vs 135.46±54.9). After admission, the indicators of CO decreased in both groups and were 3.7±0.8 L/min in the FBN group and 3,9±0.6 L/min in the NFBN group. The overall dynamics of CO increasing were better in the FBN group. According to the results of our study, the volume of fluid administered in the first 24 hours should be slightly higher than the Parkland formula. BN is a system designed to assist physicians in the use of fluid resuscitation for burns.

YIC-8.S2

Personalized Medicine Perspectives and Policies in European Nordic Countries

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The technical revolution has generated large numbers of data in healthcare and biomedical research. Thus, research and innovation became a growing priority to support a change from the one-size-fits-all paradigm of healthcare to Personalized medicine, also called precision medicine. This important pillar in realizing innovation priority in healthcare - Personalized Medicine started its moving fast forward all over the word for the last decade. The aims of PM are to solve health problems by enabling early, individualized diagnosis and treatment, using characterization of individuals' phenotypes and genotypes. The Nordic region, comprising primarily Denmark, Estonia, Finland, Iceland, Norway and Sweden, has many of the necessary characteristics for being at the forefront of genome-based Personalized Medicine development and implementation into clinical care. Remarkably, Nordic countries were the first European countries that started developing Biobank and legislation in this direction. The Joint Committee of the Nordic Medical Research Councils is a cooperative body responsible for the medical research councils of the Nordic countries, which has straightened strategies towards personalized medicine since 2011 and reaching very good result in implementation of this concept, before other European countries. All Nordic countries directed national strategies either specifically towards personalized medicine or to closely related areas, advancing infrastructure development. The most important pitfall in this region is the reliable genetic basis, which started its evolution in early 90-th by implementation of Genome Projects. Nowadays, Nordic countries show perfect example of Personalized Medicine implementation and continuous development, overcoming hurdles and setting ambitious goals.

S2-P8

Synergy Effect of Ascorbic Acid and α-Tocopherol in Kinetic Model of Lipid Peroxidation

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The synergy effect of α-tocopherol and ascorbic acid (vitamins E and C) is taken into account in the presented theoretical model of the kinetics of the process of lipid peroxidation (LPO). An analysis of the features in the course of the LPO process with the participation of vitamins E and C made it possible to apply the appropriate approximations that simplify the model system of differential equations. For cell membranes, it is characteristic that the lipid substrate and oxygen are in excess, as well as ascorbate, according to experimental data, should be considered in excess. Thus, the concentrations of reagents in excess are constant model parameters. Applying the quasi-stationary approximation to lipid radicals further simplifies the model. The synergy effect is primarily related to the ability of ascorbate to regenerate α-tocopherol, thereby protecting it from both depletion and prooxidant effect. This effect at a given concentration of α-tocopherol is enhanced with increasing concentration of ascorbate, but the ratio of ascorbate and α-tocopherol concentrations should not exceed 100, since at high concentrations the ascorbate is also able to act as a prooxidant. As a result, analytical expressions were obtained for the kinetic curves of vitamin E (in its two forms) and the main LPO product (lipid hydroperoxide). This model is minimal and quite adequately describes the LPO process. The features of the synergy effect of vitamins E and C and its significance for the effective control of the LPO process as a whole are discussed.

S2-P9

Assessment of Oxidative Stress Markers in Obese Patients with Community-acquired Pneumonia

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Obesity is associated with a low antioxidant defense compared with normal weight. Total antioxidant status is lower in obese than in normal weight adults, and this anti-oxidant imbalance favors systemic oxidative stress. Pneumonia is one of the most common infectious diseases, and the impact of obesity in the development and progression of the disease is well known. However, there are debatable opinions about the association between obesity and pneumonia risk or pneumonia mortality, some of them supporting the obesity survival paradox. The article reflects a clinical study based on initial hypothesis of more expressed pro-oxidative status and worse outcomes in obese patients with community-acquired pneumonia in comparison with normal weight patients. The study included 101 patients with CAP, who were divided into two groups, according to their weight. Serum markers of oxidative stress (advanced oxidation products, malondialdehyde, advanced glycation end products and nitric oxide) as well as pneumonia-related mortality did not differ significantly in obese and normal weight patients. Unlike other antioxidative mark-ers (total antioxidant capacity measured by ABTS method, catalase and thiolic com-pounds), total antioxidant activity measured by CUPRAC method showed a positive correlation with the obesity cases and proved to be an important and promising tool to assess the anti-inflammatory and protective antioxidative activity in community-acquired pneumonia.

S2-P10

Some Considerations of Combined Treatment in Digestive Non-Hodgkin's Lymphomas: Literature Review

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Non-Hodgkin lymphomas (NHL) are malignant lymphoproliferative tumors of monoclonal origin. Any organ or tissue is susceptible to the development of NHL. The most common site for extranodal lymphomas is the gastrointestinal (GI) system. Although gastrointestinal lymphomas are quite rare, their prompt recognition, treatment and follow-up management are of crucial importance for patient safety.

A study was conducted, in the form of a synthesis article, through a narrative review of the literature. The paper systematized and summarized a series of researches, which focused on the combined treatment of gastrointestinal NHL.

Currently, systemic therapies such as chemotherapy and radiotherapy are the main focus of management, while surgery is used only in specific circumstances. Conservative treatment is preferred, especially in localized gastric lymphomas. However, numerous studies have shown that surgery was advantageous for patients who experienced hemorrhage, perforation, or ileus, particularly in patients with intestinal lymphomas.

According to studies, the main indications for surgical intervention are the difficulty of preoperative pathological diagnosis, the unforeseen danger of life-threatening consequences, such as hemorrhage, occlusion, perforation, and rapid tumor necrosis secondary to chemotherapy/radiotherapy. In gastrointestinal NHL, the combination of surgery and chemotherapy/radiotherapy can greatly improve survival rates. Surgical treatment has selected indications, but the value of preventive surgery cannot be underestimated.

S2-P11

Literature Review: Nanotechnologies and Biomedical Engineering in Dupuytren Disease

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The review explores the potential applications of nanotechnologies and biomedical engineering approaches in the diagnosis and treatment of Dupuytren disease. Several studies have investigated the use of various types of nanoparticles for drug delivery, including paclitaxel, mitomycin C, and verapamil, which have shown promising results in reducing fibrosis and contracture formation in *in vitro* and animal models. Additionally, the use of tissue-engineered constructs, such as cell-seeded collagen matrices and nanofibrous scaffolds, incorporating platelet-rich plasma, has also shown potential in improving hand function and reducing nodule size in Dupuytren disease patients. Magnetic nanoparticles functionalized with specific antibodies have been investigated as a platform for hyperthermia-based therapy, with the ability to induce targeted cell death in nodules. Mechanical devices, such as customized splints, have also been developed to alleviate contractures in Dupuytren disease patients. Further studies are needed to optimize the techniques and confirm the safety and efficacy of these approaches for clinical use in Dupuytren disease patients.

S2-P12

Measurement of Arterial Blood Gases in Elderly Patients with COVID-19 Pneumonia and Chronic Obstructive Pulmonary Disease

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The evolution of COVID-19 pneumonia seems to be linked to underlying comorbidities, and has an increasingly rapid and severe progression in these patients. Patients with chronic obstructive pulmonary disease (COPD) are also at higher risk for severe illness from SARS-CoV-2 viral pneumonia, especially in elderly population, that is more susceptible to this illness. The article represents a clinical study of invasive arterial blood gases measurement and non-invasive measurement of capillary blood oxygen saturation in elderly and middle-aged COPD patients with COVID-19 pneumonia. The study included 101 patients admitted to COVID-19 Triage Center with COVID-19 pneumonia and chronic obstructive pulmonary disease, aged between 45 and 86 years, divided into two groups according to their age. The arterial blood gases analysis demonstrated respiratory acidosis, hypoxemia, hypercapnia and alveolo-capillary block in both elderly and middle-aged patients. Significantly elevated levels of partial pressure of arterial blood carbon dioxide were observed in patients aged more than 65 years. Simultaneously, a discrepancy between almost suboptimal oxygen saturation values measured by pulse oximeter and higher levels of hypercapnia in arterial blood gases were registered. The measurement of arterial blood gases should be an obligatory tool to assess the severity of viral pneumonia in COPD patients, especially in those elderly ones.

SECTION S3
Clinical Engineering and Bioinstrumentation

S3-1.1

Publication Practices Among Pivotal Clinical Trials of High-risk Medical Devices

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High-risk medical devices must go through a special approval process before entering the market, whereby they demonstrate sufficient safety and clinical effectiveness by submitting relevant evidence. This evidence is usually obtained by conducting one or more clinical trials. There have been occasional inaccuracies in the reporting of the results of these trials, e.g., not publishing the entire study or misrepresenting unfavorable results. Our study deals with the issue of publishing clinical trials of new, high-risk, cardiovascular medical devices. The main objective of the study was to analyze the clinical studies in SSED documents that are submitted to the FDA in the premarket approval process and compare it with the information in related peer-reviewed publications. A total of 59 medical devices that met the inclusion criteria were identified in the time period 2014-2018. Of the 64 pivotal clinical studies, 81% were published, with a median time to publication of 2 months. There were no substantial differences in randomization and blinding between SSED pivotal trials and publications. Small differences were noticed in the number of patients (8%), the mean patient age and sex (15%). No differences were observed between SSED documents and published studies in terms of primary outcomes selection and definition. Only three (3.8%) outcomes were not found in publications. Our results shown a substantial improvement both in the publication rate of the pivotal trials and in the correctness of the published information for high-risk cardiovascular medical devices.

S3-1.2

Biomechanical Analysis of the Balance of the Human Body

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This paper proposes a biomechanical analysis of the balance of the human body. The center of mass of the body directly influences the position of balance, respectively the stability of the whole body. In the case of a balance movement, this position changes causing an instability of the body, if the support area is exceeded. The area of stability represents the projection of the center of gravity and it changes depending on the movements that the human body performs. Certain occurrences require these types of movements repetitively, therefore the stability of that person changes during the action. Also certain health problems or medications can upset body balance. The paper proposes a biomechanical analysis mode for checking the balance by identifying the parameters of the stability area at the time of the body inclination and verifying the forces that appeared at that time. In order to extend the experiments, the paper propose in the end a simple structure for analysis by comparing the areas of stability in the controlled balance movement of the different segments of human body with the variations of the Fz force in the direction of the Oz axis. Human body stability is important to maintain the bipedal position, through a complex process (which involves central nervous system) and stabilizing the individual segments of the body.

S3-1.3

Primary Measuring Transducer of a Diagnostic Spirometer Based on a Venturi Flowmeter

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The presented work is devoted to the development of a primary measuring transducer implemented on the basis of Venturi flowmeter for a portable spirometer. A modified Venturi flowmeter design has been proposed to enable measurement of two phases of the respiratory cycle (expiratory and aspiratory). This modification differs from the classical version in that it has a symmetrical shape relative to the median plane, which is perpendicular to the tube axis at the throat section. It has been shown in the paper that the curves showing dependence of pressure drop Δp on inlet flow Q, for classical and modified Venturi flowmeter have good convergence. In order to develop a mathematical model of the proposed Venturi flowmeter design, basic hydrodynamic equations, such as Bernoulli equation and continuity of flow equation, have been used and calculation methodology of Venturi nozzle for rhinomanometry problems has been applied. Using the calculation results, a 3D model of the Venturi flowmeter was created in SolidWorks CAD, followed by static and dynamic studies. Based on the simulation results, the pressure distribution graphs along the Venturi flowmeter inner surface at maximum $Q = 16\,l/s$ and minimum $Q = 0{,}1\,l/s$ inlet flow rates have been obtained. These graphs made it possible to determine the minimum and maximum pressure drop at the installation points of the differential pressure sensor (secondary transmitter) and to establish the pressure variation range in which the sensor should measure. The error of the simulation and calculation results was assessed and showed good convergence in the input flow range $Q = 0{,}1 \div 8\,l/s$. Further research will focus on developing a secondary transducer and integrating it with the primary transducer to create an air volume velocity transducer with improved metrological characteristics.

S3-1.4

A LabVIEW based Brain-Computer Interface Application for Controlling a Virtual Robotic Arm Using the P300 Evoked Biopotentials and the EEG Bandpower Rhythms Acquired from the GTEC Unicorn Headset

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The brain-computer interface is a high technology inspired from science fiction with a strong impact for helping people with neuromotor disabilities suffering from complete paralysis. Leveraging the power of thoughts translated into processing and classifying the EEG based signals acquired from the brain result in controlling the mechatronic systems, such as robotic arms or smart wheelchairs aimed at the medical assistance of disabled persons. A robotic arm is necessary for grasping and moving different objects according to the users' intention. Also, a simulation based on a virtual robotic arm can support the real experimentation of a complex and expensive physical robotic arm. This paper presents a prototype of a simple brain-computer interface implemented in LabVIEW programming environment for controlling a virtual robotic arm using the commands determined by the P300 evoked biopotentials and the EEG rhythms using the GTEC Unicorn headset and the related official applications. The integration between the LabVIEW proposed instrument and the Unicorn user interfaces is facilitated by the UDP data transfer. The P300 speller human faces board is associated with the generation of the commands necessary to animate specific joints from the structure of the virtual robotic arm. The EEG data frequencies (delta, theta, alpha, beta, gamma) are mapped to the angle values of each joint (shoulder, elbow, wrist) composing the 3D robotic arm. The purpose of the proposed application is to train people how to use a brain-computer interface. It also shows the possibility of integrating the LabVIEW development environment with the Unicorn EEG technology by using the UDP transfer.

S3-1.5

Analysis of the Distribution of Forces and Pressures on the Plantar Surface in Different Walking Types

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Over time, the studies on the gait cycle have tried to highlight different behaviors of the human body and quantify movement parameters. The correlation mechanism between the forces and pressures developed at the level of contact between the plantar surface and the ground is simple and easy to use for medical evaluations on the various pathologies manifested in the locomotor system. This paper presents a procedure for identifying and measuring the dynamic parameters of the gaiy cycle for walking variants but also for different planting surfaces (flat foot, normal or hollow). In the first part of the work, in the introduction, different aspects related to the walking cycle for different types of walking are reviewed (normally relaxed, walking, walking with eyes closed, walking with blocking and walking with an added step) in order to then determine the equipment needed for recording. In the second part of the paper, the experimental concept developed for the analysis of the distribution of forces and pressures on the plantar surface in contact with the ground is presented. In the third part of the work, the results and observations obtained from the application of the analysis procedure are presented. The conclusions on this procedure come to finalize the presentation of the analysis of the measurement of the distribution of forces and pressures for the walking cycle and to establish the future directions of development.

S3-1.6

Evaluation of the Maintenance System of Medical Equipment - a Necessity for Implementing an Effective Quality System

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Evaluating the maintenance of medical equipment is essential to ensure the proper and safe operation of these systems, which are essential for the diagnosis, treatment, and monitoring of patients. Throughout the life cycle of medical equipment, regular maintenance and calibration are required to maintain its performance and accuracy. In addition, it is important that medical equipment undergoes regular reviews to verify that it still meets applicable standards and regulations. If a malfunction or problem is found in the operation of the medical equipment, it is essential to report it immediately to the supplier or distributor of the equipment so that timely corrective measures can be taken. Some key reasons for the importance of evaluating the maintenance of medical systems are patient safety, system reliability and availability, performance optimization, regulatory and standards compliance. This paper presents aspects related to maintenance, management, maintenance, and quality management of medical equipment by firstly analyzing the technological and medical information obtained through various questionnaires. Summarize the issues encountered in medical equipment maintenance and design a medical quality control system to manage the maintenance and quality control of medical equipment. In the medical equipment maintenance system, scientific management theories and methods are used to predict, adjust, inspect, and account for the quality of the entire medical process and to establish a complete quality monitoring and management system. Compliance with standards and regulations, as well as adequate training of medical personnel, can ensure the correct and efficient use of this equipment, thus contributing to the provision of high-quality medical care.

S3-1.7

Assisting Deaf and Hard-of-Hearing People in Critical Situations: Alleviating Stress and Enhancing Safety

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Individuals who are deaf or hard of hearing encounter many difficulties in their daily lives, especially when it comes to receiving important information during emergencies or disasters. Relying on others for updates can create a dependency that may hinder their ability to respond independently and effectively in critical situations. To address this problem, it is crucial to have a warning system that can provide timely alerts directly to deaf and hard-of-hearing individuals, reducing their reliance on family members, tutors, or caregivers during emergencies. Our team has developed a mobile application that can notify individuals of unavoidable events like earthquakes or fires. We used App Inventor, a user-friendly development platform, to create the app, which can be installed on wearable devices for easy accessibility. By utilizing wearable technology and mobile connectivity, our app aims to bridge the communication gap that deaf and hard-of-hearing individuals experience during emergencies. It includes several essential features to enhance its effectiveness, such as customized alert settings based on individual preferences, such as the type of alerts, urgency level, and notification formats (visual or vibration). The app also offers real-time location tracking, which can provide personalized localized alerts, giving deaf and hard-of-hearing individuals crucial information about their immediate surroundings. Furthermore, the app has multilingual support to cater to diverse deaf and hard-of-hearing communities, ensuring that signals and information are conveyed in their preferred languages.

S3-1.8

The Surveillance System of Medical Devices, in which the Responsible Individuals Have an Active Role, is the Guarantee of Patient and Medical Device User

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The surveillance of medical devices is defined as a system for collecting, storing, scientifically evaluating, and assessing incidents resulting from the use of medical devices, as well as reporting them to the competent authorities for the purpose of continuous monitoring of the risk-benefit ratio and the adoption of necessary measures to reduce occurrences. The medical devices used in medical procedures must be safe, of high quality, and efficient. This is the goal of states and their competent authorities, who have recognized and implemented the management of medical technologies at the healthcare system level, which includes reporting any malfunction or deterioration in the characteristics and performance of a device that may or has led to the death or severe deterioration of a patient's or user's health condition. Following the non-reporting of incidents involving medical devices and not taking corrective actions to prevent incidents, the medical devices that are used, does not guarantee security and performance parameters. Thus, it is very important that there are, at regulatory level, tools and methods to report incidents and to prevent their occurrence or reoccurrence. On the other hand, the best international practices, regulates the fact that for the successful functioning of the vigilance system, users are must have an active role in the surveillance system of medical devices. Safety cannot be guaranteed without a medical device surveillance system, as well as the proper involvement of responsible individuals who will ensure and guarantee the use of safe medical devices with an appropriate level of performance and security parameters.

S3-1.9

Monitoring the Physiological Parameters of Patients with Non-Communicable Chronic Diseases

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In the Republic of Moldova, non-communicable chronic diseases account for approximately 90% of all deaths, with 59% attributed to cardiovascular diseases. A major cause of this high morbidity in contemporary society is the lack of continuous, effective, and remote monitoring of physiological parameters that affect people's health and daily activities, leading to difficulties in the prompt and adequate implementation of recovery measures. This can transform these physiological dysfunctions into pathological conditions. Therefore, remote monitoring of the health status of patients with non-communicable chronic diseases through the effective exchange of medical information between patients and doctors is essential and can contribute to reducing the mortality rate.

Remote monitoring of the physiological state of the body is considered one of the most effective ways to address this issue and enables the rapid organization of healthcare to maintain health. The successful implementation of telemedicine services can also extend cost-effective access to medical services in rural or isolated areas, making a strong case for the adoption of e-medicine in the Republic of Moldova, especially in rural areas.

Physiological parameters monitored for the preventive health status of the human body include the heart rate, respiratory rate, blood pressure, body temperature, and blood oxygen saturation.

The developed multiparametric device for remote monitoring of physiological parameters of patients with non-communicable chronic diseases consists of a multiparametric monitor and an analyzer of gas and volatile compound concentrations in exhaled air (carbon dioxide CO2, oxygen O2, acetone C3H6O). This device comprises the following modules:

- The central module, based on a microcontroller, equipped with an information system for data collection and transmission to the screen of a mobile phone.
- Radio/WiFi communication module.
- Power controller.
- Module for analyzing human parameters (SpO2, heart rate, pulse, electrocardiogram (ECG), blood pressure, temperature).
- Bluetooth, WiFi or GPRS communication module.

To evaluate the device's performance, specialized software has been developed, including a set of applications:

- NIBPTEST-English-v1.2 for measuring blood pressure and pulse.
- ECG View v1.0 for measuring other parameters.

The technical characteristics of the multiparametric device determined through testing include a pressure measurement range of 20 to 270 mmHg, pressure measurement accuracy of ±3 mmHg, resolution of 1 mmHg, SpO2 measurement range of 0 to 100%, accuracy of ±2%, pulse measurement range of 30 to 250, accuracy of ±2 beats per minute, ECG accuracy, and more.

Additionally, the device for monitoring gases and volatile organic compounds in exhaled air has a significant impact on diagnosing metabolic diseases such as diabetes and renal failure by analyzing the concentrations of gases and volatile organic compounds in patients' breath. This device can analyze the concentrations of oxygen O2, carbon dioxide CO2, and acetone C3H6O, which have been identified as biomarkers for certain conditions. The device is compact, ergonomic, and powered by a Li-Ion battery, providing long-lasting functionality.

This analysis of human breath represents a non-invasive method for detecting metabolism-related diseases such as diabetes and renal failure. The sensors used are sensitive to very low concentrations, making the device cost-effective. This device can be particularly useful in medical institutions for the development of non-invasive remote diagnostics.

In conclusion, this paper and the developed devices have a significant scientific, social, and economic impact by improving access to medical services, early disease diagnosis, and reducing the mortality rate, especially in rural areas.

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S3-1.10

Techniques for Human Body Biomedical Signals Processing and Storing

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An indispensable part of modern medical devices and systems is the operator interface as well as the implemented biomedical signal processing methods and techniques, and the obtaining of useful clinical information from these signals. In order to process an unpredictable signal in real time, such as the biomedical signals recorded from the human body, used algorithms and data processing methods are in a continuously developing. Nowaday, there is an increase in the number of new medical devices based on Artificial Intelligence, but until now, around 75% of these devices are intended for image processing and are implemented in the radiological field. New algorithms based on AI for biomedical signal and image processing are continuously improving so that every year more and more such medical devices are authorized. Each type of biomedical signal recorded from the human body has its characteristics and its specific approach for processing in order to extract clinical information about the activity of the cardiovascular system, nervous system, etc.

The new methods and algorithms of the developed software system, running on the personal computer, allows the implementation of the following functions: the acquisition of biomedical signals from the human body, by means of complex systems for measurement and monitoring in medicine; storing in the computer's internal memory the volume of data related to the recorded biomedical signals; real-time processing of biomedical signals and determination of the main vital parameters (heart rate, pulseoximetry, NIBP, etc.); detailed processing of signals recorded in memory; heart rate variability analysis by processing the Electrocardiography or Photoplethysmography signal; statistical analysis of signals recorded over long periods of time and the highlighting of cardiac cycles that attest to an arrhythmia or deviation from normal activity, etc.

S3-1.11

Three Dimensional X-ray CT Reading Assistance System With Video See Through Display

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In recent years, the amount of information in three-dimensional X-ray Computed Tomography (3D X-ray CT) has been increasing, and research on Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) representations using computer graphics rendering has progressed. Conventionally, medical professionals have used Digital Imaging and Communications in Medicine (DICOM) viewer software to display data captured with 3D X-ray CT in three directions (axial, sagittal, and coronal section) on a PC monitor. Since surface and volume rendering on AR, VR, and MR is primarily used, making it is difficult for the observer to accurately represent the region of interest. In our previous research, a 3D expression system that 2D cross-section images output from DICOM on the surface-rendered object has been proposed. In this study, a representation method using a 3D expression system and showing AR images allows the user to check the internal structure of an object imaged by 3D X-ray CT in any position and rotation has been newly proposed. In addition, in order to express a cross-section of a virtual object at close range in real-time, HTC VIVE Pro, which is a camera-mounted device connected to a PC, enabled a video see-through expression. As a result, a 3D X-ray CT reading assistance system enabled the user to confirm the internal structure of a specific part of a CT-imaged object in a virtual reality space while maintaining shading and a three-dimensional impression.

YIC-9.S3

Videosupported Treatment as Method of Delivering the Healthcare to Tuberculosis

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According to the actual national policy, the patients with tuberculosis may benefit from the following anti-tuberculosis treatment options: a) directly observed delivered in the community close to the patient's home or work; b) treatment provided in hospitals or specialized dispensaries and c) video-supported treatment, which is currently in expansion, regardless the low evidence of its effectiveness. The aim of the study was to assess the advantages and issues in delivering the anti-tuberculosis treatment through the telecommunication technologies in patients with tuberculosis. Was conducted a selective, prospective and case-control study, which included 255 patients who underwent a completely video-supported treatment and 498 patients who underwent directly observed, then transferred to video-supported treatment. The patients were registered between 2020 and 2022 in the Republic of Moldova. The study results established that the issues in delivering the video-supported treatment were the main risk factors for tuberculosis: vulnerable economical state, poor living conditions, comorbid state and harmful habits. Despite the limitations in the use of video-supported treatment, as positive sputum smear and parenchymal lung destruction, one third of both groups were treated through the delivering the treatment using the telecommunication technologies. The advantages of entirely video-supported treatment were high flexibility for patients and healthcare staff, epidemiological isolation, and high treatment effectiveness. The advantages of the directly observed followed by the video-supported treatment were the establishment of the therapeutic compliance, clinical tolerance to the anti-tuberculosis drugs, the management of the health-threatening conditions under the direct supervision of the healthcare staff.

YIC-11.S3

Feasibility Study for a Robotic Laparoscopic Surgical System in a Greek Public Hospital

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Robot Assisted Laparoscopic Surgery (RALS) is a rapidly evolving field and has seen significant advances in recent years. This new technology presents potential advantages in many procedures, compared to traditional open surgery and manual laparoscopic surgery. However, to justify the use of a robotic laparoscopic surgical system by a healthcare unit, the undoubted technical advantages it offers should be translated into improved clinical outcomes, safety and sustainability. The Institute of Biomedical Technology (INBIT) undertook a project to evaluate the feasibility of acquiring such a system by a Public Sector Hospital in Greece. This analysis included the description of the examined technology, its fields of application and the potential and conditions of its utilization. Aspects of the technology such as acquisition, use and maintenance costs were reviewed alongside public health sector data related to the estimated use, to check its sustainability. At the same time, a review study was carried out to compare clinical results of robotic surgery with traditional operation methods based on existing literature. Considering this comparison, alongside the economic data, a cost-benefit estimation of the technology under consideration was carried out. Additionally, safety issues of RALS are examined based on international recalls on robotic surgical systems and relevant studies. Finally, comments are made on the procurement strategy to be followed.

YIC-13.S3

Integration of Scpi over Vxi-11 Protocols in an Automated Gas Sensing Measurement System

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Gas sensing plays a crucial role in numerous applications, such as environmental monitoring, industrial safety, and healthcare. Semiconductor oxide nanostructured sensors have emerged as promising candidates due to their high sensitivity and low cost. However, the accurate and efficient characterization of their gas sensing properties remains a challenge. In this article, we present an automated measurement system that combines a source meter device for executing measurements and a software platform for user interface, signal visualization, and data storage. The system enables both transient measurements in time and volt-ampere characteristics measurements of the sensors. The software platform provides a user-friendly interface for configuring measurement parameters, initiating measurements, and visualizing real-time sensor responses. The acquired data is processed, analyzed, and stored in the network file storage for further examination. A comparison with existing systems based on LabVIEW or MATLAB highlights the advantages of the proposed measurement system, such as improved flexibility, scalability, and ease of integration with different source meter devices. The system's modular architecture opens the way for advanced data analysis and modeling. Our approach enhances the speed, reliability, and repeatability of gas sensing characterization. The described measurement system offers researchers an effective and customizable tool for gas sensing analysis, facilitating scientific advancements in this field.

S3-P13

Impact of Frailty in Patients with Cardiovascular Diseases. A Review

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Cardiovascular diseases continue to be the leading cause of mortality, accounting 1/3 of global deaths. Frailty as a syndrome characterized by a decline in physical function, reduced physiological reserves, decreased homeostatic tolerance leads to unique challenges in the context of cardiovascular care. It has been found to be an independent predictor of adverse cardiovascular outcomes, mortality and hospitalizations.

In aim to elucidate relationships that link frailty and cardiovascular pathologies PubMed, NCBI, ResearchGate databases were searched using keywords "frailty," " heart failure," "hypertension," "arrhythmias" for the period 2018- 2022.

Frailty, as the primary geriatric syndrome, has extended its significance to the field of cardiology. The prevalence of frailty among ambulatory heart failure patients ranges from 19% to 52%, while among hospitalized patients the burden of frailty is higher, reaching 56% to 76%. Understanding the connection between frailty and cardiovascular conditions remains challenging due to potential shared pathophysiological mechanisms. Factors that may contribute to this reciprocal influence include age-related changes, inflammation, oxidative stress, neuroendocrine dysregulation, obesity, smoking. Despite a conceptual consensus on frailty, establishing a standardized assessment method for frailty in patients with cardiovascular diseases remains elusive. A comprehensive frailty assessment into both medical and social aspects is essential for diagnostic and management. An interdisciplinary approach can improve quality of life, as frailty impacts treatment tolerability, response to interventions and outcomes.

Further research is necessary to identify early predictors of frailty using a comprehensive approach, encompassing physical, psychological and social dimensions to mitigate the impact of frailty on patients with cardiovascular diseases.

SECTION S4
Biomaterials for Medical Applications

S4-1.1

Design and Simulation of a Biocompatible Prosthesis Ti-15Mo-XTa Alloy: An Analysis of Mechanical Integrity Using Finite Element Modeling

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The main focus of this work is the development and simulation of a prosthesis using a high entropy alloy known as Ti-15Mo-XTa. The selection of this alloy is based on its compatibility with the human body, which is a crucial factor when choosing materials for medical implants. Traditional metal implants can cause several problems for patients, including toxic reactions from the release of metal ions, wear and tear of joint replacements from movement, and structural failure from repetitive loading. To address these concerns, the present study creates a three-dimensional finite element model of the prosthesis using COMSOL software. The model includes both isotropic and anisotropic materials and is subjected to various mechanical loads based on experimental studies. The finite element method is used to analyze the distribution of stress and strain across adjacent elements of the prosthesis. By simulating the behavior of the prosthesis under different loading conditions, valuable insights into its performance and durability can be gained. To assess the static design, the prosthesis is tested using COMSOL simulation software and subjected to loading conditions of 70, 90 and 110 kg. The objective of this assessment is to determine the robustness and ability of the design to withstand real-world mechanical demands. By conducting these simulations and tests, the researchers hope to contribute to the development of improved prostheses that can offer better functionality, longevity and overall patient satisfaction.

S4-1.2

The Critical Size Bone Defects - In-vivo Experimental Method of the Treatment with the Decellularized Vascularized Bone Allografts

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The critical sized defects occur due to various factors (trauma, tumor resection, congenital anomalies, infections). Contemporary reconstructive orthopedic surgery cannot offer standardized treatment for all CSD, so now it's a therapeutic dilemma. Modern methods that users have a high level of morbidity and complications. Transplantation of live allogeneic vascularized bone can be potentially the "perfect" solution, only if significant and unjustified risks of long-term immunosuppression will be avoidable. For these reasons, the scientific community has focused its activity on studying simple or combined vascularized bone grafting (with local and systemic factors that grow bone bioactivity). Our work aims to study the local and paraclinical postoperative manifestations after the plasty of the critical bone defect with vascularized bone allotransplantation in the rabbit model METHODS: The 12 rabbits (New Zealand White Rabbits) were divided into three groups, weighing 2.6-4.6 kg. Lot 1 - plasty of critical bone defects with vascularized bone autograft. Lot 2 - plasty of critical bone defects with native vascularized bone allograft. Lot 3 - plasty of critical bone defects with decellularized vascularized bone allograft. We have studied the local (on the 1st, 5th, 10th, and 15th postoperative days) and the paraclinical postoperative manifestations (at 14 and 30 days postoperatively) after the lateral intermuscular and the medial approach of the thigh.

S4-1.3

Modification of Acrylic Paint by Acetamide to be Antibacterial Used for Medical Applications

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This study aimed to develop an innovative approach to produce an organic antibacterial composite material by combining acrylic paint and acetamide through a simple mixing method. Acetamide, known for its potent antibacterial properties, underwent a thorough evaluation to assess its effectiveness in the composite. The antibacterial properties were evaluated using established methods such as the minimum inhibitory concentration (MIC) and the agar well diffusion test. These tests provided quantitative and qualitative measures of inhibitory activity against two common bacterial strains, namely S. aureus and S. epidermidis. The results showed a clear correlation between the concentration of acetamide in the composite and its antibacterial activity. Higher concentrations of acetamide led to a significant increase in the effectiveness of the composite material against the targeted bacterial strains. In addition to the antibacterial properties, the mechanical and physical properties of the composite material were also analyzed comprehensively. Parameters such as wettability, swelling ratio and chemical structure were thoroughly investigated using Fourier Transform Infrared (FTIR) analysis. This comprehensive characterization enabled a detailed understanding of the behavior and performance of the composite material.

The results of this study are auspicious in the context of operating rooms. The proposed composite antibacterial polymer coatings, utilizing organic or inorganic agents at low concentrations, represent an effective solution to eliminate bacteria and maintain a sterile environment. These coatings can be applied to operating room walls and offer improved infection control and reduced bacterial contamination risk.

S4-1.4

Antigenic and Biodegradable Characteristics of the Extracellular Matrices from the Pig Dermis

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The present work demonstrates the possibility for fabrication of extracellular matrices from the pig dermis. The obtained matrices were characterized from the point of view of antigenic, biodegradability and the ability to absorb the fluid from the environment, making them prospective for fabrication of intelligent dressings. Five parallel groups of extracellular matrices were established and the mean value was calculated. The size of the grafts was 10×10×2 mm and the weight of 87.9±3 mg for all the study groups. Histological examination revealed the presence of fewer number of cells. As a result, we were able to remove around 80.5% of the genetic material from the porcine dermal structures, demonstrated by spectrophotometric DNA quantification. In the in vitro graft degradation study in 0.01 M of phosphate buffer solution with the pH 7.4 combined with collagenase, we determined a significant ($p < 0.05$) loss of graft mass by 91.3% during 35 hours. In the absorption test, we obtained a variable depending on the exposure time, respectively the soaked samples ended up exceeding four times the initial mass of 87.9±3 mg at the 4th hour of immersion in the liquid. Acellular grafts from the porcine dermis can play a key role in the wound care and facilitating tissue engineering strategies by the acting as an acellular and immunologically inert scaffold, as a source of the bioactive molecules with the hydrophilic and biodegradable properties.

S4-1.5

Effectiveness of Tissue Engineering in Obtaining the Extracellular Composite Vascularized Bone Matrix

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Massive bone defects are considered to be one of the basic causes of functional disability. The gold standard, which nowadays is autologous grafting, is a perfect combination of mineralized extracellular matrix, bone marrow, and osteogenic cells. However, the available amount of such biological material is limited and the bone large defects remain a challenge. The lack of oxygen and nutrient transport actually remains the basic technical challenge in tissue engineering that limits the achievement of an effective bone allograft in the treatment of massive bone defects. The purpose of the paper is to present the results collected from the experimental study in obtaining the biocompatible extracellular composite vascularized bone matrix (vECCBM). We present a universal approach to a decellularization protocol based on the consecutive use of an isotonic solution, a chelating agent, anionic and ionic detergent as well as an enzyme solution. The effectiveness of decellularization was tested by histological examination (H&E and DAPI staining) and DNA quantification. The biocompatibility test was performed using the cultivation of the STEM cells from the bone marrow. Results: we were able to obtain a protocol for decellularization of the composite grafts, bone + vessel (soft and hard tissue) with the preservation of the vascular pedicle integrity and its connection with the bone compartment having in this way the possibility of applying anastomoses between the decellularized matrix and host.

S4-1.6

A New Approach in Detection of Biomarker 2-propanol with PTFE-coated TiO_2 Nanostructured Films

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Certain molecules act as biomarkers in exhaled breath or outgassing vapors of biological systems. Metal oxide gas sensors are of great interest to detect these molecules. However, often they are not selective enough to identify the specific molecules. In addition, they typically lose their excellent performance at high humidity levels. In this study nanoscale polytetrafluoroethylene (PTFE) thin films deposited via solvent-free initiated chemical vapor deposition (iCVD) were investigated as a possible pathway to tune the selectivity of metal oxide gas sensors as well as hydrophobic surface functionalization. The gas-sensing properties of two types of PTFE-coated gas-sensing structures are measured for this purpose at several operating temperatures. The first structure is a thermally annealed TiO_2 film while the second structure is a thermally annealed TiO_2 film with an additional CuO film. After the deposition of the iCVD PTFE thin films the structures exhibit a high response and excellent selectivity to 2-propanol vapor. The experimental data presented here, promote the use of such PTFE-coated gas sensing structures as reliable, accurate and selective sensor structures for the tracking of gases at low concentrations. This enables new possibilities in application fields like biomedical diagnosis, biosensors, and the development of non-invasive technology.

S4-1.7

Effect of Gold Nanoparticles Functionalized by *Arthrospira platensis* on Rats

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The influence of unmodified engineered AuNPs versus biofunctionalized by cyanobacterium *Arthrospira platensis* (spirulina) on rats was studied. Au NPs were administered per os in a quantity of 1μgAu/day per animal for 28 days, followed by a clearance period of the same duration. The accumulation of nanoparticles in different organs, the change in hematological and biochemical parameters in the experimental animals were assessed at the end of the nanoparticle administration and the clearance periods. The amount of gold accumulated in organs was determined by applying neutron activation analysis at the IBR-2 reactor. Biochemical and hematological analyses of the blood were performed using a semi-automated system StarDust MC15. The biofunctionalized nanoparticles were accumulated in larger amounts, and the amount of metal remaining after the clearance period was also higher in the case of the functionalized nanoparticles. Only biofunctionalized nanoparticles accumulated in the ovaries. Both types of nanoparticles possess high biological activity, inclusive of their induced changes in the leukogram, glucose, urea and liver transaminases levels. More pronounced changes being characteristic for unmodified gold nanoparticles. Tested nanoparticles can cause long-term or delayed effects, which include the increase in glucose and urea levels as well as the increase in ALT activity after the clearance period.

S4-1.8

Synthesis and Characterization of Self-Assembled Hydrogels Based on Amphiphilic Derivates of Chitosan and Gelatin

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Self-assembled hydrogels based on amphiphilic derivates of biocompatible polymers, prepared through non-covalent interactions, without using chemical cross-linking agents, are receiving great attention as matrix for cells encapsulation. To our best knowledge, there are no studies in the literature regarding the design of self assembled hydrogels based on a combination between palmitoyl chitosan and palmitoyl gelatin. In this context, this paper is devoted to the synthesis and characterization of self-assembled hydrogels based on amphiphilic derivates of chitosan and gelatin. Palmitoyl-chitosan and palmitoyl gelatin were prepared through the acylation reaction of polymers (chitosan and gelatin) with palmitoyl chloride. Self-assembled hydrogels based on amphiphilic derivatives of chitosan and gelatin were obtained by dropwise adding of the polymer solutions in cell culture media and spherical hydrogels with stable structure and a diameter of 4-5 mm were obtained. The composition of the hydrogels was confirmed by FTIR-ATR spectroscopy and the stereomicroscopy data indicated a porous structure. The hydrogels swelling degree and mechanical features, in terms of elastic modulus were evaluated and the values obtained for elastic modulus, registered in the range between 3801.52 N/m2 and 4577.49 N/m2 are suitable for hydrogels manipulation and their applications in soft tissue engineering. In vitro cytotoxicity tests, pointed out their cytocompatibility that offers future perspectives for applications in 3D-cell culturing and encapsulation.

S4-1.9

Composites based on Biopolymers and Ag Nanoparticles as Potential Wound Dressing Materials

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Nanotechnology is an emergent, rapidly growing field with numerous technical and biomedical applications. With antibacterial properties, silver nanoparticles have been tested in various medical domains, including the treatments of the skin. The paper presents the preparation of negatively charged silver nanoparticles(NP) in presence of olive leaf extracts and the nanoparticles application in formulations as wound dressings (films and porous scaffolds). Nanoparticles were obtained with high stability, negative zeta potential and antioxidant properties. Xanthan/methacrylated xanthan and methacrylated gelatin have been used to prepare films (by drying) and porous scaffolds (by freeze-drying) with inclusions of silver nanoparticles. FT-IR data confirmed the structure and composition of the NPs and prepared scaffolds. Scanning electron microscopy data indicated a homogeneous mixing of polymers and nanoparticles resulting microporous architecture and uniformly distributed pores at low content of NP or some clustering phenomena at increased content of NP. The volume of fluids retained in the prepared materials is highly influenced by the ratio between polymers, respectively by the NP concentration; the swelling degree values varied over a wide range (1000%-6000%). The materials are bioadhesive and the adhesive properties to substrate are strongly dependent by the polymers structuring and their interaction with silver nanoparticles. In vitro cytotoxicity tests (MTT method and calcein assisted fluorescence microscopy) showed that porous materials are cytocompatible.

S4-1.10

Effects of Nickel, Molybdenum, and Cobalt Nanoparticles on Photosynthetic Pigments Content in Cyanobacterium *Arthrospira platensis*

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Nanoparticles are utilized in the cultivation media of cyanobacteria and microalgae to enhance productivity and the accumulation of biologically active compounds. This study focused on investigating the impact of Ni, Mo, and Co nanoparticles stabilized with polyethylene glycol, which was added to the cultivation medium of the cyanobacterium *Athrospira platensis* (spirulina), at concentrations ranging from 0.25 to 2.5 mg/L, on photosynthetic pigments. *A. platensis* was cultured in a laboratory setting using a mineral medium supplemented with nanoparticles for 6 days. The results revealed that Ni nanoparticles, within the concentration range of 0.25 to 1.5 mg/L, did not alter the levels of chlorophyll and phycobiliproteins but led to an increase in the content of β-carotene in the biomass. On the other hand, the decrease in photosynthetic pigment content caused by Mo and Co nanoparticles was compensated by an augmentation in phycobiliprotein levels. These nanoparticles inhibitory or stimulatory effects correlated with their concentrations in the cyanobacterium's cultivation medium. The study concluded that the type of nanoparticles plays a crucial role in shaping the response of the spirulina culture by redirecting biosynthetic activity to maintain photosynthetic processes. Mo and Co nanoparticles, particularly at concentrations that stimulated phycobiliprotein synthesis, can be employed as stimulators in the cultivation technologies of the cyanobacterium *Arthrospira platensis*.

S4-1.11

Preservation of Microorganisms of Biotechnological Interest Involving Fe_2O_3, Fe_2ZnO_4, and ZnO Nanoparticles

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Microorganisms are inexhaustible and advantageous sources of bioactive substances, which is why they are widely used in biotechnology. The in-depth study of the interactions between microorganisms and nanomaterials opens new ways to improve the biosynthetic properties of microorganisms of biotechnological interest for their application in various technological fields. The use of nanoparticles in the process of cultivating microorganisms that have a beneficial effect on their biosynthetic properties facilitates obtaining valuable bioactive substances, as well as contributing to maintaining stable biosynthetic properties in the process of conservation and long-term storage. The effect of nanoparticles on the biosynthetic activity of microorganisms varies depending on the chemical composition, size, morphology and concentration of the particles, as well as on the physiological-biochemical particularities of the culture. In the process of lyophilization of microorganisms, numerous factors cause the appearance of various problems related to the safety of the initial properties of strains of microorganisms of biotechnological interest. The results of the research presented in this material, carried out on the basis of micromycetes of the genus *Trichoderma* and the genus *Penicillium*, demonstrate that the involvement of Fe_2O_3, Fe_2ZnO_4, ZnO nanoparticles in the preservation process by the lyophilization method can contribute to the stimulation of the strains' sensitivity to some phytopathogens. Thus, the application of nanomaterials in the process of long-term conservation of microorganisms of biotechnological interest, with the subsequent involvement of crops in obtaining biopreparations for agricultural use, contributes to increasing their efficiency in combating phytopathogens and obtaining ecological products.

S4-1.12

Synthesis and Study of Some Compounds with Antibacterial Properties Obtained from Nitrofuran and Chitosan Derivatives

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We report on possibilities to obtain new antibacterial substances based on chitosan polymer materials grafted with nitrofuran, isohydrafural and furacilin derivatives. The antibacterial properties were assessed via the serial dilution method in liquid nutrient medium (2% meat peptone broth), followed by re-cultivation of standard Gram-positive and Gram-negative bacterial cultures on peptone agar for 24 hours. Both composites obtained on the basis of chitosan grafted with isohydrafural or furacilin showed bactericidal activity against a wide range of Gram-positive and Gram-negative microorganisms, varying within the concentration of 75–300 µg/ml. Due to long-term 48 and 72-hour incubation of microbial cultures cultivated on peptone broth, obvious changes in increasing bactericidal activity of both composites were found over time. Thus, the antibacterial substances isohydrafurol and furatsilin among nitrofurans, grafted onto chitosan maleate, retain their bactericidal activity in the range of 75-300 µg/ml, have prolonged antibacterial activity and can be recommended as active substances in the development of new antibacterials.

YIC-5.S4

The Significance of Computed Tomography in Diagnosing Pediatric Tuberculosis

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Pediatric tuberculosis (TB) presents unique diagnostic challenges due to various factors, including the low sensitivity of sputum examination, difficulties in obtaining samples, and the presence of paucibacillary forms of the disease. This retrospective-descriptive study aimed to evaluate the role of Computed Tomography (CT) in diagnosing pediatric TB. A total of 142 pediatric TB cases were analyzed using CT scans. The most common CT finding was enlarged lymph nodes, observed in 86% of cases. Other notable findings included nodules (38%), parenchymal consolidation (27.5%), bilateral dissemination (2%), destructive changes (5%), pleural effusion (3%), Tree-in-bud appearance (1.5%), ground glass opacities (3.5%), bronchiectasis (2%), atelectasis (2%), calcifications in intrathoracic lymph nodes (6%), and calcifications in lung parenchyma (3%). These CT patterns played a crucial role in the accurate and timely diagnosis of pediatric TB, aiding in differentiating it from other conditions and facilitating the initiation of appropriate antituberculosis treatment. The integration of CT in pediatric TB diagnosis offers several advantages. It provides precise lesion localization, allows differentiation from anatomical landmarks, and enables comprehensive evaluation of the disease, especially in cases involving intrathoracic lymph nodes. By providing valuable anatomical and pathological information, CT enhances clinical decision-making and improves the management of pediatric TB cases. In conclusion, CT examination plays a vital role in the diagnosis of pediatric TB. Its ability to provide detailed imaging findings helps in accurate disease identification, differentiation, and prompt initiation of appropriate treatment.

YIC-6.S4

Mechanical Characterization of Decellularized Blood Vessels: A Valuable Tool to Provide Comprehensive Information about the Scaffold

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Cardiovascular diseases (CVDs) remain an important global health problem. Surgical revascularization (or bypass surgery) has been established as the most optimal therapeutic approach for patients with severe injury; however, not in all cases a suitable vascular substitute can be identified. The field of vascular tissue engineering and regenerative medicine aim to produce suitable tissue-engineered vascular grafts (TEVGs) for vascular repair, replacement, or reconstructive aims. Decellularization (DC) is a promising approach because it completely removes the antigenic cellular components. The goal of the proposed study was to examine the mechanical integrity of the decellularized porcine carotid arteries (a prototype of small-diameter vascular grafts).

The developed DC procedure included osmotic shock, chemical surfactant treatment, and enzymatic digestion. Agree to other DC protocols reported previously, we were able to demonstrate, on the one hand, complete removal of cells throughout the arterial wall by performing H&E staining and DAPI, on the other hand, good biomechanical properties of decellularized tissue by performing the suture retention strength testing. The average suture retention strength of native porcine vessels was 1.08±0.39 N. The average suture retention strength of decellularized vessels was 1.14±0.38 N ($p=0.0731$). In summary, the both control and treated vessels exhibited similar mechanical properties; the used combined method had beneficial effect in this study.

YIC-7.S4

Comparative Assessment of *in vitro* Effects on the Human Lymphocytes in Tuberculosis Patients of the Zinc Oxide Nanoparticles Biofunctionalized by Sulfated Polysaccharides from Spirulina

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The *in vitro* study of the influence of the zinc oxide nanoparticles biofunctionalized by sulfated polysaccharides compared with sulfated polysaccharides used the peripheral blood lymphocytes collected form 65 patients, new cases with pulmonary tuberculosis (TB). The patients were distributed in the main study group, which included 34 cases with multidrug-resistant TB (MDR-TB), divided in the 1st study group with 12 cases with primary drug-resistance and the 2nd study group with 22 patients with acquired drug-resistance during the anti-tuberculosis treatment, and the control group composed by 31 patients with drug susceptible TB The immunological indices were assessed through the lymphocyte's blast transformation reaction at phytohaemagglutinin and immune modulating index. The experiments demonstrated that the exposure of the lymphocytes to the biologically active compounds - zinc oxide nanoparticles biofunctionalized by sulfated polysaccharides exerted a higher immune stimulating effect compared with the purified sulfated polysaccharides. The biological activity was more pronounced on lymphocytes collected from the patients with primary drug resistance compared with those who acquired the drug-resistance during the anti-tuberculosis treatment and the effect was more pronounced in patients with drug susceptible TB compared with those with drug-resistant TB. The biochemical indicators of the glucose metabolism, identified a low glucose consumption, low activity of the aldolase and lactate dehydrogenase during the lymphocyte's proliferation test at phytohaemagglutinin, which was increased significantly at the exposure of the lymphocytes to the zinc oxide nanoparticles biofunctionalized by sulfated polysaccharides, and higher in the group of patients with drug-susceptible tuberculosis.

YIC-10.S4

Ionic Crosslinked Biopolymer-Ceramic Beads for Bone Tissue Engineering

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In several situation when bone integrity is prejudiced, advanced regenerative medicine approaches are involved in order to get a good result, being designed and applied synthetic tissue engineered architectures. This rapidly evolving interdisciplinary domain, tissue engineering, is centered on developing three-dimensional scaffolds, which can be prepared from ceramics, polymers or the combination between those two, resulting a complex material mimicking the composition of the natural bone. Among polymers, polysaccharides are a remarkable class, due to the inexhaustible source, great biocompatibility and versatility in terms of processability. Alginate and guar gum, included in this class have the ability to crosslink in the presence of Ca^{2+} ions, resulting easy to handle beads. Due to the similarity with human inorganic matter, calcium phosphates are used in orthopedy, frequently combined with polymers to overcome one of the main disadvantages of

ceramics: brittleness, which negatively influences mechanical behavior. All these aspects being considered, the aim of the study was to obtain alginate–calcium phosphate beads with inclusion of carboxymethyl guar gum nanoparticles as scaffolds for bone tissue engineering and analyze them in terms of morphology and composition (Field Emission Scanning Electron Microscope and Energy-dispersive X-ray Spectrometer), chemical structure (Fourier Transform Infrared Spectrometer) and behavior in simulated body fluids.

S4-P14

Interaction Between Thin Layers of Polysaccharides Studied by Quartz Crystal Microbalance with Dissipation (QCM-D)

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In this paper, the adsorption behavior of both unoxidized pullulan and its C_6 oxidized correspondent, onto cellulose films derived from trimethylsilyl cellulose (TMSC), was monitored using one of the most sensitive techniques namely Quartz Crystal Microbalance with Dissipation (QCM-D). Pullulan (Pu) was converted into its oxidized counterpart using a selective oxidation protocol that targets only the C_6 atom of the anhydroglycosidic unit and involves the presence of a trio of reagents: sodium hypochlorite, sodium bromide (co-oxidants), and a stable radical, *i.e.*, 2,2,6,6-tetramethylpiperidin-1-yl (TEMPO), in the role of mediator in water. The oxidation reaction was carried out at room temperature, and the resulted product, oxidized pullulan (OxP) analyzed using FTIR and ^{13}C-NMR. Buffer solutions of Pu and OxP were prepared at various pH values, and added into contact with thin cellulose layers, the interaction being *in situ* monitored by QCM-D. The cellulosic matrix deposited on the QCM-D crystals has been prepared by using trimethylsilyl cellulose (TMSC) as a precursor, following spin coating procedure and subsequent hydrolysis under acidic environment. Under the experimental conditions, the QCM-D studies demonstrate that at pH 5 and higher electrolyte concentrations, the highest adsorption occurs. Pullulan that hasn't been oxidized, adsorbs more effectively than its 6-carboxy derivative, which may be explained by the former's low water solubility and the potential for weak repulsive forces to form between OxP's anionic charged groups and the surface of the cellulose.

S4-P15

Synthesis and Study of Dextran: Zinc Aminomethylphthalocyanine Copolymers for Medicinal Applications

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This paper describes the synthesis and characterization of a new water-soluble zinc aminomethylphthalocyanine: dextran copolymers for medical applications. Mono-ZnAMPc has been synthesized by the hydrolysis of mono-(carboxybenzamidomethyl) ZnPc in an acidic medium using a closed reaction system. Dextran has been modified with cyclic and acyclic carbonate groups using triethylamine as catalyst. The FTIR spectra of the functionalized polymer show absorptions at 1805 cm^{-1} and 1745 cm^{-1} that indicated both cyclic and acyclic ethyl carbonate groups. Grafting of dextran to zinc aminomethylphthalocyanine was performed using ethyl chloroformate. The metal phthalocyanine content in copolymer varies in a range of (10–50) wt %. FTIR spectra of zinc aminomethylphthalocyanine:dextran copolymers indicated the appearance of new vibrations at (3300–3450) cm^{-1} and (1550–1650) cm^{-1} in the copolymers that confirm the presence of amide bound. It is found that the copolymers containing (10–30) wt % of zinc aminomethylphthalocyanine: dextran, ratio 1: 1, are water soluble. Also, for the solubilization of the copolymer, the DMSO: H_2O mixture was used. The UV–Vis spectra of the developed copolymers showed more broadening of Soret and Q absorption bands in water than in the DMSO: H_2O mixture. Mono-aminomethyl substitution enhances the solubility of ZnPcs, and dextran conjugation conferred water solubility.

S4-P16

Stem Cells in the Wrist Instabilities. Experimental Study

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Wrist joint instabilities are injuries associated with sprains, subluxations, dislocations, fractures, nonunion or osteoarticular diseases of carpal bones [Taqi, 2022]. There are different types of surgeries for treatment, one of option is arthrodesis [Ross, 2013]. It is a rescue surgery performed with the cost of some range of motion, but removing the pain and increase the strength of the hand [Buzu, 2014]. Our study was based on experimental research on 21 New Zealand rabbits and evaluation of benefits of stem cells using in wrist arthrodesis. For the initial stage, it was prepared demineralized bone grafts and bone marrow sampling. By tissue engineering was obtained osteo-cellular grafts (OCG) - allograft combined with isolated autologous stem cells. 3 study groups were formed, each by 7 laboratory animals. In the group A were performed standard arthrodesis of wrist joint, in the group B - arthrodesis with allograft, and in the group C - arthrodesis using OCG. In all cases the clinical and radiological evaluation was carried out immediate postoperative and at 4, 8 and 12 weeks. Computer tomography was done 12 weeks postop. Histological examinations also were studied. Our study showed that the arthrodesis of the wrist using the allograft have a good impact in the process of osteogenesis, but the best results were performed in the cases where it was used the allograft combined with autologous stem cells.

SECTION S5
Innovation, Development, and Interdisciplinary Research

S5-1.1

Design of the Hardware Subsystem of a Proposed Autonomous Drone

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The present paper aims to describe what are the steps to design and connect a minimum hardware subsystem to obtain a low-cost drone that might be useful in times of pandemics or hard-to-access areas, for the transport of medication or other necessary things. It also presents the limitations and possible future directions of improvement. The paper starts with a simple block diagram of an autonomous drone and describes the hardware elements that are used to assemble it and a solution for attaching/detaching of package. To carry out the action of detaching the package, a system composed of 2 components was created connected by a pin actuated by a servo motor. When coordinates are like the delivery destination's, the servo motor is activated and releases the box from the support. The described device is a low-price (approx. 240 euros) UAV that has the advantage of being used in hard-to-access areas or in the case of pandemics. The trend to use 3D printers, scanners, and DIY projects will lead to the development of UAVs that are already part of our daily life and the current pace of development will increase civil applications, but not only. The interest in this field should increase as even nowadays there still are areas hard to access due to pandemics, earthquakes, etc.

S5-1.2

Nanotechnology, Counterproliferation and Proliferation

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The interference of nanotechnology with chemical, biological, information and material sciences opens new horizons not only for peaceful but also offensive and defensive military uses. Nanotechnologies are revolutionizing weapons of mass destruction, offering prospects for new methods of manufacturing, delivery and miniaturization at the same destruction capacity. Nanotechnologies can also generate new weapons of mass destruction based on new principles. On the other hand, nanosensors could detect tiny quantities of chemical, biological, radioactive, or other agents in the environment, creating an effective early warning system. Some of these materials could even simultaneously destroy or annihilate harmful substances. For these reasons, countries with advanced results in nanotechnologies allocate impressive budgets for microelectronics and nanomaterials intended for detection and protection against biological, chemical and radiological threats as well as other types of new convention weapons.

This paper presents a brief review of the use of nanotechnologies for the proliferation and counterproliferation of weapons of mass destruction. The purpose of the article is to raise awareness among researchers regarding the responsibility of the possible use of research data in the development of weapons of mass destruction. As possible preventive measures, it is recommended to assess the risk at the initiation of the research, but also periodically during the subsequent phases of the research.

S5-1.3

The Recovery of Alpha-Lactalbumin at the Electroactivation of Whey

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The electroactivation of whey allows the recovery of α-lactalbumin in the protein mineral concentrates depending on the processing regimes, variation of the pH values, temperature, and the processing duration. The presence of α-lactalbumin in the lactose synthetase complex explains its recovery in the protein mineral concentrates towards the end of the processing at the maximum isomerization of lactose into lactulose according to the Amadori mechanism. During the electroactivation of whey, favourable conditions for the ”capture” of α-lactalbumin in protein compounds have been created. Electroactivation allows the recovery of whey proteins into protein mineral concentrates, ennobling them with certain protein fractions at different processing regimes and obtaining concentrates with a predetermined protein content at the simultaneous isomerization of lactose into lactulose. The nanostructuring of protein systems during the electroactivation of whey makes it possible to extract different whey proteins, especially α-lactalbumin which is recovered in mineral protein concentrates due to multiple inter- and intramolecular mechanisms and creates optimal conditions for ennobling mineral protein concentrates with α-lactalbumin. The intensive saturation of the whey with calcium ions, which migrate from the anode cell through the cation exchange membrane in the cathode cell, favors the formation of different protein complexes, especially of α-lactalbumin with bivalent ions.

S5-1.4

Antibacterial Activity of “Green” Silver Nanoparticles (AgNPs) in Combination with Benzylpenicillin and Kanamycin

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Due to the lack of progress in the development of antibiotics, there is a pressing need for innovative approaches to treat bacterial infections. Nanotechnology and repurposing existing drugs are innovative approaches that can potentially replace traditional antimicrobials. Silver nanoparticles (AgNPs) have the potential to not only exhibit antibacterial and antibiofilm properties but also serve as carriers for antibiotics and natural antimicrobial compounds. Our study involved testing the antibacterial activity of biogenic AgNPs and their complexes with the antibiotics benzylpenicillin (BP) and kanamycin (KM) against the growth of the gram-negative bacteria Escherichia coli K-12. The antibacterial activity of preparations studied with the disk diffusion method, determined the colony-forming activity by serial dilutions, and calculated the minimum inhibitory concentrations (MIC) of the preparations. Additionally, we determined the growth phases of Escherichia coli K-12. Our findings indicate that the AgNPs at the studied concentrations do not possess cyto- and genotoxicity. The results showed that the action of AgNPs in combination with BP against the growth of the bacterium Escherichia coli K-12 has a synergistic effect at concentration 0.5 mg/ml and higher, which can reduce the antibiotic dose up to 8 times, while in the complex with KM has additive activity, in this case, AgNPs reduce the active dose of KM by 30 times. The tested complexes have potential antivirulence effects that inhibiting the development of biofilm formation at concentrations below the MIC. These findings suggest that the complexes could be used as safe alternatives to antibiotics.

S5-1.5

Influence of CYP2C19*2 Polymorphism on Clinical Outcomes in Moldova's Patients Treated with Clopidogrel After Percutaneous Coronary Intervention

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Clopidogrel is one of the most commonly antiplatelet agents used for the secondary prevention of atherothrombotic events in patients with cardiovascular disease (CVD). Clopidogrel is a prodrug that requires biotransformation by cytochrome P450 (CYP450). This study evaluated the effect of genetic polymorphism in CYP2C19*2 on clinical response in Moldova's patients treated with clopidogrel after percutaneous coronary intervention (PCI) with drug-eluting stent (DES). A total of 172 coronary patients after PCI were treated with clopidogrel and aspirin for at least 6-12 months; we recorded major adverse cardiac events (MACE) within 6-12 months. The CYP2C19 polymorphisms were evaluated using TaqMan genotyping procedure. During a 6-12 months follow-up, the CYP2C19*2 carriers had an odds of cardiac death of 4.42 (95% CI 1.68, 11.65), of myocardial infarction of 8.69 (95% CI 2.95, 25.53), of stent thrombosis of 11.4 (95% CI 1.15, 112.98), and of unstable angina by 3.47 (95% CI 1.316, 9.149) compared with non-carriers (p<.001). The CYP2C19*2 gene polymorphism modulates the drug efficacy of clopidogrel in patients undergoing PCI and further enhance the risk of MACE. Clinical testing of CYP2C19 genotype can be used to personalize the selection of antiplatelet therapy and reduce the risk of major adverse cardiovascular events.

S5-2.1

The Impact of Biogenic Silver Nanoparticles on the Enzymatic Antioxidant System of Wistar Rats' Kidney

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Nanotechnology is an advanced and promising field that focuses on creating unique nanoparticles with various properties. Among them, silver-based nanoparticles have gained significant attention and are extensively studied. The liver and kidney are particularly vulnerable to AgNPs because they play a crucial role in excreting exogenous substances.

The objective of this research was to comparatively assess the effects of biogenic AgNPs, stabilized in a 50% extract of O. araratum, on the antioxidant system (AOS) of Wistar rats' kidney, considering different exposure durations. The activity of superoxide dismutase (SOD), peroxidase (PO), and the concentration of malondialdehyde (MDA) in the kidney homogenate of experimental animals were measured using colorimetric methods.

The study revealed that regardless of the duration of exposure, there was an increase in SOD activity. However, PO activity was inhibited, leading to elevated levels of hydrogen peroxide, as indicated by the higher concentration of MDA, after 7 days of exposure to stabilized biogenic AgNPs. On the other hand, exposure for 14 days resulted in the normalization of MDA content. Prolonged exposure to AgNPs reduced the destructive effects of rosmarinic acid (RA) and the extract. These outcomes shed light on the diverse properties of biogenic AgNPs responsible for inducing oxidative stress. However, despite this critical mechanism, protective mechanisms are also observed in vivo during long-term exposure.

S5-2.2

The Sentinel Surveillance System of Severe Acute Respiratory Infections Associated with Influenza in Children from Republic of Moldova

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Acute respiratory pathology has the highest incidence in children, the most vulnerable are still those aged up to 5 years. Extremely difficult are the cases with severe acute respiratory infections (SARI), manifested by pneumonia and bronchopneumonia associated with influenza. Essential method used is the sentinel epidemiological surveillance; molecular biology techniques in real time (rRT-PCR) to detect viruses in biological material (nasopharyngeal exudates); isolation of influenza viruses in cell cultures MDCK and MDCK-SIAT1 after WHO methodology; identification by the hemagglutination inhibition test with reference antisera for influenza A(H1N1) pdm09, A(H3N2) and B, provided by the WHO Collaborating Centre, National Institute of Health Researches (London, UK). Thus, it was found that SARI associated with the flu threatens the health and life of children, with a major risk in children aged between 0-4 years. In conclusion, the obtained results show, that the identification and evaluation of phenotypic, genotypic and antigenic properties of the influenza viruses, have a major importance, in the context of fairness policy, for the use of influenza vaccine in compulsory seasonal immunization of the children, optimizing the management of treatment and prophylaxis of influenza, including in combination with SARI, foreseeing epidemic process and reducing the negatively impact on the health system.

S5-2.3

Neural Circuits-Adjusted Diagnostic Approach to Predict Recurrence of Atrial Fibrillation

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Recently the high informational input on individuals of modern society is a real challenge for the capacity of the central nervous system. It has to overcome not just the big data amount, but also a state of permanent hyperactivity due to informationally-induced neuronal circuits, including artificially-induced neural circuits, originating from advertising and directed informational streams. Pathologically hyperactivated interconnectivity of the neural circuits leads to a permanently increased central component of heart rhythm modulation leading to favorable conditions for atrial fibrillation recurrence in patients with paroxysmal atrial fibrillation. Two new parameters of cardiorhythmogram analysis – low-frequency (LF) drops and high-frequency (HF) counter-regulation are dynamic indicators for the intensity of affection of the heart rhythm regulation by the pathological hyperactivity of the central nervous system. Here we show in the case-series study of 350 cardiorhythmograms of patients with paroxysmal atrial fibrillation, that the LF drops and HF counter-regulation are sensitive biomarkers to predict the onset of recurrence of atrial fibrillation. The hyperactivity of the central nervous system leads to atrial fibrillation onset. The increased centrally-driven heart rhythm modulation can be visualized on cardiorhythmograms by the feature LF drops. The capacity of the vegetative nervous system the compensate for this state in order to maintain normal sinus heart rhythm can be assessed by the HF counter-regulation. The features HF counter-regulation and LF drops reflect the answer of the heart regulation to the neuronal circuits-induced central hyperactivation and can be evaluated in the cardiorhythmograms for the prediction of atrial fibrillation recurrence in patients with paroxysmal atrial fibrillation.

S5-2.4

Predicting Pain Scores Using Personality Trait Facets and Personality Trait Domains Assessed by Personality Inventory for DSM-5

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Personality disorder is different from mental illness because it is more persistent during adulthood, while mental illness results from a morbid process of a certain type and has a more recognizable onset and evolution. Pain is a subjective experience that is influenced by genetic, gender, social, cultural and personal parameters. The link between personality disorders and acute pain has been shown to be increasingly significant because the link is bidirectional and, in both cases, they act as risk factors for each other.

The psychometric assessment was performed using the PID-5, the pain test was performed using a submaximal effort tourniquet technique. The relationships of potential predictors and pain perception in the first, second and third minute were estimated using regression analysis, bootstrap being applied for model stability estimation.

The analysis of the prediction models for pain perception in 5 domains of personality states that no domain was found as a predictor in first minute model, Negative Affect and Detachment which are included in the internalizing category were found as predictors in the 2nd minute model, same as the facets which are included in this category. Both facets included in Psychoticism domain and the domain itself were found as predictors in the 3rd minute model, with the inverse relationship.

Our results allow us to consider that personality changes can change the perception of pain, which requires corrections in the diagnosis and therapeutic approach of disorders associated with pain.

S5-2.5

Towards Improved Assistive Inertial Positioning Solutions by Using Finely Tuned Wavelet Functions

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In this article, we discuss improving navigation accuracy by refining signals achieved from the inertial navigation system's (INS) detection unit. The accuracy of navigation depends on inertial sensors to a large extent. However, their errors can cause interference with signals. Researchers have developed different calibration procedures to address this issue to integrate INS navigators with other navigators. Two types of errors exist - deterministic and stochastic. Sensor noise greatly affects navigation solution quality. Traditional noise reduction methods cannot directly filter noise in the navigation signal due to its frequency spectrum. An alternative option is to use wavelets to denoise signals from inertial sensors. Our methodology uses fine-tuned wavelet functions and the Directed Transfer Function approach to eliminate noise interference with the sensors' signals. Reference signals obtained from Global Positioning Satellites (GPS) are utilized during the tuning process. We tested our technique by installing an INS navigator with a micro-electro-mechanical (M.E.M.S.) inertial measurement unit and a GPS navigator in a portable assistive device. We optimized the wavelet filters' decomposition levels for each inertial sensor in the measurement unit by analyzing experimentally acquired data. This method can significantly impact various industries, including human assistive technologies, transport, and logistics. It can also be extended for indoor monitoring purposes.

YIC-1.S5

Thyroid Hormones Interpretation in Children With Juvenile Idiopathic Arthritis

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It is well known that thyroid hormones are extremely important for the linear growth of the human body and skeletal maturation. There are substantial changes in thyroid-stimulating hormone (TSH) and thyroid hormone levels over childhood. Little is known about the association between juvenile idiopathic arthritis and thyroid dysfunction or autoimmune thyroid disease itself. Juvenile idiopathic arthritis (JIA) is a chronic inflammatory arthritis of unknown origin which can be considered an autoimmune disease. On the other side, autoimmune thyroid disease is the most common thyroidopathy in children and adolescents. Routine biochemical examination of thyroid function in rheumatic patients should be strengthened. In this paper we discuss the relationship between JIA and thyroid dysfunction. Through our study we revealed significant differences in the interpretation of thyroid hormones according to percentiles by age and sex compared to the results obtained by applying the standard references of the laboratory. Furthermore, we proved a highly significant, directly dependent correlation between the absolute and categorical values of the percentile for TSH (r=0.936) and thyroid hormones, as well as for free thyroxine (fT4) (r=0.955), and free triiodothyronine (fT3) (r=0.752). Thus, we highlight the importance of age- and sex-specific reference intervals for TSH, fT3 and fT4 in pediatric population, especially in those with a chronic condition, like in JIA.

S5-P17

Nutritional Quality of Bread and Bakery Products. Case Study: Republic of Moldova

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Within nutritional food models, the role of carbohydrates is essential in understanding the evolution of non-communicable, diet-related diseases and in proposing effective interventions, and bakery products, especially bread, play a central role in this scenario, as they remain the staple foods of human nutrition, providing 70% of people's food. This research aims to evaluate the nutritional quality of bread and bakery products packaged and sold in the Republic of Moldova through the lens of nutritional and health claims. The product categories selected for the research included bread and bakery products with and without gluten, packaged and sold in markets in Chisinau. A total of 155 products were validated. The quality of local bread, packaged and sold in the Republic of Moldova, evaluated according to the nutritional and health claims, for the most part, falls into the categories of *low-fat content*, *low saturated fat content*, *low sugar content*. Still, it has significant deficiencies in regarding the fibre content, whose contribution to human health and well-being is proven. At the same time, the results obtained show that the insistence of research and efforts in the development of gluten-free products to improve nutritional aspects have yielded results. The results of the study could be applied to guide the formulation of dietary standards, improve labelling systems, and help consumers make informed choices about healthy foods. At the same time, nutrition assessment studies are needed through valid and effective assessment systems considering multidimensional indicators.

S5-P18

Environmental, Activity-dependent Modulation of Theta Rhythm During REM Sleep by its Selective Deprivation and Subsequent rebound

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The work is aimed at experimental testing of the possibility of an activity-dependent increase in power and representation of theta rhythm (4-8Hz) in REM sleep episodes. Polysomnography was performed in mature male rat (n=20) by means of electroencephalogram, electrohippocampogram, electrooculogram, electromyogram (EEG)/EHpG/EOG/EMG) leads using "Spike4" software (Cambridge Electronic Design) and was combined with video behavior monitoring. Recordings were repeated three times: baseline, selective REM sleep deprivation, and post-deprivation recovery sleep during daylight hours (08:00 am–06:00 pm). 8 electrodes were implanted by neurosurgical interventions using general anesthesia by inhalation of oxygen and isoflurane (1-3%) mixture. Interruption of REM sleep episodes was implemented by auditory stimulus application (natural alarm rat squeaking) of different intensities (50-60 dB). For arousal estimation the latency and desynchronization of total power of EEG and EHpG theta rhythm after stimulus application were measured. Total spectral power of theta band was determined for ten 5-second epochs. Theta/delta ratio (T-ratio) was calculated. Statistical analysis was realized by use of ANOVA method. Averaged total spectral power of EEG and EHpG theta rhythm during post-deprivation recovery sleep was gradually increased within REM sleep episodes elevated by frequency and duration in comparison with baseline recordings. The theta/delta ratio was also enhanced in EEG during post-deprivation sleep. The selective interruption of REM sleep episodes can provoke explorative behavior and modulation of synaptic plasticity in neocortex-hippocampus networks associated with REM sleep rebound during post-deprivation recovery. Theta rhythm enhancement may reflect intensification of spatial-temporal and emotional memory formation in REM sleep episodes during post-deprivation recovery.

S5-P19

Application of the Josephson Junction for the ANNs Energy Efficient Memory

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For progress in the field of high–performance computing and artificial intelligence, it is necessary to improve the energy efficiency and density of integration of existing circuits, which can be realized only with the use of a new element base - superconducting neurons and synapses. The proposed study is relevant due to the possibility of developing new energy-efficient computers with non-von Neumann architecture based on elements of superconducting spintronics. For this reason, the use of superconducting materials seems to be the most promising direction that meets these tasks. Traditionally, in superconducting logic and memory, information is associated with a quantum of magnetic flux, which, firstly, limits the degree of integration (a cell must contain one quantum of flux), and secondly, determines the localization of information, which complicates the physical implementation of information processing algorithms. These limitations lead to a low functional density of existing superconducting circuits and make it difficult to develop circuits based on non-classical principles of information processing, such as deep neural networks, which are key components in the creation of artificial intelligence. Recently, fundamental physics research in superconductor-ferromagnet thin-film tunnel structures based on magnetic Josephson Junctions created a new opportunity to solve this long-standing problem.

S5-P20

Combination Thermostated Vacuum Gauge

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To expand the measured pressure range, a prototype of a CVG-3 combination vacuum gauge using different physical principles of pressure measurement has been developed and constructed; it includes an electronic controller and a specially designed TTD-2 deformation–thermoelectric combination transducer. The transducer includes thermoelectric and deformation sensors. The sensitive element of the thermoelectric sensor consists of an electrically insulating film with heating and measuring circuits formed on the film surface by vacuum deposition; the measuring circuit is an array of thermocouples. The use of a thin insulating film in constructing the sensitive element has made it possible to significantly expand the measured pressure range toward high vacuum. The sensitive element of the deformation sensor is a silicon chip with a thin membrane in the middle; a tensoresistive bridge is formed on the membrane surface. The decrease in the membrane thickness has made it possible to increase the sensitivity of the sensor at pressures below 1 Torr. To decrease the pressure measurement error depending on changes in ambient temperature, the sensors are thermostated. Each sensor has an individual thermostat. The use of the thermocouple and tensometric principles of pressure measurement has made it possible to expand the measured pressure range from deep vacuum to atmospheric pressure, while maintaining high measurement accuracy. The large overlap of the measurement ranges of the sensors has made it possible to exclude jumps in the vacuum gauge readings upon switching from one physical principle of pressure measurement to another.

SECTION S6
Bioinformatics, Biomedical Signal and Image Processing

S6-1.1

Measurement of Biokinetic Parameters with the CvMob Program at the Level of the Lower Limb with a Functional 3D Printed Knee Orthosis

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The aim of this research is to evaluate the kinematic parameters, velocity and acceleration at the knee joint during flexion and extension using a functional 3D printed knee brace. For this purpose, the Contemplas system was used together with the CvMob program to record and analyze knee movements in real time.

The subject wore a functional knee brace that was activated at an angle of 30 degrees. The Contemplas system recorded images of the knee motion during flexion and extension, and the CvMob program was used to analyze the kinematic parameters through discrete graphics.

The obtained results revealed significant changes in the kinematic parameters of the knee during the use of the functional knee orthosis. The velocity of knee flexion and extension was assessed and plotted in distinct graphs, highlighting changes in knee joint motion. Acceleration was also measured and analyzed in the context of orthosis use.

The Contemplas system and the CvMob program provided an efficient way to record and analyze knee movements, allowing a detailed assessment of knee joint performance.

This research demonstrates the importance of using the functional 3D printed knee orthosis, together with the Contemplas system and the CvMob program, in assessing and improving kinematic parameters, velocity and acceleration at the knee joint. These results can be applied in the development of personalized rehabilitation and therapy strategies for patients with knee conditions and injuries, with the aim of improving the functionality and mobility of the joint.

S6-1.2

Legal Frameworks for the Integration of Artificial Intelligence

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The lightning-fast development of artificial intelligence and neural networks in general has had a tremendous impact on many different fields, and biological engineering is only one of those fields. These innovations have the potential to completely revolutionize the field of medicine by enhancing diagnostics, treatment planning, and tailored medication. This might be accomplished. However, there are ethical and legal concerns about the manner in which they should be incorporated into biomedicine. This study's objective is to investigate the existing legal frameworks that regulate the uses of artificial intelligence and neural networks in biomedical engineering and to evaluate how effectively such frameworks address the challenges posed by technological inclusion. On a global, regional, and national basis, we evaluated the rules and regulations that regulate the use of artificial intelligence and neural networks in biomedical engineering. These laws and regulations control the field. According to the findings of our research, even if the current legal frameworks have been improved in some respects, substantial problems are still present. These problems are particularly prevalent in the areas of data privacy, algorithmic responsibility, and ethical dilemmas. Also, the article discusses the need of doing ongoing evaluations and making adjustments in order to keep up with the fast advancement of artificial intelligence and neural networks in the area of biomedical engineering.

S6-1.3

Irregular Step of Changing for Neural Network Data Sets Improves the Accuracy of Resistive Sensors Calculation

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A linear multiport is considered as a model of multiwire communication lines with resistive sensors of physical quantities or as a model of the sensors themselves. The calculation of sensor resistance from measured input currents using a neural network as an approximation problem is investigated. To demonstrate such a problem, using the parameters of multiports with one and two sensor loads, the corresponding number of input currents for a particular set of loads is calculated in a given range of changes in their values. The input and target vectors are composed in this way. The dimension of the input vector is equal to the number of input currents. Numerical experiments were carried out in the MATLAB Deep Learning package for the feed-forward network. The trained model is further tested on the control data set to ensure the given computation accuracy conditionally for "all possible" load values. The data sets generation is carried out with both the traditionally constant and an irregular or variable step of change in values. For the irregular step, in the divided data into training, test and validation sets, an internal pattern is excluded and the network shows a greater ability to generalize. The same control data set shows a reduction in relative error for a series of numerical experiments. The repeatability of training results with preset value of relative error is introduced, as special index for quantitative assessment of training quality when comparing training results of neural networks with generated training data. The obtained results provide the basis for the study of both chains with a large number of loads, as well as other approximation and regression problems.

S6-1.4

Statistical Distortion Detection of Interference Microscope Image

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The purpose of the article is reducing distortions of geometric characteristics which characterize the density uniformity of the erythrocytes quantity distribution on the plane of the microscope image due to the technical improvement of the optical scheme of the polychrome microscope, based on the use of the coherent source of light. For a comparative study of the operational properties of a semiconductor light source, two types of lasers were chosen: laser 1 is a light laser diode and laser 2 is a laser module with additional optical elements. The image plane was divided into 36 rectangular zones: 4 central, 12 intermediate and 20 edge. Counting of uniformity distributed erythrocytes number for each of the zones made it possible to statistically compare the distortions of the initial uniformity for lasers 1 and 2. The use of linear regression analysis with applying Fisher's F-statistics for evaluation of the regression statistical significance led to important conclusions. Statistical analysis showed that for lasers 1 and 2 there are different geometric curvatures of the image. Laser 2 has order of magnitude smaller edge effects for the aver-age density of erythrocytes quantity for each of the 36 zones created with a help of modified chamber equivalent to a Goryaev chamber. It is proved that the edge effects for laser 1 are statistically uniform over the entire perimeter of the image. As for the laser 2, its use does not provoke geometric curvatures of the image, including geometric models of edge effects. The presence of additional optical elements in the laser 2 solves the problem of technical improvement of the light source, ensuring the achievement of the purpose.

S6-1.5

Mathematical Modelling of the Multifactorial Influence of Striking Fragments on the Dynamics of the Rehabilitation Processes of the Wounded

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The article analyses the possibility of solving an important scientific and technical problem that is relevant for the security and defence of any country where natural and man-made disasters, military conflicts and other emergencies occur, in which penetrating injuries of people occur. The article reports on the possibility of improving the efficiency of the rehabilitation technology for patients with penetrating gunshot wounds by reducing the rehabilitation period using modern methods of medical diagnostics, mathematical modelling and statistical methods for processing biomedical information. The scientific idea underlying the conducted research is that dynamic changes of a set of biomedical indicators depend not only on the time of their observation, but also on the levels of those physical factors that characterize physical parameters: temperature and dynamics of fragments. As a working hypothesis, in this case, it is possible to consider the inverse task, in which it is possible to solve the problem of assessing the levels of physical factors characterizing fragments using measurements of biomedical indicators during the initial examination of the wounded. In the paper, the authors substantiated the possibility of using primary biomedical measurements to assess the physical characteristics of fragments. This, in turn, makes it possible to take into account the characteristics of the physical impact of fragments on the dynamics of changes over time in biomedical indicators characterizing the treatment, and will lead to a reduction in rehabilitation time.

S6-1.6

NLP Tools for Epileptic Seizure Prediction Using EEG Data: A Comparative Study of Three ML Models

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Natural Language Processing (NLP) is an ever-evolving field of computer science that involves the development of algorithms that can process, analyze and understand human language. One of the most exciting areas of NLP is the creation of NLP language models with applications across almost every industry. However, most people only associate NLP with its traditional use in language translation, sentiment analysis, and chatbots. In reality, there are many less-common uses for NLP models that have the potential to transform businesses, improve customer experiences, and even save lives. In the healthcare industry, NLP models can be used to analyze unstructured medical data and help diagnose and treat patients more efficiently. For example, NLP can be used to analyze clinical notes, lab results, and other data combing through vast amounts of data to identify patterns and create targeted treatment plans. NLP-based medical diagnosis is still in its infancy, but it has the potential to revolutionize the healthcare industry in the coming years. This article explores a less common use of machine-learning language models built on transformed EEG data for epilepsy prediction using the Kolmogorov-Chaitin algorithmic complexity as the first step in generating text-like data, which are finally used for building machine learning models.

S6-1.7

A Less Common Algorithmic Complexity Approach to EEG Signal Processing for Machine Learning

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Electroencephalography (EEG) is a widely used neuroimaging technique that records the electrical activity of the brain. EEG analysis provides valuable insights into brain dynamics and understanding of neural processes. As EEG data analysis relies heavily on signal processing and statistical analysis, it is crucial to have a robust framework for analyzing EEG data that produces reliable results. One very useful framework for EEG data analysis is the use of algorithmic complexity measures. Algorithmic complexity is a measure of the complexity of a given sequence of data such as the EEG waveform. It provides a way to quantify the amount of randomness and predictability within EEG data. Along with traditional complexity measures like Sample Entropy, Hurst Exponent, Multiscale Entropy, etc., there is a less-known approach involving Kolmogorov-Chaitin algorithmic complexity, which is a mathematical approach used for measuring the complexity of a string of information. It is based on the idea that a complex string of information cannot be compressed or represented by a simpler algorithm. The advantages of using Kolmogorov-Chaitin complexity include its objectivity, non-linearity, ability to capture content and robustness. This paper presents the basics of the later approach and shows how it can be used for machine learning on EEG data.

S6-1.8

Opportunities and Risks in the Use of Artificial Intelligence Models in Healthcare

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The advancements in artificial intelligence are triggering discussions on transforming many processes in the industry, society or economy, including the healthcare sector. The new capabilities offered by emerging technologies applied in healthcare help deliver more accurate and efficient diagnoses and treatment options. Artificial intelligence models can be used for various purposes in healthcare, from functions such as personal assistant, up to analyzing data an providing recommendations for tasks such as medical imaging analysis, drug development, disease identification, and emergency support. Furthermore, artificial intelligence models can support research actions, to speed up the development of certain cures or medicines. They can also assist in detecting high-risk conditions in patients, discovering and researching new drugs and medicines, and developing of new treatment plans. However, these digital technologies come with cybersecurity risks, both due to the underlying technical systems, such as computers used, up to the risks or issues in the models themselves, which can lead to questions on the accuracy of the recommendations and solutions provided by the models, or data breaches and cyber-attacks. Such incidents can lead to serious consequences, including compromised data privacy and safety. This paper presents some potential use cases of the AI model in the healthcare industry. In addition, several cyber security recommendations are offered to ensure that the adoption and use of such emerging tools minimize potential cyber risks.

S6-1.9

In vivo and in silico Studies of the Neuroprotective Effect of Artemisinin in Prevention of Alzheimer's Disease in an Animal Model

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Currently, artemisinin (ART) and many of its semisynthetic derivatives are considered as potential neuroprotectors. The effect of ART in an animal model of Alzheimer's disease (AD) induced by aggregated amyloidogenic peptide $A\beta_{1-42}$ was studied by electrophysiology and morphology analysis to detect changes in brain memory caused by activation of the entorhinal cortex as synaptic potentiation and depression as well as identifying a correlation with in silico studies of the direct interaction of ART with amyloidogenic peptides $5A\beta_{17-42}$ and $18A\beta_{9-40}$.

We have shown the preventive effect of ART in an animal model of AD. Electrophysiological studies showed that in the pre-injection of ART, there is an obvious and significant decrease in excitotoxicity, which precedes both depressor and excitatory post-stimulus effects, approaching normal, indicating its powerful protective effect. Protection was more effective in relation to the depressor sequence. Histo-morphological analysis showed that the preliminary injection of ART acts as a neuroprotective agent that prevents or slows down damage to brain tissue and also promotes the restoration of neurons and their environment.

The conducted in silico studies indicate the direct interaction of ART with amyloidogenic peptides $5A\beta_{17-42}$ and $18A\beta_{9-40}$ with high binding energies. At the same time, ART can stop the formation and growth of the $18A\beta_{9-40}$ fibril, as well as destabilize the already formed amyloid, which correlates with in vivo studies.

S6-1.10

Methodology and Use of Experimental Techniques in Analyzing Wound Dynamics of Penetrating Injuries

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This research paper focuses on the experimental studies of the process of high-speed object penetration into human body simulators and the automated registration of physical phenomena parameters related with this process. It highlights the need for a comprehensive understanding of the physical processes involved and the challenges posed by the lack of biomedical information. It emphasizes the importance of studying the volume and characteristics of damage around the wound channel. The paper also proposes a methodology encompassing mathematical modeling, experimental studies using non-biological simulators, and data processing techniques to investigate wound dynamics. An experimental setup with a distributed information and measurement system is presented, enabling the collection and analysis of physical parameters during penetration impacts. The structure of a distributed information-measuring system has been developed that allows recording the parameters of physical processes that occur during the penetration of a high-speed object into the simulator. The problem of synchronization of many distributed sensors, which is important for recording the parameters of short-term processes, is analyzed in detail. An example of obtaining data when launching a high-speed object into a simulator using an electric mass accelerator within the framework of the proposed system is given. The research aims to enhance medical practices, and protective equipment design, contributing to improved treatment outcomes and patient care.

S6-1.11

Computational Modeling and Analysis of Wound Formation in Gunshot Injuries

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This research aims to investigate the physical processes accompanying high-speed element penetration in gunshot wounds and understand the formation of wound channels, trajectory characteristics of bullets, and damaging effects on surrounding tissues. The study utilizes 3D computer modeling to simulate high-speed element penetration based on the 3D finite element method (FEM).

The paper presents a methodology of computer simulation with mathematical basics and algorithmic descriptions. The approach uses direct explicit numerical integration over time for the impact of the metallic bullet into the gelatin block specimen that analyses within the framework of its plasticity considering the nonlinear pressure dependence in a shock wave. The algorithm of simulation incorporates the process of material destruction, where elements that reach critical strain values are removed from the model. The study provides insights into the behavior of different bullet types and their impact on tissue deformation from computational experiments that simulate the penetration into ballistic gelatin of two types of bullets, the 7H6M type, and the V-max type. The simulation results reveal the distribution of equivalent stresses in the wound channel at different moments in time. Additionally, the study analyses the penetration depth and diameter of the damaged material for both bullet types. The developed 3D computer modeling method can serve as a valuable tool for further investigations, facilitating the development of advanced medical treatments

S6-1.12

Multimodal Machine Learning for Sign Language Prediction

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Numerous applications, including translation tools, interpreting services, video remote interpreting, human-computer interaction, online hand tracking of human communication in desktop settings, real-time multi-person recognition systems, games, virtual reality settings, robot controls, and natural language communications, benefit from sign language recognition advantages. Multimodal data contains information from different sources such as video, sensors, electrocardiograms (ECGs), while emotions refer to the non-verbal cues that accompany language use, such as facial expressions and body posture. Integrating these additional sources of information helps to better understand the user's intent, which improves the performance of the sign language recognition model. To build such a model, a set of multimodal data and emotions must be collected. This data set should be differentiated and cover different individual/isolated signs, emotions and body gestures. The model isdesigned to integrate multimodal data and emotions, which would involve combining different machine and deep learning algorithms adapted to different types of data. In addition, the model will need to be trained to recognize the different emotions that accompany sign language. Once the model is trained, it can be tested on the test dataset to assess its performance and also plan for a test on real data (with signing people). In this paper we propose a study to use the multi-modal machine learning for sign recognition language.

S6-1.13

Unsupervised Knowledge Extraction from Biomedical Data

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In this paper we introduce a study on the use of the unsupervised representation learning on biomedical data i.e. on Growth weight data and Wisconsin Diagnostic Breast Cancer obtaining good performances in terms of clustering In this study, we propose an adaptation of the unsupervised topological learning to deals with biomedical datasets based on a new approximation strategy to visualize high dimensional datasets. In data containing high-dimensional data manifold, the level of the discrepancy changes depending on the dimension of intrinsic data manifold. Then the strength of the repelling power is dependent of dataset. The proposed approach is based on t-SNE (Stochastic Neighbor Embedding) dimensionality reduction method with a different inhomogenous approximation strategy of the t-Distribution. In order to avoid the exponential computation we propose an inhomogenous approximation of the t-Distribution having the precision order of 10-***3***. By using this inhomogenous approximation we allow to optimize approximately the t-Distribution with respect to the number of degree of freedom and also to reduce the computational time. We illustrate the power of the proposed approach with two bio-medical real datasets and the obtained results outperform classical SNE and t-SNE methods.

YIC-14.S6

Approaches to the Processing and Segmentation of Non-electrical Biological Signals

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In this paper, the signal processing of non-electrical biosignals is studied and a number of results are presented. One of the most famous examples is that of the respiratory cycle. So that recordings of respiratory signals can often have a series of artifacts/noises at the time of signal acquisition. To eliminate these noises, a variety of high-performance digital filters are needed. Carrying out a filtering as thorough as possible depending on the type of signal given for analysis and the type of filter chosen for processing. After filtering, the biosignals can be exported, allowing a doctor to analyze this information and establish a diagnosis or a certain medical behavior. The working and display interface of the processed signals was developed with the help of the MATLAB 2021B software for the digital filtering of the signals and also for their segmentation according to the type of recognized noise. Having introduced a series of functions necessary for filtering and segmenting the signals given in the analysis. The digital filter specific to respiratory cycles being Butterworth that responds to the frequency range of interest. In addition to this filter, the High pass, Low pass filters and last but not least the Notch 50Hz filter were also implemented. Certain functions were also introduced to segment signals according to function. Recommendations are presented for selecting the most appropriate topology for the applied filter, whether it is finite impulse response or infinite impulse response. In order to check the filter results, we accessed the public database "ICBHI 2017 Challenge". This reference database supports those who want to evolve in the field of respiratory parameter analysis and research. The paper compares (before and after filtering) a series of respiratory biosignals, which can be exported for analysis and comparison.

S6-P21

UV-A to Red Light Induced Neutrophil Extracellular Traps

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Neutrophils play an important role in the pathogenesis of inflammatory, autoimmune, and oncological diseases. In this study, we investigated the role of radiation in a wide range of wavelengths, from UV-A to red visible light, based on the concept of photoacceptance by two cytochromes: cytochrome_b_{558} and cytochrome_*c* oxidase. Raman spectroscopy was applied to record characteristic Raman frequencies of radicals, particularly hydrogen peroxide and hypochlorous acid as well as the spectrum of citrulline in the low-frequency lattice vibrational modes. Using selective inhibitors of NADPH oxidase (apocynin) and PAD4 (GSK484), we have demonstrated different effectiveness of NET suppression depending on the activation wavelength. We recorded sharp peaks of ROS and citrulline in the process of neutrophil irradiation, indicating the involvement of intracellular ROS during light exposure. In conclusion, we believe that the development of new drugs designed to suppress NETs can lead to the inhibition of the NET formation at sites of UV and visible light exposure and, as a result, to decrease in the symptoms of UV-induced photoaging and other organ damages.

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Author index

D

E

F

G

H

O

P

Q

R

S

T

U

V

A

Notes

Notes

Notes

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