Book of Abstract

APMAS 2023

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13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

11-17 October 2023

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PLENARY SPEAKER

Id-2340

Pristine and Functionalized Cellulose at the Service of Medicine

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Abstract: The present lecture is focused on the recent advances on cellulose (from macromolecular size to fibers morphologies) and its chemical modification (mainly surface modification), as a starting material for medical applications. It will be divided into three parts:

1. The first part will be devoted to the basic consideration on cellulose, its origin and current and perspective uses with a special focus on those aiming at helping medicine in specific challenges.
2. Then, surface phenomena with a special care about the difficulties associated with surface contamination, the surface energy characterization, the surface properties determinations, will be given, with a focus on the potentiality of providing high-added value functions to these natural renewable resources.
3. The third part points out the most relevant surface modification strategies to which the cellulose surface could be subjected, in order to graft new functions. These include, (i) physical treatments (ii) chemical grafting by direct condensation, “grafting from” and “grafting onto” approaches. In this context, recent works investigating green solvent-based or solvent-less systems will be reported .
4. All these treatments aim at providing these substrates specific functions, such as hydrophobic character, anti-microbial properties, etc.. Typical examples of achievements in this field will be given and discussed, with a special focus on those aiming at helping medicine in specific challenges. Thus, active surfaces (antimicrobial for example) working in contact or release modes will be given. Other energy providing cellulose-based medical devices will also described and discussed.

Finally, some relevant concluding remarks and perspectives will be given.

Keywords: Cellulose, Nanocellulose, Functionalisation, Chemical grafting, Medical applications.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

PLENARY SPEAKER

Id-2448

Advancements and Future Prospects in FinFET Technology: Unleashing the Power of Next-Generation Transistors

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Abstract: FinFET technology has emerged as a game-changing solution to address the performance and scalability challenges faced by traditional planar MOSFETs. With continuous advancements, FinFETs have evolved to offer enhanced device performance, reduced power consumption, and improved integration capabilities. This talk explores the latest developments in FinFET technology, highlighting key advancements and their impact on semiconductor industry. We begin with an overview of the historical background of thin-film transistors (TFTs) and their limitations, which led to the development of FinFETs. We discuss on the motivation behind transitioning to FinFETs, including the need for improved control over short channel effects and reduced leakage currents. Subsequently we lay fundamental concepts of FinFET technology, explaining the unique structure of FinFETs and their advantages over traditional planar devices. We cover critical aspects such as the fin height, fin width, and gate length, which significantly influence device performance and scalability. Presentation highlights the role of high-k dielectrics in FinFETs to mitigate short channel effects and enhance gate control. It explores the adoption of innovative materials, such as ε-functionally graded dielectrics (ε-FGMs) and their potential to further improve device performance through tailored electrical properties. We also discuss the various challenges associated with FinFET technology, including process integration, variability, and power dissipation. It presents recent developments in addressing these challenges, such as advanced fabrication techniques, variability modeling, and power optimization strategies. We finalize with future of FinFET technology. We emphasize ongoing research efforts in areas such as device scaling, novel materials, and device architectures, which aim to push the boundaries of semiconductor technology and drive the development of next-generation nanoelectronics.

This comprehensive overview of the latest developments in FinFET technology provides valuable insights into the advancements and challenges in the field. It may serve as a foundation for researchers, engineers, and industry professionals to stay aware of the current state of FinFET technology and its potential for shaping the future of semiconductor devices.

Keywords: FinFET, thin-film transistors, high-k dielectrics, ε-functionally graded dielectrics, device performance, power dissipation, scalability.

PLENARY SPEAKER

Id-2451

Barocaloric Materials for Sustainable Heating and Cooling

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Abstract: Half of the world's CO_2 emissions can be attributed to heating and cooling. This is primarily due to heating with natural gas and cooling with compression of greenhouse gases, which are neither environmentally friendly nor energy efficient. Therefore, there is great interest in developing solid-state heat pumps that can replace these environmentally damaging technologies. During this talk I will describe our work on mechanically responsive barocaloric materials and present our recent advances on barocaloric heating and cooling systems.

Keywords: Emission, barocaloric, heating, cooling.

PLENARY SPEAKER

Id-2453

Bose-Einstein Condensation of Photons and a Non-Hermitian Phase Transition

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Abstract: Bose-Einstein condensation has been observed with cold atomic gases, exciton-polaritons, and more recently also with photons in a dye-filled optical microcavity. I here report on experiments observing a non-Hermitian phase transition in a photon Bose-Einstein condensate realized in the dye-microcavity pla tform. The dissipative phase transition occurs due to an exceptional point in the condensate that is associated with the (small) system losses. While usually Bose-Einstein condensation is separated by a smooth crossover to lasing, the presence of the here observed phase transition reveals a state of the light field characterized by a bi-exponential second order coherence that is separated by a phase transition from lasing. In more recent work, we have performed a critical test of the thermal nature of the photon condensate coupled to the reservoir of photo-excitable dye molecules by probing the fluctuation-dissipation theorem in this system.

Keywords: Bose-Einstein condensation, Optical quantum gases.

PLENARY SPEAKER

Id-2485

Transformative Carbon Engineering Driving Our NextGen Energy and Smart Device Industry

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Abstract: Presentation will highlight global race in technology development for future energy security and the role of carbon materials as a driver. From semiconductor to biosensors to advanced automation industry are in the race to win nanoscale technology development that not only requires highly scare metals but also highly specialized fabrication skills. Nanofabrication and their art of manufacturing is not going to replace by AI for a long time to go. Therefore, the drive to miniaturize fabrication process with state-of-art equipment needs outstanding human led skill to win the race of technology world in decade to come. In this area we shall bring a global overview on how nanofabrication of materials are rapidly evolving in diverse supply chain and their implication in managing supply chain of materials and skill driven energy sectors. More specifically we can highlight the role of skillsets and carbon-based nanofabrication technology that is going to bring transformative changes in the future battery, hydrogen fuel cell and renewable energy technology revolution. More specifically we shall highlight case studies that involves leading edge carbon nanoscale engineering and its unprecedented functionality that are drive the energy sectors including solid state and structural batteries and the role of carbon in catalytic transformation of renewable energy including methanol to hydrogen transformation. In yet another case study we discuss future outlook for an AI driven functional lightweight materials technology integrating artificial-intelligence (AI)-inspired robotics to fabricate state-of-the-art CFC battery pack casings with unparalleled fire-proofing, crashworthiness, and metal-like stiffness for Auto-makers next-gen EV battery systems. Dispersion-impregnation, melt-coated prepregs, and thermoplastic overmolding. In the dispersion-impregnation process, powdered functional graphene and reduced GO (RGO) with nano-layered graphitic structure will be dispersed in melt-phase polyamide to impregnate tuned graphite applying a high shear in a thermo-kinetic-mixer to exfoliate the graphitic interlayer. Design, modelling and performance of chemical barrier properties with increased surface coverage, enhance flame-retardant carbonaceous thin layer formation, and improve EMI shielding characteristics by improving electron flow through graphitic crystals interlayers of the reduced band gap will the key features of the presentation.

Keywords: Energy, Energy Materials, Battery, Fuel Cell, Green Hydrogen, Renewable Fuel, CO_2.

PLENARY SPEAKER

Id-2521

Nano-/subnano-liter Droplets

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Abstract: Droplets of nano-/subnano-liter are useful in a wide range of applications, particularly when thei r size is uniform and controllable. Examples include biochemistry, biomedical engineering, food industry, p harmaceuticals, and material sciences. One example of their many fundamental medical applications is th e therapeutic delivery system for delivering site-specific therapy to targeted organs in the body and as the carriers for newer therapeutic options. The size, size distribution, generation rate, structure, and manipulat ion at nano-/subnano-liter scales are critical in all these applications. Prof. Wang will show the big impact o f small droplets with an overview of their generation, manipulation, and application. Their precision genera tion counts on system geometries, fluid properties and flow rates; their effective manipulation is magically enabled with the phase separation, microfluidic channels, and fiber or light touch; their beautiful applicatio n includes embolic particles, smart colloidosome drug delivery, and super anti-pathogenic coatings.
Keywords: Nano-/subnano-liter Droplets, Generation, Manipulation, Application.

PLENARY SPEAKER

Id-2542

Dielectric Relaxation of Crystalline Molecular Gyrotops with a Dipolar Rotor

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Abstract: Macrocage molecules having a bridged π-electron system have been investigated as crystalline molecular gyrotops, because of their rotatable π-electron system. In this study, 1,2-difluorophenylene-bridged macrocages were designed and synthesized as crystalline molecular gyrotops with a dipolar rotor. Specifically, the 1,2-difluoro-3,6-bissilylphenylene surrounded by three C14-alkyl chains could exhibit dynamic exchange of the rotor between two distinct stationary positions within the crystalline state. The crystal structure was analyzed through X-ray crystallography. The interdigital interaction among molecular cages formed an array, they aligned to form 2-dimensional sheets, and these layers stacked, the crystal structures were consisted. The thermal ring flipping behavior of the dipolar rotor in the crystal was investigated using solid-state NMR and dielectric relaxation spectroscopy of powder samples. Temperature dependent flipping rates were analyzed by both spectroscopy, and the rotational barriers estimated by Arrhenius plots were confirmed to be identical. Additionally, a comparative analysis of spectroscopic properties in relation to relevant compounds was conducted.

Keywords: Dielectric Relaxation, X-ray Crystallography, Nuclear Magnetic Resonance (NMR), Artificial Molecular Rotor.

PLENARY SPEAKER

Id-2553

Nanoprecision Interfaces in Energy and Healthcare

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Abstract: The engineering challenges of energy-efficiency, robustness, sustainability etc. are particularly acute at interfaces; nearly any failure starts at or creates new interfaces. Therefore, innovative engineering of surfaces and interface-integrated sensors elicits interest from a broad ranging of scientific community. In the first part of this presentation, I will show a few examples of how nanoengineering is either already helping to or offers a strong promise to address these challenges. I would like to share a few latest developments in high-resolution 3D printing and bottom-up nanofabrication approaches we have introduced. This will start with example of miniature force/haptic sensors for new interventional sciences and surgical instruments. Materials considerations for self-powered, nanogenerator-based sensors will also be presented. In the second part, I would like to discuss the need for precision and scalability in surface manufacture, with an emphasis on surfaces for anti-icing and other phase change control applications. This strategy is also likely be useful in designing surfaces antimicrobial applications, thereby targeting the antimicrobial resistance (AMR) challenge. Lastly, I will share some perspective on how surface nanoengineering and diagnostics technologies may need to evolve to meet future human healthcare and net zero considerations in infrastructure resilience, built environment and transport applications.

Keywords: Nanoengineering, Energy-Efficiency, Surfaces, High-Resolution Printing, Haptics, Sensors.

PLENARY SPEAKER

Id-2558

Recent Advances in Hf Based Ferroelectric Films: Al Doped HfO_2-Structural Analysis by DFT-Assisted EXAFS Analysis

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Abstract: HfO_2-based ferroelectrics have become important for future applications in CMOS technology such as negative capacitance low-power field effect transistor (FET) logic, FeRAM or FeFET memory, and FeFET- or ferroelectric tunnel junction (FTJ)-based neural network accelerators.

In our previous studies, we have used density-functional theory (DFT)-assisted extended X-ray absorption fine-structure spectroscopy (EXAFS) to identify the crystalline phases in the films of ($Hf_{0.46}Zr_{0.54}O_2$) as grown by atomic layer deposition [1]. In these films, Ferroelectric switching in TiN/$Hf_{0.46}Zr_{0.54}O_2$/TiN metal-insulator-metal capacitors is verified. We confirmed that the frequently invoked polar orthorhombic *Pca2₁* phase is present in ferroelectric hafnium zirconium oxide, along with an equal amount of the non-polar monoclinic *P2₁/c* phase. For comparison, we verified that paraelectric HfO_2 films exhibit the *P2₁/c* phase. In this study we are extending our studies to identify the crystalline phases in Al-doped HfO_2 thin films. We have again used density functional theory (DFT)-assisted extended X-ray absorption fine-structure spectroscopy (EXAFS) to determine the structural symmetry of Al doped HfO_2 thin films. The 8-nm thick HfO2-based films were grown by atomic layer deposition in a metal-insulator-metal (MIM) stack configuration with varying doping levels Al and annealing temperatures. Grazing-incidence fluorescence-yield mode Hf L_3 and Zr K absorption edge EXAFS experiments were performed at the 6-BM beamline at the National Synchrotron Light Source II of Brookhaven National Laboratory. The results of the EXAFS multiphase fitting and the effect of Al doping levels to crystalline phases will be discussed in conjunction with the electrical properties.

Keywords: Hf, Ferroelectric Films, EXAFS.

PLENARY SPEAKER

Id-2565

Enhancement of Energy Systems Performance Using Nanoparticles

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Abstract: This presentation delves into the significant role nanoparticles play in enhancing the efficiency, reliability, and overall performance of various energy systems. Nanoparticles, with their unique properties and elevated surface area to volume ratio, serve as key components in refining energy systems, encompassing renewable energy sources, thermal management systems, and more.

We will begin by exploring the intrinsic interactions between nanoparticles and energy systems, highlighting enhancements in heat transfer. Further, we will examine the incorporation of nanoparticles in photovoltaic cells, solar collectors and solar desalination systems.

Illustrative case studies will elucidate the successful adaptation of nanoparticles in different energy paradigms, considering sustainability and economic feasibility. We will also discuss the inherent challenges and constraints in integrating nanoparticles, like stability and agglomeration, and the potential environmental repercussions, proposing probable solutions and mitigation strategies.

Concluding, we will cast light on the prospective trajectory of nanotechnology in energy systems, identifying emerging trends and potential breakthroughs expected to bring transformative advancements in the energy domain. The objective of this talk is to impart a comprehensive understanding of the impactful role of nanoparticles in energy systems, promoting innovative discourse in the pursuit of sustainable and advanced energy solutions.

Keywords: Nanoparticles, Energy Systems.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

INVITED SPEAKER

Id-2318

Innovation and Tendencies of the State-Of-Art Computer X-Ray Diffraction Tomography. Towards To Solution of The Inverse Radon Problem for Crystal Structure Characterization

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Abstract: On the past few decades, the high-resolution X-rays diffraction techniques have been developed all around the world to learn the crystal structures, which can be prospective to create newly microelectronics devices.

To be specific, *ab initio* X-ray diffraction tomography (XRDT) technique has provided a good start and nowadays, plays a significant role in investigating the crystal-defects due to its high-sensitivity to minor crystal-lattice-parameter alternations.

Freely speaking, the key-idea of the computer XRDT is consisted to solve the *inverse* Radon problem of recovering the 3D elastic displacement field function $f(\mathbf{r}\text{-}\mathbf{r}_0) = \mathbf{h}\cdot\mathbf{u}(\mathbf{r}\text{-}\mathbf{r}_0)$ over the 2D defect-image-patterns (DIPs) set obtained under the crystal-sample rotation around the diffraction vector $\mathbf{h}$, $\mathbf{r}_0$ is the defect-location radius-vector.

It is noteworthy to state that one of the main obstacle to apply the XRDT technique to the crystal-structure-characterization is the cutting-edge issue of denoising the 2D IPs data collected for the 3D high-resolution recovery processing.

In the report, the state-of-art of the XRDT problem has been presented, namely:

1. Based on the fundamental Takagi-Taupin equations, innovative theoretical approaches and the advanced computer numerical algorithms to solve the *inverse* Radon XRDT problem are discussed and analyzed.
2. Modern tendency-models of noise-filtering the 2D IPs data are discussed including the neural-data-networks, data-acquiring of average- and geometric-means methods and *etc*. are treated.
3. Implementation of all the above XRDT processing methods in the scope of the *inverse* XRDT problem are shown on example of decoding the reference 2D IPs data for the Coulomb-type point defect in crystal Si(111), diffraction vector $\mathbf{h} = [\bar{2}22]$, the X-ray $MoK_{\alpha 1}$-radiation, the wavelength λ=0.071 nm.

Keywords: Computer X-Ray Diffraction Tomography, The Takagi-Taupin Equations, The Coulomb-Types Point Defect, Quasi-Newton Gradient Descent Algorithm, The XRDT X^2-Target Function

INVITED SPEAKER

Id-2321

Single Photon Sources Based on Quantum Dots in Nanowires And Other III-V Nanostructures on Silicon

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Abstract: Nowadays hybrid semiconductor nanostructures based on III-V nanowires (NWs) with quantum dots (QDs) are attracting increasing interest of researchers for creating optoelectronic applications [1]. Progress in the development of modern synthesis methods, such as molecular-beam epitaxy (MBE), makes it possible to controllably create high-quality QDs in the body of NWs within a single growth process. However, to increase the number of applications based on NWs with QDs, it is necessary to expand the set of materials of QDs and NWs. NW geometry, where a small footprint is dictated by a metal catalyst particle assisting the NW growth via the vapor-liquid-solid (VLS) mechanism [1]. Moreover, it has recently been shown that [111] grown nanowires, especially heterostructured, are ideal candidates for the generation of entangled photon pairs .

In this work we present the results of experimental studies on AlGaAs NWs with GaAs, InGaAs QDs MBE growth on silicon surface and physical properties of grown nanostructures.

AlGaAs NWs with InGaAs QDs were grown using MBE setup Riber Compact 21T. Si(111) S-I wafers were used as the substrates for MBE growth. On the preliminary stage Si surfaces were chemically cleaned using HF aqueous solution (1:10). Then substrates were loaded into metallization chamber of the MBE setup and heated to 950°C for thermal cleaning and removal of remaining native oxide layer from the Si surface. On the next step substrates temperature was decreased to 550℃ for deposition thin (~0.1 nm) Au layer with 1 minute pause for formation of Au droplets on the surface. After cooling the samples to room temperature, substrates were transferred into the growth chamber with no vacuum brake. On the final stage, substrates temperature were increased to growth one (330-510°C), and sources shutters were opened for NWs growth. The QDs in the NWs body were formed by briefly (5-20 s) closing the Al shutter and opening the In shutter.

The morphology of the grown NWs was studied by scanning electron microscopy (SEM). Structural properties and chemical composition of the grown NWs were investigated by transmission electron microscopy (TEM). Optical properties of grown nanostructures were studied by photoluminescence technique at room temperature and 4K.

The results of studying the dependence of the nanostructures physical properties on growth conditions showed that by changing the quantum dots growth time, the ratio of III materials fluxes and the growth temperature, it is possible to control the size and composition of quantum dots. The possibility of AlGaAs nanowires growing at low temperatures makes it possible to synthesize InGaAs quantum dots with a high indium content and get closer to telecommunications wavelengths of radiation from quantum dots, which is difficult in case of GaAs nanowires growing. Moreover, studies of the grown nanostructures optical properties have shown the presence of narrow lines in the photoluminescence spectra at 4K. This fact indirectly indicates that the grown nanostructures can be promising for creating sources of single photons. Thus, the grown nanostructures with controlled properties are promising for creating applications in the field of quantum informatics, cryptography, and telecommunications. Thus, the grown nanostructures with controlled properties are promising for creating applications in the field of quantum informatics, cryptography, and telecommunications.

Keywords: Quantum Entanglement, Quantum Information and Quantum Cryptography.

Acknowledgement: This work was done under financial support of St. Petersburg State University under research grant № 94031047.

INVITED SPEAKER

Id-2331

Supressing Energy Loss in Disordered Polymers Blend Solar Absorber of Thin Film Organic Solar Cell

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Abstract: Energy loss is one of the critical factors that influence the performance of thin film polymer solar cells (TFPSC). In this investigation, metal plasmonic nano-particles are employed to suppress charge recombination and energy loss in TFPSC. Trimetallic nano-composite was successfully synthesized, composed of copper, nickel, and silver (Cu/Ni/Ag) using wet chemistry. The nano-composite was incorporated into polymer based solar absorber layers at different concentrations. The absorber layer is a fullerene-based bulk-heterojunction design using poly-3-hexylthiophene (P3HT) donor polymer. The results show that the power conversion efficiency (PCE) of the device doped with nano-composite has improved by 85 % compared to the undoped one. The incorporation of tri-metallic nano-composite into the polymer blend solar absorber resulted in enhanced optical absorption and improved collection of photo-current as reflected by recorded high short circuit current density. The enhancement of the device performance is due to the occurrence of local surface plasmon resonances in polymer medium. The experiment indicated that there is some increment in an open circuit voltage, which is attributed to the low energy losses as the result of improved exciton dissociation, charge carrier transport, and collection.

Keywords: Conducting Polymer, Polymer Solar Cells.

INVITED SPEAKER

Id-2365

Microstructure Control in Fabrication of Novel Ti-Alloys via Powder Metallurgy and Hot Extrusion

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Abstract. Microstructure tailoring and selection of effective alloying elements are important factors in the design and development of high-performance Ti alloys. Solid solution strengthening is a technique often used for enhancing the tensile strength of Ti alloys. The reduction in ductility is a major issue in using alloying elements, therefore, the development of new Ti alloys with a trade-off between strength and ductility is an essential factor for structural applications. Microstructure characteristics including grain size, morphologies and constituent phase fractions govern the mechanical properties. Thermomechanical treatment such as hot extrusion is one of the important approaches in microstructure development via dynamic recrystallization and grain refinement considering optimized process parameters (temperature and extrusion rate). The solubility of Tungsten (W) in the β-Ti is high since has a stabilizer characteristic. Therefore, it is attractive for β-Ti strengthening due to its high stiffness, strength, and melting point. Powder metallurgy is a promising method for the fabrication of materials consisting of elements with large differences in melting point and density. In this study, a novel Ti–4Fe–3W alloy with two phases (α+β) was fabricated using spark plasma sintering and hot extrusion. Morphology, grain size, and phase fractions were controlled by amounts of solutes and hot extrusion. Additionally, strong textures were formed in both α and β phases of extruded alloys. As a result, excellent tensile strength (1123 MPa) with high elongation (26%) was achieved in the fabricated alloy.

Keywords: Microstructure control; Tensile strength; Powder metallurgy; Hot extrusion; Strong-ductile Ti alloys.

Acknowledgment: This study was financially supported by International Joint Research Promotion Program promoted by Osaka University, and the “Project to Create Research and Educational Hubs for Innovative Manufacturing in Asia,” Osaka University of the Special Budget Project of the Ministry of Education, Culture, Sports, Science, and Technology-Japan.

INVITED SPEAKER

Id-2427

Leakage and Relaxation Phenomena in Ferroelectric Thin Films

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Abstract: Ferroelectrics are prominent materials for various electronic applications, including nonvolatile memory, MEMS, sensors, etc. Leakage and relaxation phenomena have a significant effect on electrical properties of structures based on thin ferroelectric films [1]. One of the key sources of low-frequency relaxation phenomena is the defects chemistry in PZT caused by volatility of PbO and formation of oxygen and lead vacancies. The migration of oxygen vacancies is the most responsible for leakage current, electrical degradation, fatigue, retention, imprint, and other electrical characteristics of PZT ceramic films.

In this report, we discuss the comparative quantitative studies of relaxation processes in PZT capacitors with different electrode materials having opposite behavior with respect to the oxygen vacancies migration. The PZT/Au and PZT/lanthanum nickelate (LNO) interfaces are «transparent» to the migration of oxygen vacancies, while the PZT/Pt or PZT/Ir interfaces are «impermeable» to oxygen vacancies, which leads to their excessive concentration at the interface when an applied electric field has corresponding polarity.

The capacitor structures were polarized before the short-circuit discharge measurements by a positive or negative voltage to provide saturation of spontaneous polarization (2.5–3 times higher than the coercive voltage). The low-frequency relaxation current was modeled by exponential functions with relaxation times τ_1 and τ_2. It is discovered that the permeability of the ferroelectric/electrode interfaces with respect to oxygen vacancies has a decisive influence on the low-frequency relaxation of PZT capacitors. The capacitors with «impermeable» to oxygen vacancies interfaces demonstrate 1.5 – 2 times lower relaxation charge and more than two times lower relaxation times τ_1 and τ_2 in contrast to ones with transparent interfaces. This is an important argument when choosing the design of a ferroelectric capacitor for various applications.

Keywords: Ferroelectrics, Thin Films, Interface, Leakage Current

Acknowledgments: This work was supported by Russian Science Foundation, grant No 23-79-30016 and the Ministry of Science and Higher Education of the Russian Federation (project number 0706–2020–0022 FSFZ-2023-0005).

INVITED SPEAKER

Id-2428

Sol-Gel Films for Advanced Electronics Applications

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Abstract: We discuss formation, properties and applications of sol-gel thin films of porous dielectric and ferroelectric materials and composites. Various types of dielectric materials with a nanometer pore size and various configurations of the porous structure, formed by the molecular self-assembly method, and their application as an insulating dielectric with a low dielectric constant (low-k) for BEOL (back-end-of-line) process are considered. The matrix material is an inorganic-organic hybrid, in which, along with the silicon-oxygen framework, there are bridging organic groups to strengthen the framework and terminal methyl groups to hydrophobize the pore surface [1]. The role of the interface between two phases in the processes of charge carrier transport and other electrical properties of such structures is discussed [2-4].

The report also discusses porous ferroelectric PZT films prepared with different structure-directing agents, including polyvinylpyrolidinone and nonionic surfactants [5]. The main structural characteristics, formation mechanisms, the role of interfaces, and properties of the formed films are considered. The formed porous ferroelectric film can serve as a template for filling the pores with another material to create a composite structure. The pores were filled by atomic layer deposition using a self-limited chemical reaction, which ensures high conformity of relief reproduction. The properties of such composite structures are discussed. Among the promising applications of porous ceramics and composites are piezoelectric MEMS, pyroelectric detectors, memory devices, gas sensors, etc.

Keywords: Sol-Gel, Molecular Self-Assembly, Dielectrics, Ferroelectrics, Thin Films, Porosity

Acknowledgments: This work was supported by Russian Science Foundation, grant No 23-79-30016.

INVITED SPEAKER

Id-2434

Resistive Switching Memory (ReRAM) Through Bio-degradable Composites

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Abstract: Environmental friendly, bio compatible and biodegradable green technologies are the need of the next generation sustainable life style. In this context electrical conduction and resistive switching properties of several biomaterials and biodegradable composites have been studied in detail. Raw bio materials like plant and animal milk, bio-nano composites of Gelatin, Chitosan etc with the incorporation of suitable nano particles are used as functional materials to fabricate ReRAM devices[1-7]. All devices are well characterized and studied in detail for conducting and resistive switching properties. We report on the unexpected resistive switching memory behaviours in raw cow milk and other plant extracts. The ReRAM parameters are not comparable to the state of art inorganic ReRAMs in the literature, but one can see a grand opening into the bio compatible and biodegradable ReRAM developments. Our measurements show a definitive cycling dependence and calls for further optimization of these devices. Here we present our latest results and review in the light of current ReRAM technologies.

INVITED SPEAKER

Id-2444

Novel Bioactive Sr-Based Phosphates with Whitlockite Structure For Bone Implants

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Abstract: Calcium phosphates play an essential role in the bone regeneration during the healing of trauma or different bone disorders. These materials for therapy typically consist of a combination of hydroxyapatite (HAP) and whitlockite (WT) phases, which also belong to calcium phosphates. The possibility of substitutions in the crystal structure opens up prospects for the incorporation of ions of different types, such as Zn^{2+}, Mg^{2+}, Sr^{2+}, Fe^{2+}, Cu^{2+}, and others. The main aim of such substitutions is to provide specific properties of the material related to the ion. For example, Mg^{2+} improves osteogenic differentiation, Cu^{2+} stimulates angiogenesis, Fe^{3+} improves the mechanical strength of the material etc. Sr^{2+} ions increase osteoblast production and shows promising properties in osteoporosis treatment. Both HAP and WT structures are characterized by high isomorphic capacity for such cationic substitutions. However, WT-based materials facilitate bone-specific differentiation compared to HAP structures [6], and substitutions in WT structures seem more relevant..

It should be noted that the WT structure can be built not only from Ca^{2+} ions and PO_4 tetrahedra. It has been shown that in a narrow phase region, some strontium-based phosphates can crystallize in the WT structure. For the stabilization of the WT structure, the ion with small ionic radii must fully occupy the octahedra site. Deviations from this full occupation lead to the formation of palmierite-type structure [8]. However, phase purity plays a key role in understanding bioactive properties.

Novel strontium-based phosphates with WT-type structure have been synthesized using solid-state synthesis. The common chemical formula for the obtained samples is $Sr_8ZnR(PO_4)_7$ and $Sr_8MgR(PO_4)_7$, where R = La^{3+}, Nd^{3+}, Sm^{3+}. The phase purity was controlled using the PXRD method. Rietveld refinement of the structure confirms the full occupation of the octahedra site by Zn^{2+} or Mg^{2+} ions, while R^{3+} ions jointly with Ca^{2+} are distributed through two polyhedra with CN = 8. A cytotoxicity study of extracts from $Sr_8ZnR(PO_4)_7$ and $Sr_8MgR(PO_4)_7$ powders was carried out using cells of the NCTC clone L-929 fibroblast cell line of mouse subcutaneous connective tissue by means of the MTT test. According to the results, all

of the synthesized samples, except $Sr_8MgLa(PO_4)_7$, did not show any cytotoxicity. Additionally, the study of antibacterial properties on *E. coli* and *S. aureus* shows the inhibition of bacterial growth approximately at 10% in comparison with control.

The obtained novel bioactive phosphates can be considered as novel materials for healthcare. However, this must be confirmed by an *in vivo* study.

Keywords: Phosphates, Whitlockite, TCP, Doped Phosphates, Antimicrobial Properties

Acknowledgement: The study was supported by RSF (Project 23-73-10007).

INVITED SPEAKER

Id-2486

New Method Of Enantioseparation Of Chiral Molecules And Its Importance In Pharmacology And Medicine

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Abstract: In his study a new effect is discovered i.e. magnetization switching of ferromagnetic (FM) thin film induced solely by adsorption on a metallic layer of chiral molecules (magnetism induced by a proximity of adsorbed chiral molecules - MIPAC). The local magnetization switching is achieved by adsorbing the chiral molecules as a self-assembled monolayer (SAM) on a gold-coated FM layer with perpendicular magnetic anisotropy. The direction of the magnetization depends on the handedness of the adsorbed chiral molecules. Owing to spin-selective electron transfer, the FM layer underneath the SAM molecules becomes spin polarized, and hence magnetization direction is determined. Here we have combined the two effects, the electron transfer due to SAM formation and the chiral-induced spin selectivity (CISS) effect (where the spin is polarized either parallel or anti-parallel to the electrons' velocity vector according to the handedness of the molecules) in order to demonstrate the ability to control magnetization direction in a FM layer, by adsorption of SAM made from chiral molecules. The SAMs were made using two enantiomers of the oligopeptide, which are based on α-helix polyalanine L and D. The oligopeptides were adsorbed on predetermined areas on the top gold layer. Chiral recognition and enantiomeric selectivity, both in nature and in artificial systems, are commonly assumed to be related to a spatial effect, with the recognition process typically described by a “lock and key” type model. Accordingly, chromatography-based enantioseparation requires the chiral substrate to be adjusted so as to interact optimally with a specific enantiomer. Indeed, enantio-separation is an extremely important process in the pharmaceutical and chemical industries. The importance of chirality was only realized by scientists in the sixties of last century after a disaster with Thalidomide drug used by pregnant women which caused birth of children with malformations due to mutagenic effect of one of the enantiomers. Since then chromatography and electromigration techniques have long been the methods of choice in this field. However, despite intensive efforts, obtaining enantiomerically pure synthetic materials remains a challenge, as the cost of separation is relatively high and an extensive effort is required. A new method of enantio-separation is proposed based on the interaction of chiral molecules with a perpendicularly magnetized substrate. One enantiomer adsorbs preferentially when the magnetic dipole is pointing up, whereas the other adsorbs faster for the opposite

magnetization alignment. The interaction is not controlled by the magnetic field but by the respective electron spin orientations of the ferromagnetic layer and chiral molecules. This method is relatively cheap and universal as it works efficiently for different types of chiral molecules while separating columns used now must be designed differently for different types of chiral molcules.

Keywords: Nanomagnetism, Spin Polarisation, Separation Of Chiral Molecules, Magnetic Thin Films.

INVITED SPEAKER

Id-2498

Urinary Catheters: Strategies to Prevent/Reduce The Catheter-Associated Urinary Tract Infections

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Abstract: Urinary catheters are simply inserted through the urethra into the bladder and left in place for a period of time (from minutes to days and even longer) to empty to it during the treatment of the hospitilized patients and then removed. The percentage of the hospitilized patients receiving urinary catheters during hospital stay has reached to 25% even more globally. Urinary tract infections due to urinary catheterization are the most common healthcare-associated problems - that may lead secondary nosocomial bloodstream infections - which means higher morbidity and mortality risks.

Different type of polymers, PVC, silicone, poliurethane, etc. are used to produce tubings in preparation of urinary catheters. These are hyrdophobic materials that pathogenic bacteria like to adhere, propagate and form biofilms which may highly complex 3D structures - could be describes as castles to protect them from the host immune system. Biofilms are dynamic - means that patogenic bacteria are detached and move other sites to developmmore castles. These are hard-tofight battlefields for the host. Bacterial invasions resulting infections is getting a huge health problem globally as a result of insreasing the number of antibiotic resistive pathogenic bacteria. We have to develop challenging strategies to fight with these deadly species - to prevent/reduce infections.

Several strategies have been investigated. Preparation of passivated/antifouling surfaces is the easiest strategy in which surface hydrophilicities of catheter surfaces are increased which are much less prone to bacterial attachment and further biofilm formation. Coating of hydrophobic catheter surfaces with hydrophilic polymers (such as polyethylene glycol) and using several cold plasma techniques to create hydrophilic surfaces are leading strategies having already sucessful antifouling/hydrophilic urinary catheters commercially available. Using antibacterial bioactive surface coating/layers on the hyrophobic catheters is the other main strategy to prevent/reduce urinary catheter-associated infections. In the earlier periods, antibitic loaded/releaind catheters have been developed - seems that this is not and option now due to antibitic resistance. Other bactericidal agents, including nanotubes, graphene oxide, metal and metal

oxide nanoparticles, antimicrobial peptides, bacteriophages have been studied but no commercial outcomes yet.

All these strategies/materials will be briefly described/discussed in the min review by focusing on cold plasma applications and using bacteriophages as antibacterial agents to modify urinary catheters - which is our own interests in this field.

Keywords: Urinary catheters, Infections, Biofilm, Plasma techniques, Antibacterial agents, Antifouling surfaces, Bacteriophages.

INVITED SPEAKER

Id-2504

Engineering Of Electrodes With 2D Mxene Nanosheets for Flexible High Electrical Power Triboelectric Nanogenerator

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Abstract: This work focusses on the development of a triboelectric nanogenerator (TENG) using advanced 2D nanomaterials and an innovative fabrication method to create a robust TENG with high-power density and improved cycling performance. We fabricated a unique layer-by-layer stacked vertical contact-separation (CS) mode TENG. The design involved incorporating thin films of micron-sized Ti3C2Tx-MXene ultrathin sheets into a polyethylene terephthalate based tribo-negative electrode, while a tribo-positive layer was formed by integrating an optimized amount of NaCl into a polyvinyl alcohol matrix. After optimizing both triboelectric layers, the TENG exhibited impressive electrical performance. These enhanced results were attributed to the combined effect of the TMSs as a charge trapping layer on the electronegative side and the impact of the NaCl:PVA impregnated layer on the electropositive side of the TENG. The ultrathin-layered sandwich structure of the TMS film served a dual function as both a charge accumulation and charge trapping entity, thereby increasing the charge separation due to its high dielectric constant and resulting in a higher overall output power for the TENG. The fabricated TENG was further tested as a pressure sensor for monitoring various sensitive physiological movements of the human body. Additionally, the TENG demonstrated potential applications, such as powering multiple LEDs, an electronic calculator, and rapidly charging micro-capacitors using its direct output power. By investigating the role of TMSs in enhancing TENG performance through electrode engineering, the study offers valuable insights. The research opens up new possibilities for designing self-powered pressure/motion sensors in robotics and harnessing biomechanical energy as electrical energy for sustainable electronics.

Keywords: Triboelectric nanogenerator, MXene, Pressure Sensor, Nanaosheets, Self-powered.
Acknowledgements: This work was supported by Khalifa University, Competitive Internal Research Awards CIRA-2020-024 (8474000278).

INVITED SPEAKER

Id-2516

Unknown properties of Carbon Quantum Dots

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Abstract: Carbon-based quantum dots (CQDs) are widely suggested as excellent carriers of drugs, genes or other bioactive molecules. Due to their fluorescent properties, CQDs are among the most frequently employed biomaterials in the theranostics. They allow for the real-time optical imaging of cells and tissues, facilitate intraoperative image-guided surgery, and fulfill the role of efficient and easy-to-track drug carriers. In addition to the fascinating photoluminescent properties, CQDs are water dispersible, chemically stable, cell-permeable, and fairly biocompatible or at least non-toxic to the cells and tissues. The benefits of low-cost, simple synthesis, and environmental friendliness are not to be underestimated. Two distinct approaches to the synthesis of CQD have been widely described: the graphitized quantum dots are synthesized from reduced graphene oxide as a precursor, and the amorphous ones, which are obtained mainly via the hydrothermal treatment of carbon-rich molecular precursors. The carbon source for the latter method can be inter alia carbohydrates, gelatin, soy milk, bovine albumin, polyacrylamide, and many other. Different precursors, such as aminoacids, peptides, or proteins, allow us to obtain specific CQDs with extremely low toxicity and outstanding biodegradability, and thus, they appear to be ideal tools for biomedical applications. However, to use them and fully understand their properties, one has to answer some questions: what about their surface chemistry? What kind of functionalities causes their fluorescence? Can we modify their properties? In the literature, there are no answers to these questions. However, surface chemistry is the key factor in understanding the observed phenomena, like high water adsorption capacity and surface ionic conductivity. A new experimental method called the “evaporating droplet ATR technique” is proposed to perform this. The technique enables the observations and characterization of selected coatings i.e. diffusive or Stern layer above the surface of tested materials, via controllable removal of water and thus selective uncovering of the hidden layers. While working with carbon quantum dots (CQDs), some unexpected phenomena like (i) presence of Eigen/Zundel-like water structures in the Stern layer; (ii) extremely high water adsorption capacity (ca. 1.7 g/gCQD at 100 % RH), (iii) unusual shape of differential water adsorption enthalpy, entropy, and Gibs free energy curves; (iv) high conductivity, (v) superhydrophilicity, and others, are possible to be detected. By confirming surface functionalities, one can easily modify their character and thus explain unexpected phenomena mentioned above.

Keywords: Carbon Quantum Dots, Physicochemical Properties, Exotic Water Srtuctures.

INVITED SPEAKER

Id-2517

Nanobiocatalytic Systems for Modern Enzyme-Based Therapies

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Abstract: Recent advances in nanotechnology have provided a plethora of various nanomaterials, some of them with potential biomedical applications, including but not limited to enzyme immobilization, drug delivery, and tissue regeneration. Enzyme immobilization has been widely proposed as a powerful tool for the improvement of enzyme kinetic properties such as activity and stability. Therefore, therapeutically useful enzymes could benefit from immobilization on an appropriate support.

Our previous studies, and results from other research groups, clearly demonstrated that graphene oxide (GO) fulfilled most of the conditions required for enzyme immobilization support, i.e. it bound the protein with high yield, and did not decrease catalytic activity, even after storage or lyophilization. It is of a great importance that this material is cytocompatible and exerts no toxic effects on cell viability. In the case of enzymes, such as adenylate kinase (AK), expected to act in the extracellular microenvironment, GO seems to be the most convenient support preventing the cellular internalization of AK-GO system. Additionally, our innovative method to prepare nano-GO allowed for obtaining nano-sized flakes that are safe for systemic administration.

Based on that, we performed a series of studies with immobilized, therapeutically useful enzymes. The detailed *in vitro* evaluations confirmed the improved anti-cancer activity of L-asparaginase-based nanobiocatalytic tool (ASNase-nGO), as well as beneficial activity of adenylate kinase-based nanobiocatalyst (AK-GO) in regulation of nucleotides balance in the extracellular environment of various (normal and cancer) cells. In an on-going study we are testing *in vitro* and *in vivo* the capability of AK-GO to influence the ecto-ATP and ecto-ADP concentrations in the microenvironment of human endothelial (HUVEC) cells. Through the control of nucleotide concentrations, such nanobiocatalytic systems would regulate the processes of platelet aggregation, inflammation, and restenosis in vascular system diseases.

Summing up, the biological outcomes confirm that presented GO-based nanobiocatalysts are very promising regarding the development of next-generation enzyme-based therapies.

Keywords: Graphene Oxide, Enzyme Immobilization, Therapeutic Appications

INVITED SPEAKER

Id-2526

Direct Tunneling Probe of the Superconducting Order Parameter in $EuCsFe_4As_4$

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Abstract: $EuCsFe_4As_4$ compound related to a so-called 1144 family shows a set of unique properties differing from other Fe-based superconductors (SC) [1]. $EuCsFe_4As_4$ superconducts in the stoichiometric state with maximum critical temperature $T_c \approx 37$ K, whereas a magnetic ordering in the Eu planes develops below T_c at $T_m \approx 15$ K. The Fermi level is crossed by about 10 bands forming hole barrels near the Γ point and electron barrels near the M point of the first Brillouin zone, where several SC condensates develop below T_c.

In order to directly determine the structure of the SC order parameter, we used incoherent multiple Andreev reflection effect (IMARE) spectroscopy. Andreev nanojunctions of the SC–thin normal metal–SC (SnS) type were formed at T = 4.2 K by a planar “break-junction” technique. Generally, IMARE causes an excess current at I(V) curve of SnS junction at any bias voltage eV, zero-bias conductance peak, and a series of SC gap features in the dI(V)/dV-spectrum. The positions of the latter directly relate with the SC gap magnitude at any temperature until T_c.

Below T_c, we directly determined three SC energy parameters Δ_L^{out}, Δ_L^{in}, and Δ_S with the characteristic ratios $2\Delta_i(0)/k_BT_c \approx 5.3$, 3.2, and 1.3, respectively. Δ_L^{out} and Δ_L^{in} could be either two distinct and isotropic SC gaps developing at different Fermi surface sheets, or the edges of a single, anisotropic SC gap Δ_L developing at one and the same Fermi surface sheet. In the latter case, the determined gap edges correspond to the maximum and the minimum Cooper pair coupling energies in the momentum space. The degree of the possible Δ_L anisotropy $A_L \approx 40\%$ points to an extended *s*-wave symmetry without nodes. The detected small SC gap Δ_S could be either isotropic (nodeless *s*-wave), or, contrary, strongly anisotropic with $A_S > 50\%$ or even nodal.

The directly measured the temperature dependences of the SC gaps are typical for a moderate interband interaction. The anisotropy degree of the large SC gap A_L remains almost constant with temperature until T_c. The SC gap structure of $EuCsFe_4As_4$ (the shape of dI(V)/dV spectra of SnS junctions, the values of A_L

and the characteristic ratios) and its temperature behaviour ($\Delta_i(T)$, $A_L(T)$) resemble those for $Ba(Fe,Ni)_2As_2$ pnictides studied by us earlier.

Above T_c we reproducibly observed a residual nonlinearity of the d(V)/dV spectra of tunneling junctions, showing a normal-state dI(V)/dV hump at zero bias and dips at $eV >> 2\Delta_L$. Such normal-state features could originate from the electron density of states (DOS) features in the vicinity if the Fermi level, or its renormalization by a resonant electron-phonon interaction.

Keywords: Superconductivity, Fe-Based Superconductors, A-1144, Tunneling, Andreev Reflection, MAR, MAR Effect Spectroscopy, IMARE

Acknowledgement: The work was performed using equipment of the Lebedev Physical Institute's Shared Facility Center. This research was funded by the RSF project number 22-22-00776.

INVITED SPEAKER

Id-2531

Evolution of Superconducting Gap Structure of Alkali Metal Based Na(Fe,Co)As Pnictides

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Abstract: Layered NaFeAs relates to the 111 family of Fe-based superconductors (SC). It has nontrivial phase doping diagram: showing a low $T_c \approx 10$ K in the stoichiometric state and a coexistence of bulky separated SC and antiferromagnetic phases, its SC properties could be optimized by (Fe,Co) doping up to $T_c \approx 10$ K for (4–5)% Co concentration [1,2]. Due to alkali metal, the SC properties of NaFeAs rapidly degrade even in presence trace amounts of oxygen or water vapor. This feature strongly complicates any studies of the 111 family pnictides, and results to a lack of experimental data on NaFeAs available to date. Using a “self-flux” technique, we have grown large $NaFe_{1-x}Co_xAs$ single crystals of various composition with $x = 0.02$-0.05 and $T_c \approx 18$–22 K, respectively. For all the experiments, the sample mounting was made in a dry argon atmosphere.

At 4.2 K, using a planar “break-junction” technique we formed tunneling junctions of SC–constriction–SC (ScS) type. Below T_c we for the first time observed an incoherent multiple Andreev reflection effect (IMARE). We detected a multiple-gap superconductivity and estimated the magnitudes of the large and the small SC gaps: the small SC gap with characteristic ratio $2\Delta_S(0)/k_BT_c \approx 2 < 3.5$, and the large SC gap possibly anisotropic in the k-space (extended s-wave symmetry type) [4]. We detected a small decrease of the Δ_L anisotropy in overdoped compound as compared to underdoped one which indicates a spin-fluctuation origin of the observed anisotropy. Both SC gaps turn to zero at the same T_c, whereas the directly measured temperature dependences of the SC gaps $\Delta_L(T)$ and $\Delta_S(T)$ are typical for a moderate interband interaction in the momentum space.

Acknowledgement: The work was performed using equipment of the Lebedev Physical Institute’s Shared Facility Center. This research was funded by the RSF project number 22-72-10082.

INVITED SPEAKER

Id-2536

Development of Pvdf Piezoelectric Properties Using Fillers and Mechanical Stretching

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Abstract: Piezoelectric polymers are very useful in various electromechanical applications because of their strong piezoelectric response, flexibility, lightweight and formability. While fillers nucleate b phase in the PVDF matrix, subsequent mechanical stretching helps in aligning the dipoles to some extent. Therefore, the aim of the first part of this study is to prepare ferroelectric b-PVDF films by incorporating a hybrid filler (micro-CaCO3+ nanoclay) followed by mechanical stretching. While the tensile properties show a gradual decrease, dielectric constant increased gradually with increasing CaCO3 content in the hybrid filler. The maximum piezoelectric d33 coefficient of 30 pC/N is obtained for stretched hybrid composite films. Ferroelectrets, on the other hand, are another type of functional polymer films with heterogeneous cellular structure and internal quasi permanentdipole moments. The piezoelectricity in ferroelectrets originates from the change in dipole moments under an applied mechanical stress.Therefore, in this part of the study, a new thermally stable ferroelectret has been investigated using commercial processing technique with strong piezoelectric response. Solid PVDF/hybrid filler (micro-CaCO3 + nanoclay) films were extruded and subsequently stretched to create the initial cellular structure inside the films. While CaCO3 acts as void nucleation centers, nanoclay increases the stretchability of the highly CaCO3 filled PVDF films. Gas diffusion expansion (GDE) or controlled inflation is preformed to adjust the voids dimensions to lens-shaped voids leading to lower elastic moduli and stronger piezoelectricity. The inflated films are then subjected to corona charging at room temperature to create the dipoles inside the voids. Finally, PVDF ferroelectrets show piezoelectric d33 coefficient as high as 251 pC/N with N2 inflation and 327 pC/N for CO2 treatment. As expected, PVDF ferroelectrets exhibit better thermal stability than PP, PETP, COP and PEN and as high as Teflon. Samples charged at room temperature have their working temperature up to 120 °C.

Keywords: PVDF, Piezoelectric, Stretching, Fillers.

INVITED SPEAKER

Id-2544

Ln(III) Chelates Nanoparticles as Alternatives to Organic Fluorescent Dyes in Thermo- And Chemosensing

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Abstract: Due to the excellent optical properties lanthanides (Ln(III) can be considered as a prominent candidates to substitute organic fluorescent dyes, which are conventionally used nowadays in biomedical analysis, medical diagnosis, components of sensors, and cell imaging. Long luminescence lifetimes, sharp characteristic emission bands, and large Stoke's shifts, which are Intrinsic for Ln(III) allow getting rid of biological background autofluorescence, which is of great importance when biomedical experiments are conducted.

The wide applicability of lanthanide complexes in fluorescent sensing of residual amounts of drugs, including antibiotics, in water or biological fluids is well-known[3, 4]. In this regard, the synthesis of new lanthanide complexes, where ligand-to-metal energy transfer is enough for sensitizing lanthanide-centered luminescence, and ligand-metal coordination bonds are tight enough for the safe conversion of the complexes into water-dispersible nanomaterial with high lanthanide-centered luminescence is a challenging scientific task.

The applicability of the developed aqueous colloids as nanosensors (chemo- and thermosensors) will be demonstrated by their luminescent reply on ceftriaxone, which is the third generation of cephalosporin antibiotic widely applied in treating of such socially relevant bacterial infections as meningitis, pneumonia and many others as well as fluoroquinolones antibiotics, glyphosate and temperature.

Keywords: Lanthanides, Nanoparticles, Luminescence, Organic Fluorescence Dyes, Sensing; Luminescence Thermometer.

Acknowledgement. RZ and AD thank the Kazan Federal University Strategic Academic Leadership Program (PRIORITY-2030) for financial support. The authors thank the Russian Science Foundation (grant 22-23-00853) for support.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

ORAL PRESENTATION

Id-2323

Antibonding Ground States in Crystal Phase Quantum Dots

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Abstract. Crystal phase quantum dots are formed during the nanowire growth by vertically stacking distinct crystal phases of the same chemical compound [1]. We show, using a multi-million atoms atomistic many-bod\y approach [1,2], that InP crystal phase quantum dots may exhibit a peculiar and rare antibonding hole ground state [3]. Interestingly, even small strains due to wurtzite–zinc-blende lattice mismatch—which is often neglected—can strongly affect the properties of the lowest hole states, resulting in unusual double-peak features in the excitonic optical spectra. We also show that crystal field splitting in the wurtzite phase, as well as spontaneous polarization originating from the phase interfaces, will strongly affect the properties of the lowest hole states in InP crystal phase quantum dots and in turn the excitonic optical spectra [4]. Additionally, we show that the artifact-free modeling of crystal phase quantum dots should incorporate any additional potentials on equal footing with the electron-hole interaction. The importance of accurate excitonic calculations for such systems is highlighted in view of their potential applications in nanowire photonics, yet further research is necessary for bringing theory and the experiment in agreement.

Keywords: quantum dots; crystal phase quantum dots; atomistic calculations; excitons

Acknowledgment: The authors acknowledge the support from the Polish National Science Centre based on Decisions No. 2015/18/E/ST3/00583 and No. 2018/31/B/ST3/01415.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

ORAL PRESENTATION

Id-2357

The Importance of Long Time Scales Relaxation Measurements for Investigation of Vortex Dynamics in Superconductors

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Abstract: Superconductors can be used for a wide range of applications and understanding their behavior and the underlying physics are very beneficial for the market penetration of these materials. Vortex movement is influenced by thermally activated depinning, which can be emphasized by analyzing the corresponding pinning energies by long-time relaxation measurement $m(t)$ in a constant magnetic field. In the range where $\ln(|m|)$ versus $\ln(t)$ is linear, i.e. not too close to the irreversibility line and for a moderate relaxation time window t_w, we can extract the normalized vortex-creep activation energy $U^*=-T\Delta\ln(t)/\Delta\ln(m)$ averaged over t_w. U^* increases with temperature in the collective (elastic) vortex-creep regime (ordered vortex phase) and decreases for plastic (dislocation mediated) creep (disordered vortex phase). We analyzed different types of superconductors such as: single-crystals (superconducting cuprates and iron based superconductors) of various pinning strengths which exhibit second magnetization peak appearing on the magnetic hysteresis curves [1], $Nb_{0.89}Ti_{0.11}$ alloys thermo mechanically processed which show peak effect or second magnetization peak on magnetic hysteresis curves, depending on the thermomechanical treatment to which they were subjected [2], and $Y_1Ba_2Cu_3O_{7-x}$ thin films with different coatings [3-5]. Our analysis supports the scenario in which both second magnetization peak and peak effect are generated by the pinning induced disordering of the low-field Bragg vortex glass. Also, the coatings have a big impact on the superconducting properties of $Y_1Ba_2Cu_3O_{7-x}$.

Keywords: superconductors, pinning, hysteresis curves, relaxation measurements, vortex dynamics

Acknowledgment: We acknowledge the Core Program of the National Institute of Materials Physics, granted by the Romanian Ministry of Research, Innovation and Digitalization under the Project PC2-PN23080202. We also acknowledge support from the EU COST Actions CA19108 Hi-SCALE, CA20116 OPERA and CA21144 SUPERQUMAP.

ORAL PRESENTATION

Id-2358

Flexible Sensors Based on Metallized Electrospun Polymeric Fibers for Ion Detection in Biological Fluids

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Abstract: Obtaining flexible platforms/substrates that can withstand mechanical/bending stress is necessary for wearable biosensors. One of the potential materials for these applications are electrospun polymeric fibers. In order to provide a conductive path, these nanostructured surfaces are easily covered with metal layers. The sensing capabilities of the devices and the detection of analytes are enhanced by nanostructuring electrode surfaces. Using sensors with different configurations, information on pH, salts, or certain other biomolecules like glucose, lactate, or uric acid can be collected. Thus, a tool for the early diagnosis of some medical disorders can be obtained by continuously and in real-time monitoring the processes that occur in the human body utilizing wearable (bio)sensors. In order to create a device that can detect certain molecules, this study is based on the design and production of new (bio)sensors made from functionalized metallized electrospun polymeric fibers with various ionophores and different ions from sweat were targeted. The potentiometric electrochemical sensors served for ions determination and quantification in different media, including artificial sweat in presence of targeted ions and were characterized by scanning electron microscopy with energy dispersive X-Ray spectroscopy, Fourier-Transform Infra-Red Spectroscopy, Raman Spectroscopy and by electrochemical techniques.

Keywords: Sensors, electrospinning, polymeric fibers

Acknowledgements: Financial support from the Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI), Romania, Project code: PN-III-P1-1.1-PD-2021-0319.

ORAL PRESENTATION

Id-2445

Photodynamic Activity of Novel Porphyrin Conjugated to Nanomaterials against of *Escherichia coli* and Staphylococcus

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Abstract: The fast-growing global population and contamination of water resources by human activities pose a challenge in achieving clean, microbe-free water for drinking and domestic purposes. In most rural areas water is stored in backets or water tanks, this can result in biofilms. A biofilm comprises of microorganisms in which cells stick to each other on a surface. These adherent cells become embedded within a slimy extracellular matrix. Acquiring pure water free of contaminants (pollutants) and pathogens is a matter of concern which calls for new, effective, and low-cost water disinfection techniques. Antimicrobial photodynamic inactivation (aPDI) represents a potential, alternative for the inactivation of microbial cells and has already shown to be effective in vitro against bacteria, fungi, viruses and protozoa. There are various photosensitizers which have been developed for aPDI, the focus lies in porphyrinoids conjugated to nanostructured materials. Nanostructured materials have demonstrated desirable antimicrobial properties through various mechanisms including inhibition of enzyme activity and photocatalytic production of reactive oxygen species to destroy the microorganisms.

Keywords: singlet oxygen, antimicrobial photodynamic therapy, nanostructured materials, porphyrins.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

ORAL PRESENTATION

Id-2465

Soft Magnetic Alloys Designed for Multilayer Electromagnetic Shielding Materials Manufactured by Magnetron Sputtering Deposition Method

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Abstract: The objective of this paper is to establish a laboratory method for the development of magnetron sputtering targets, from soft magnetic alloys, by the powder metallurgy sintering method. The targets thus developed will be used in the fabrication of multilayer materials consisting of alternating thin films of metals with high electrical conductivity, copper and silver, and soft magnetic materials with high permeability, Permalloy iron-nickel alloys, layers that they are deposited on KAPTON polymer support. The multilayer material thus obtained is designed for electromagnetic shielding in aerospace and data security applications, for a very wide range of disruptive electromagnetic field (10Hz-18GHZ) and maximum magnetic induction of the disruptive field up to 50mT. The advantages of these types of materials consist in the fact that two electromagnetic shielding mechanisms are involved, namely: one is based on the intrinsic properties of the material, and the other is based on the effect of multi-reflections. To maximize the magnetic permeability, the target composition and deposition parameters are tuned to avoid the columnar structure of the deposited layers. The influence of the stoichiometry of the soft magnetic alloy layer versus the composition of the iron-nickel powder mixture and sintering parameters is discussed. The influence of the support layer material (silver and copper) was also studied. Investigation methods focused on X-ray diffraction and scanning electron microscopy (SEM/EDAX) to determine the structure and microstructure of the multilayer thin films. Magnetic properties (magnetic permeability and saturation field) of the deposited layers are also investigated.

The main result of this work is to establish the optimal composition and method of fabrication of engineered magnetron sputtering targets, high permeability soft magnetic layers, and to establish layer characterization

methods. In addition, a correlation was established between the microstructure of the deposited layers and the obtained magnetic permeability.

Keywords: soft magnetic alloys, powder metallurgy, multilayer materials, magnetron sputtering, electromagnetic shielding.

Acknowledgment: This work was supported by the Romanian Ministry of Research, Innovation and Digitalization, Contract no. 42/2023- Project no. PN 23140301/2023-The development of advanced materials and innovative measuring equipment for electromagnetic shielding technologies with special and industrial applications and Project no. 25PFE/30.12.2021-Increasing R-D-I capacity for electrical engineering-specific materials and equipment with reference to electromobility and "green" technologies (PNCDI III, Programme 1).

ORAL PRESENTATION

Id-2492

Stress Relaxation in Sugar Beet Root Tissue

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Abstract: Stress relaxation measurements are commonly used for the identification and assessment of mechanical properties of biological materials particularly fruit, vegetables as well as industrial plants. The tests are of particular significance because their results make it possible to propose a mechanical model of studied material. The aim of the study was to determine the effects of initial deformation and deformation velocity on the parameters of generalised Maxwell model during stress relaxation in sugar beet root. The cut sugar beet samples used for the experiment were cylindrical in shape, with 9.5 mm in diameter and 20 mm in height. The samples were initially compressed along the vertical axis in a state of uniaxial stress and constant deformation was maintained while recording the force response for 30 seconds. Tests were performed with texture analyser (model TA.HD plus, Stable Micro Systems, Goldaming, UK) at three deformations: 2 mm, 3.5 mm and 5 mm and four deformation velocities: 1 mm/s, 2 mm/s, 10 mm/s and 20 mm/s. Two-branched generalised Maxwell model with an additional elastic element was used to describe the experimental force response curves. Dimensions of the sample as well as initial deformation velocity were taken into consideration in the model formula. Two relaxation times of the model decreased with the increase of deformation velocity and increased with the increase of deformation value. The relaxation times were related to the process of gas and liquid flows in the intercellular spaces. Changes of model parameters in the function of deformation velocity could testify the appearance of internal micro damages in the material during deformation. The increase in the peak force response along with the increase of deformation velocity shows typical viscoelastic behaviour of sugar beet root flesh.

Keywords: sugar beet root, stress relaxation, maxwell model.

ORAL PRESENTATION

Id-2557

Fabrication of the Laser-Induced Graphene and Structural Influence on the Polyvinylidene Fluoride

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Abstract: Polyvinylidene fluoride (PVDF) is a complex material and it can be used in many applications. It is often used with the carbon-based filler material. PVDF mainly have three different phases and filler materials can effect the structure. In this work, we have synthesized Laser-Induced Graphene (LIG) as a filler material. Firstly, LIG films and particles films has analyzed with X-ray Diffraction (XRD), Scanning Electron Microscope (SEM), X-ray Photoelectron Spectroscopy (XPS) and Raman Spectroscopy. Following procedure is the LIG particles are added into the PVDF with different amount and PVDF-LIG inks are coated with the drop-casting method. Composite films are analyzed with the XRD, Fourier-Transform Infrared Spectroscopy (FTIR) and XPS method.

Keywords: Beta-phase, laser-induced graphene, semi-crystalline.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

ORAL PRESENTATION

Id-2560

The Effects of the Preparation Method and Post Treatment on the Electrical Conductivity Behaviour of the PEDOT:PSS Films

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Abstract: Poly (3,4-ethylenedioxythiophene) (PEDOT) is a conjugated and electrically conductive polymer, which makes it attractive for many applications. However, PEDOT is insoluble in many solvents and therefore blended with poly (styrene sulfonate) (PSS), which acts as a non-conductive surfactant for easy processability. While blending with PSS improves the processability, it disrupts the electrical conductivity of the PEDOT. Some polar organic solvents like ethylene glycol (EG) or dimethyl sulfoxide (DMSO) are used in secondary doping process to increase the electrical conductivity of PEDOT:PSS films. In this study, four different ink combinations were prepared containing EG, DMSO and their mixture. The total solvent concentration was kept as 5 vol% for all samples. The films were prepared by drop-casting onto the glass substrates. As a post treatment method washing with the organic solvent were conducted. SEM/EDS were used to determine the conformational change of polymer chains and the distribution of the atoms of the elements, respectively. The change in the PSS content was determined by XPS analysis. The film thickness was obtained with SEM and the electrical conductivities of the films were measured by 4-point probe technique. The organic solvent, the production route and, the post treatment effects were compared after the experiments. It was concluded that the organic solvent and post treatment methods are effective routes to remove excess PSS and improve electrical conductivity. The highest electrical conductivity was achieved through the treatment of the sample with dimethyl sulfoxide (DMSO) and subsequent washing with ethylene glycol (EG). This thermoelectric ink-based process holds potential for the efficient prototyping of thermoelectric textiles.

Keywords: PEDOT:PSS, electrical conductivity, post treatment, ethylene glycol, dimethyl sulfoxide.

ORAL PRESENTATION

Id-2561

Laser-induced Graphene Coated Conductive Sponges

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Abstract: Polymers, especially porous polymers or elastomeric materials, find applications in flexible electronics, sensors, energy, and various other fields. This study presents the fabrication of macroporous graphene/Ecoflex sponges with pore sizes ranging from 420 to 850 μm using the sugar templating method. Initially, we generated graphene powder through laser-induced graphene (LIG), a technique known for its cost-effectiveness, simplicity, speed, and scalability in graphene production. Subsequently, this obtained graphene powder was utilized to create a conductive ink which was then incorporated into an Ecoflex sponge. We examined the morphology of the graphene sponges and assessed their mechanical and electrical property. The fabricated graphene/Ecoflex sponges exhibit a compelling combination of properties that set them apart from existing materials or alternative methods. Their flexibility, controlled pore sizes, electrical conductivity, and compatibility with Ecoflex position them as a versatile material with a wide range of potential applications, particularly in fields such as flexible electronics, sensors, and wearable technology.

Keywords: porous polymers, laser-induced graphene, graphene/ecoflex sponges.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2448

Application of Track-Etched Membranes in Membrane Distillation of Low-Level Liquid Radioactive Wastes and Salt Solutions

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Abstract: Membrane Distillation (MD) is one of the membrane separation processes known for more than fifty years and still needs to be improved for its successful application. The main problems of MD are related to high energy consumption, high energetic and economic costs, the lack of membranes and modules for MD that can lead to flawless operation without simultaneous wetting or fouling of the membrane. The efficiency of the MD mostly depends on the type and characteristics of the membrane used, which is well studied in a numerous papers devoted with membranes suitable for MD [1, 2]. For such application, membranes should have high porosity and hydrophobicity, low heat transfer flux and pore tortuosity, large pore size, uniform pore size distribution and optimal thickness, satisfactory thermal and chemical stability (in the case of chemicals separation.

In this work, track-etched membranes (TeMs) were tested in MD process. Astana branch of the Institute of Nuclear Physics has all appropriate technological base to design on a large scale of TeMs with well characteristics. The main disadvantage of TeMs is low porosity (5-30%), along with that TeMs have calibrated pore size and excellent pore size distribution. Their pores are cylindrical shape without any tortuosity. Moreover, TeMs usually have a thickness of 5-24 μm. Characteristics reviewed above make TeMs perspective for MD application, especially for accurate separation or concentration of different liquids. Toward this goal, TeMs based on poly(ethylene terephthalate) (PET) have been chosen as objects of research due to its appropriate chemical, physical, mechanical properties and convenient method of preparation. However, PET is a semi-hydrophobic polymer and for successful application in MD process its modification is required. We will discuss a simple method of photoinduced graft polymerization of hydrophobic monomers on PET TeMs for successful application of such kind of membranes for the water purification.

Prepared membranes have been tested in DCMD of saline, and low-level liquid radioactive wastes. The effect of temperature, membrane pore diameter and concentration on water flux and salt rejection was studied. Salt rejection was evaluated by conductometry and atomic emission method (for Cs, Mo, Sr, Sb,

Al, Ca, Fe, K, Mg and Na). Decontamination factors of radioisotopes were evaluated by gamma-ray spectroscopy. Salt rejection and decontamination factors depend on pore diameter and conditions of DCMD. In most cases degree of rejection was more than 90% and close to 100%. Decontamination factors of 137Cs, which is hardly removable from the processed waste by most of the known methods reached to 1727.3.

Keywords: Polymeric membranes, track-etched membranes, membrane distillation, water purification

POSTER PRESENTATION

Id-2324

Synthesis of Heterocyclic Extended 1,8-Naphtalimides

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Abstract: In the area of anticancer research, the development of small molecules capable of interacting with deoxyribonucleic acid (DNA) and exhibiting anticancer activities has received enormous attention in recent years. Amongst these it has been found that 1,8-naphthalimides and its derivatives possess high anticancer activity towards various human and murine cells. In literature, many examples are known where anticancer activities of naphthalimides have been significantly affected via fusing aromatic or heteroaromatic rings or varying the position and size of side chains.

Consequently, the 1,8-naphthalimide compounds has been extensively used as strongly absorbing and colourful dyes, building block for artificial light harvesting arrays, and fluorescent chemical probes for the sensing of biologically relevant cations and anions.

In our laboratory we have developed several new building block molecules that have found wide application for the synthesis of various naphthalene based fluorophores and chromophores[1,2]. Authors are grateful to the Bulgarian National Science Fund project NSF KP 06-N61/1.

Keywords: 1,8-naphthalimides, anticancer activities, heterocyclic compounds, building block molecules

POSTER PRESENTATION

Id-2326

Peri-Substituted Dichalcogenides of Naphtalimide as Promising Anticancer Agents

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Abstract: 1,8-naphtalimides are well established DNA intercalating agents and a diversity of many derivatives were synthesized to evaluate both their cytotoxic and antitumor activities, thus finding potential application in anticancer treatment therapies. The amide moiety and the naphthalene core play crucial role for the compound to be biologically active. Two representative examples of this class are mitonafide and amonafide which even reached clinical trials as topoisomerase II intercalating substrates. However, they were interrupted because both compounds exhibited strong central nervous toxicity amongst patients. Since then, many more tuned structures were designed to overcome this issue. Subsequently, it was found that adding another heterocycle to the naphtalimide considerably increased its antimutagenic properties.

Inspired by this research area, our group developed novel peri-disubstituted chalcogenide derivatives and measured their activities against several cancer cell lines. Provided their simple and easily accessible synthesis, we shall continue to tune their structures to obtain even more potent and selective antiproliferative candidates. Authors are grateful to the Bulgarian National Science Fund project NSF KP 06-N61/1.

Keywords: 1,8-naphthalimides, anticancer, dichalcogenides, in-vitro activity.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2334

Forest Fire Spread with Non-Universal Critical Behavior

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Abstract: Recently, forest fires have taken the attention of scientific researchers due to their increase and their enormous material, human and even economic damage. This phenomenon threatens billions of forest and natural terrestrial resources. It severely destroys the forests and the natural resources of safeguard (no future generation) as well as the soils by the disappearance of the humus and the essential organic matter. Understanding this mechanism and predicting fire spread is mainly established by modeling; An extension of the original Small World Network model [Nature 393 (1998)] introduced by N.Zekri (Phys.Rev 2005) adapted to forest fires, has been used as a paradigm to the Ising Model in this paper, this variant is basically a percolation model with Two types of long-rang connections beyond nearest neighbors. A probabilistic interactions induced by firebrand emission (not considered in this work) and a deterministic one due to flame radiation. a weighting process induced by the combustibles' ignition energy and the flame residence time. Unlike magnetic systems, this model exhibits a non universal phase transition. The critical exponents of the rate of spread depend both on the local interaction and on weighting. Near the transition, the exponent x of rate of spread is found to be equivalent to that of correlation time. The weighting process exhibits a new phase transition related to the heating process. This transition is analogous to the gelation transition in spin glasses. Furthermore, the critical exponents of the fire susceptibility caused by the wind effect exhibit a crossover from a standard isotropic percolation (IP) to a directed one (DP)

Keywords: Fire behavior, Forest fire spread, non equilibrium phase transition (theory), critical exponents and amplitudes (theory).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2335

Critical Behavior of an Extreme Fire "Fire Junction"

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Abstract: In this paper the concept of extreme forest fire behavior denominated as Junction Fire is analyzed, this phenomena consists of the interaction between two linear fire fronts which in their propagation intersect at a single point making a small angle between them. In their process of fusion, the phenomena of heat transfer by radiation and convection are extremely amplified due to the concentration of energy at the point of intersection. The concentration of energy and therefore the development of the powerful heat transfer mechanism induces an extremely high and sudden increase in the rate of spread until it reaches a maximum value after which begins to decrease. This behavior of the order parameter exhibits a non-universal phase transition. The analysis carried out in the ADIA-LEIF laboratories show that fires junction are a source of instability which leads to serious safety and management problems for those who are confronted with this type of forest fire. The results show that the fire junction spread exposed two main regimes; an initial acceleration phase characterized by a high rate of spread depends essentially on the initial angle between the fire fronts □0, which shifts during the evolution of the fire until the limit of creation of a single front of fire in a straight line explaining a decreasing phase. Nevertheless, the front fire dynamics depends both on the initial angle between the fire fronts □0 and on the slope ground αJ exhibiting a non- universal phase transition known in the literature.The first author would like to thank the Erasmus Modulus Group—Al idrisi II—for the opportunity to improve my studies, Prof. Domingos Xavier Viegas for invitation and for the supervising during this scholarship. The first author also wants to thank Dr. Jorge Raposo for his support, guide and suggests, to all the personal and teams of ADAI and LEIF for their help, guide and their advises.

Keywords: Extreme fire behavior, Forest fire junction, Merging fires, Dynamic effects, non equilibrium phase transition (theory), critical exponents and amplitudes (theory).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2339

Self-Associated 1,8-Naphthalimide as a Selective Fluorescent Chemosensor for Detection of High Ph in Aqueous Solutions and Their Hg^{2+} Contamination

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Abstract: 1,8-aphthalimides exhibit high potential for applications as optical sensors due to their light stability, high emission quantum yield, wide stock shifts and considerable dependence of their absorption and emission on the surrounding environment. A novel diamino triazine based 1,8-naphthalimide (NI-DAT) has been designed and synthesized.[2] Its photophysical properties have been investigated in different solvents and its sensory capability evaluated. The fluorescence emission of NI-DAT is significantly impacted by the solvent polarity due to its inherent intramolecular charge transfer character. Moreover, the fluorescence emission quenches at higher pH as a result of photo-induced electron transfer (PET) switching from triazine moiety to 1,8-naphthalimide after cleaving the hydrogen bonds in the self-associated dimers. Furthermore, the new dendrimer exhibits a good selectivity and sensitivity towards Hg^{2+} among all the used various cations and anions in the aqueous solution of ethanol (5:1, v/v, pH = 7.2, Tampon buffer), as the emission at 540 nm is quenched remarkably only by Hg^{2+}, even in the presence of other cations or anions as interfering analytes. Job's plot revealed a 2:1 stoichiometric ratio for NI-DAT/Hg^{2+} complex. Authors are grateful to the Bulgarian National Science Fund, project NSF KP 06-N49/2.

Keywords: Diaminotriazine; self-assembly; 1,8-naphthalimide; Fluorescent probe

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2344

Processıng and Selected Properties of Polymer - Sands Composites

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Abstract. Material recycling of polymeric plastics, is the recovery from waste and reprocessing allows for the management of waste plastics that must otherwise be landfilled. A product that can be made from waste plastics with a few tens of % addition of mineral compounds are polymer-mineral compositions, which can be used to manufacture garden architectural elements (bench slats, balcony panels, outdoor floor profiles), replacing concrete, ceramic, cast and vibro-pressed products. Concrete products, however, have their disadvantages, they are heavy, so that their transportation, logistics must meet more stringent requirements, they are products that are not very resistant to cracking due to impact, they are brittle, they also have a tendency to permanent staining, color changes under the influence of oils, greases, acidic substances. The technology for manufacturing polymer-mineral compositions is based on the technology of extrusion and pressing of the resulting compositions. Polymer compositions are most often secondary materials, after recycling in the form of recyclates, flakes and waste plastics, mineral fillers, i.e. waste ceramic dust, sand, as well as activating substances (dyes, plasticizers, adhesive compatibilizers, polymer-mineral wetting agents). The purpose of the research presented in this paper is to determine the feasibility of processing by extrusion of a polymer-mineral composition containing mainly recycled plastic (PEHD) and mineral filler (silica sand) in the amount of 10 to 80% in the plastic. The polymer processing was carried out with the use of a single-screw extruder, type T-32 with the screw diameter of D=32 mm. The plasticizing unit was equipped with four heating zones. The paper presents studies of processability indices, density, mechanical strength, impact strength and hardness of the polymer-sand compositions tested. The influence of the type of plastic and mineral filler content on the structure of the produced materials was determined. The advantage of products obtained from the polymer-mineral composition is reduced weight high mechanical strength, impact resistance and adequate hardness, low abrasiveness, resistance to weathering. There is also an increase in the efficiency of use, occurring in large quantities, of post-production and post-consumption waste from polymer plastics, post-production waste and waste mineral substances such as ceramic waste and fly ash.

Keywords: Recycled plastics; Polymer - sands composites, Composites processing; Physical and mechanical properties.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2349

Enhancing the Antibacterial Activity of PAMAM Dendrimer Modified with 1,8-Naphthalimides and Its Copper Complex via Light Illumination

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Abstract: In recent years, the decrease in antibiotic efficiency has seriously affected the world due to the emerging resistance of pathogenic microorganisms toward the antibiotics used in clinical practice. Accordingly, that leads to the appearance of infections caused by bacteria, which are resistant to the implemented medications. Because of this reason, the spreading of resistant and particularly polyresistant microorganisms has been an enormous challenge to treat such infections. That requires intensive investigation of new highly effective substances exhibiting antimicrobial activity in clinical practice and research on new strategies for dealing with antibiotic resistance.

In this work, a new photoactive dendrimer has been obtained by peripherally modifying the PAMAM dendrimer with 4-dimethylamino-1,8-naphthalimide units. This dendrimer has a yellow color and emits yellow-green fluorescence in organic solvents. It has been used as a ligand to obtain a copper complex [$Cu_2D(NO_3)_2$]. EPR analysis has shown that copper ions are included in the metallodendrimer and coordinate mainly with nitrogen atoms of the dendrimer structure. The color characteristics of the new dendrimers have been determined to evaluate their potential for dyeing cotton fabrics. The possibility of generating singlet oxygen by subjecting the dendrimers to sunlight has been studied with the iodometric method. The metallodendrimer has been found to have better activity than the ligand. The ability to generate singlet oxygen is preserved even after the deposition of the substances onto cotton fabrics. The antibacterial activity of the new dendrimers has been tested in vitro against Gram-positive B. cereus and Gram-negative P. aeruginosa in solution and after the deposition onto the cotton fabric. The tests have been performed in the dark and after illumination with visible light. The complex [Cu2D(NO3)2] has turned out to be more effective than the dendrimer ligand in treating the relevant pathogens. The antimicrobial activity of the compounds has enhanced after exposing them to sunlight. This effect is more prominent in the case of Gram-positive B. cereus. The results indicate that the new dendrimers can be applied in colored antimicrobial textiles production. The authors are grateful to the Bulgarian National Science Fund, project NSF KP 06-N49/2.

Keywords: PAMAM, antibiotics, antimicrobial

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2350

Hybrid Metal@Paf Materials as Smart Catalysts for Cross-Coupling and "Click" Reactions

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Abstract. Porous Organic Polymers (POPs) became important competitors for Metal Organic Frameworks (MOFs) and classic polymers due to a large series of advantages consisting in higher stability, better control of the structure and texture (pore size, porosity), tunability for specific applications, rational design by the combination of the geometries of different building blocks, achievement of their synthesis by the multitude of specific reactions of organic chemistry. The use of POPs as catalysts for cross coupling reactions is based on Metal@POP hybrid materials which in the majority of cases are obtained by doping POPs with salts of the desired doping metals followed by the reduction of metal cations to native metal which then is trapped in the pores of POPs as nanoparticles. [1] Porous Aromatic Frameworks (PAFs) are POPs with high rigidity, constructed by carbon−carbon bond linked aromatic based building blocks, they are stable under harsh chemical treatments and environmental conditions and they are suitable for a plethora of applications. [2] In this work we report the one step synthesis of a Pd@Cu@PAF hybrid catalysts by the Sonogashira cross coupling reaction of 3,3',6,6'-tetraiodo-9,9'-spirobifluorene or 1,3,5,7-tetra(*p*-iodophenyl)adamantane with 1,6-diethynylpyrene. The Pd(II) and Cu(I) catalysts used for the achievement of the Sonogashira synthesis of the PAF are reduced during the reaction (by the excess of diyne) to Pd (0) (major) and Cu (0) (minor) and these metals are entrapped as nanoparticles in the PAF pores resulting directly the Pd@Cu@PAF hybrid materials. These materials were successfully used as obtained (without additional Pd or Cu sources) as catalyst for Suzuki-Miyaura, [3] and Sonogashira "click" reactions. The hybrid material catalysts provided high yields (in many cases quantitative reactions), good TOF values and excellent recyclability, proving to be excellent multifunctional catalysts based on easy fabrication procedures, reduced consume of metals and high chemical stability. This work was financially supported by UEFISCDI by project PN-III-P4-PCE-2021-1812 (ICOFCOSC).

Keywords: PAFs; Me@PAF hybrid catalysts, heterogenous catalysis, Sonogashira, Suzuki-Miyaura and "click" reactions

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2352

Supramolecular and Covalent Organic Frameworks Based on 9,9'-Spirobifluorene Building Blocks

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Abstract. Supramolecular Organic Frameworks (SOFs) are exciting porous materials obtained under dynamic conditions. They are formed by secondary bonds (hydrogen, halogen bonds, π-donor-π-acceptor complexes or hydrophobic contacts) between molecules. Covalent Organic Frameworks (COFs) are porous polymers in which the network is built by covalent bonds. The synthesis of COFs can be conducted also under dynamic conditions if they are constructed by reversible reactions (e.g. imine formation). Tetrasubstituted 9,9'-spirobifluorene derivatives are powerful substrates for the access to COFs and SOFs and they are either tetrahedral (if the substituents are located at positions 3,3',6,6') or quadrilateral (2,2',7,7' derivatives) building blocks. [1] In this work we investigated SOFs formed by N---I halogen bonds obtained by the cocrystalization of 2,2'7,7'-tetrapyridyl-9,9'-spirobifluorene (TPSBF) with pentafluoroiodobenzene (PFIB) and the isomers of diiodotetrafluorobenzene (DITFB) [2] and imine COFs exhibiting the 9,9'-spirobifluorene motif. The formation of SOFs was confirmed by powder X-ray diffraction (XRPD). The single crystal X-ray diffraction of the cocrystals revealed similar structures of the polymers despite the highly different binding behaviour of *ortho*-, *meta*- and *para*-DITFB and PFIB. These high structural similarities between these SOFs are due to the formation (in all cases) in the lattices of catemers of DITFB (or PFIB) by I---F or F---F halogen bonds in which the tetrameric units exhibit an arrangement of the I-C_6F_4- fragments which is mimicking the disposal of the pyridyl groups in 2,2',7,7'-TPSBF. The arrangements of TPSBF molecules around these catemers are similar in all cases and thus the structures of polymers are alike. On the other side 2,2',7,7'- or 3,3',6,6'-tetra(*p*-formylphenyl)- or -tetra(*p*-aminophenyl) and 1,3,5,7-tetra(*p*-aminophenyl)adamantane were used for obtaining imine based COFs exhibiting combinations of tetrahedral-tetrahedral or tetrahedral-quadrilateral building blocks. These COFs were dopped with $Pd(OAc)_2$ or $Rh(OAc)_3$ and after the reduction with $NaBH_4$, metal@COF hybrid materials were obtained and successfully employed as catalysts for Suzuki-Miyaura cross-coupling or primary alcohol oxidation (to

aldehydes) reactions. This work was financially supported by UEFISCDI by project PN-III-P4-PCE-2021-1812 (ICOFCOSC)

Keywords: SOFs; COFs, 9,9'-spirobifluorene, N---I halogen bonds, Me@PAF hybrid catalysts

POSTER PRESENTATION

Id-2356

PDA@Sio_2 Nanocomposite as a Platform for Studying Polydopamine Adhesion

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Abstract. Since its discovery in 2007, polydopamine (PDA) has emerged as one of the most versatile surface modification agents, primarily due to its material-independent strong adhesion, simple deposition process and facile post functionalization. The formation of the PDA coatings occurs by oxidative polymerization of dopamine, but the effective mechanisms of PDA formation as well as a detailed structural elucidation remain fields of active research. Despite the growing number of PDA applications reported each year, there are still fundamental challenges remained in the field, such as the adhesion mechanisms as well as a widely accepted structural model. The amorphous character of PDA, and the high degree of disorder at all levels (monomers, oligomers, supramolecular aggregates), pose serious limitations upon the information content provided by the analytical techniques widely used for its investigations: mass spectrometry – because this is a destructive technique, X Ray photoelectron spectroscopy, Fourier transform infrared spectroscopy – although non-destructive, they only offer global information, with no site-specificity. By contrast, solid-state NMR spectroscopy is non-destructive and offers a higher degree of chemical-site selectivity, especially when isotopically labelled samples are engineered. Here we present the results of a systematic ss-NMR investigation of PDA@SiO_2 nanocomposites, focusing on the spectral differences between PDA thin films deposited on silica nanoparticles and the PDA in bulk. Based on these results, potential adhesion mechanisms are discussed. This study is expected can bring new and valuable insights into this fascinating material.

Keywords: Polydopamine, adhesion, functional surfaces, solid-state NMR

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2364

Wire Treatment for Reduction of Metal Contamination in Hot Wire CVD

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Abstract: The hot wire (HW) CVD method is attracting attention as an alternative deposition method to the plasma CVD method because it can deposit silicon films and silicon nitride films at low temperatures. However, it is not good at forming an oxide film. Since the HWCVD method generally uses a W wire as a heated catalyst, there is a problem that the W surface is oxidized when the oxygen species of O_2 and H_2O are decomposed. To avoid this problem, there is a method using H_2O highly diluted by H_2 [1]. However, depending on the conditions, W oxidation occurs, and W is contained in the film. As a solution, we proposed the surface of the W wire with carbonization to stabilize the catalyst surface. However, suitable carbonization conditions are not clear. The purpose of this study is to investigate the surface composition and surface morphology of the carbonized W wire and to show its usefulness.

A W wire was carbonized using an HWCVD apparatus. HMDS ($HN[Si(CH_3)_3]_2$) was used as a source gas for the carbonization treatment. For the carbonization, the W wire was heated at a temperature T_f of 1700 ^oC with $H_2$100 sccm and HMDS 1.3 and 2.0 sccm for 60 min. After that, the Si substrate (100) was oxidized with hydrogen-diluted H_2O using each carbonized W wire. Oxidation was performed at T_f: 1900 ^oC, and H_2/H_2O: 100 sccm/0.02 sccm, for 10 minutes. The composition and morphology of the surface of carbonized W wire were investigated using XPS and SEM. For the formed SiO_2 film, XPS was used to analyze the composition of the surface and calculate the film thickness.

Figure 1 shows the XPS W 4f and C 1s spectra of the surfaces of an untreated W wire and treated W wires with different HMDS flow rates. It can be seen from the W 4f spectrum that the tungsten carbide peak is dominant in the carbonized wires. It was confirmed that in the treatment with HMDS: 1.3 sccm, the W surface was carbonized in the bonding state of W_2C, and in the treatment with HMDS: 2.0 sccm, W was carbonized in the bonding state of WC. The Si2p spectra of oxidation-treated Si substrates show, SiO_2 peaks in any of the untreated W wire, W_2C and WC wires, confirming that Si surfaces were oxidize. However, from the W 4f spectra, it can find that W peaks were observed when untreated W is used. On the other hand, when carbonized W was used, W peaks were not observed. Therefore, it is said that W contamination can be suppressed in W_2C and WC.

In the HW method, it was found that the W wire surface could be carbonized in two different carbonization

states, W_2C and WC, by HMDS. When carbonized W wire was used to oxidize Si by the HW method, the SiO_2 film formed without W contamination could be obtained.

Keywords: Hot-wire, HMDS, W, carbonized, oxidation

POSTER PRESENTATION

Id-2367

Formation and Relaxation of the Second Optical Harmonic in Glasses Under the Electron Beam Irradiation

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Abstract. Second harmonic generation in glasses is of high interest due to their formability, low cost, and chemical stability. To introduce the second order optical nonlinearity to initially isotropic glasses, one needs to make a certain direction in this material. This can be achieved by glass poling, mechanical stress or irradiation of glass by an electron beam. The latter ensures the formation of a highly localized nonlinear region determined by the focal spot of the irradiation beam. In the present work, we experimentally studied and numerically modelled the formation of optical nonlinearity and the generation of the second harmonic signal in glasses irradiated with an electron beam of different energy. In experiments, we obtained the dependences of the second-harmonic signal on the electron energy and the density of the transmitted charge, and developed a technique for observing the dynamics of relaxation of the second-harmonic signal at an elevated temperature. It was shown that dependence of the second harmonic signal on the charge density tends to saturation with increasing charge density. This result is consistent with the dynamic double-layer model, according to which an electric potential formed on the surface of dielectrics during irradiation prevents the penetration of electrons. Using the developed technique, we measured the temperature relaxation of the second harmonic signal in the temperature range from 100 to 200 C. The relaxation time varied from ~400 to ~12000 seconds as the temperature was lowered from 200 and 100 C. We also performed numerical Monte Carlo simulation of the formation of a space charge in glasses under the irradiation and studied the influence of the glass composition and its density on the electron penetration depth, as well as the dependence of the penetration depth on the beam energy. For the simulation, we took glass compositions of different content of heavy elements, such as Pb or W. It was shown that when glass is irradiated with an electron beam, the electron penetration depth decreases with an increase in the percentage of heavy elements contained in the sample or the density of the sample. The values of the exponent, which determines the degree of dependence of the penetration depth on the beam energy, were determined, and the dependence of this value on the glass composition was also obtained. This exponent also showed a

tendency to decrease with an increase in the content of heavy elements in the glass. The calculated values showed satisfactory agreement with the experiment.

Keywords: electron beam irradiation, glasses, space charge, optical nonlinearity.

Acknowledgment: The research was funded by the Ministry of Science and Higher Education of the Russian Federation as a part of World-Class Research Center program: Advanced Digital Technologies (contract No. 075-15-2022-311 dated 20.04.2022).

POSTER PRESENTATION

Id-2368

Modification of Glasses in Plasma Using Resistive Barrier Discharge

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Abstract. The process of thermo-electric modification of glasses, i.e. glass poling, has been known for decades. Similar to the charging of glass electrets it results in an accumulation of the electric charge. Glass heating under applied DC potential allows the drift of ions, and further cooling of the glass under the voltage applied “freezes” the formed distribution of ions, providing a highly stable charged structure capable of numerous applications. Most importantly, poling breaks isotropy of glasses that provides their second order optical nonlinearity, allowing for optical second harmonic generation. Here we present a technique for poling of glasses using a resistive barrier plasma discharge in the atmosphere in a gap of hundreds of microns and studying soda-lime glasse slides treated in this way. In particular, we established that at room temperature 22 °C and relative humidity of the air 35%, the voltage of about 1100 V is a characteristic voltage of plasma discharge formation in the 200 μm gap configuration (“plasma voltage”), which results in the appearence of current through the slides and in visible to the eye blue light emission attributed to the excited N_2 molecules. The experiments show that voltage exceeding the “plasma voltage” (that is sufficient to ignite the discharge) provides efficient poling, whereas for lower voltages the poling effect is close to zero. Measurements of visible and IR spectra of the poled slides and the second harmonic generation (using the Maker fringes technique) have been performed. Essential penetration of hydrogen/hydronium ions in the glasses has been registered. We attributed it to a large number of hydrogen/hydronium ions generated from the atmospheric water vapors by the plasma discharge in the gap, which are drifting in the glass. Processing of the optical absorption spectra, which demonstrate oscillations because of different refractivity of the modified glass layer and the initial glass, allowed us to deduce the dependence of the penetration depth, that is the thickness of the modified layer, on the poling conditions. After several minutes of poling, the light emission disappears, though the current remains gradually decreasing, i.e. the plasma discharge changes its type to the so-called “dark discharge”. This is due to an increase in the resistance of the glass slide due to the injection of hydrogenated ions into it, the mobility of which is much less than that of sodium ions, the main charge carriers in the glass. We have developed a simple model of the poling

according to Ohm's law, analyzed the temporal dependencies of the polarization current and, basing on the model, estimated the mobilities of hydrogen/hydronium and sodium ions in the glass: μ_H = (2.4 ± 0.8)×10^{-18} $m^2V^{-1}s^{-1}$ and μ_{Na} = (4.8 ± 1.8)×10^{-15} $m^2V^{-1}s^{-1}$. The values obtained are very close to the known literature data. The study was supported the Ministry of Science and Higher Education of the Russian Federation (project FSRM-2023-0009).

Keywords: Glass, plasma discharge, poling, second harmonic

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2369

Solid-State Interactıons Between Ketoconazole-Adipic Acid Co-Crystal and Excipients in Formulation Development

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Abstract: Drug-excipient compatibility study represents the essential basis for excipient selection in the pre-formulation stage of any new drug development process. The potential physical or chemical interactions between active pharmaceutical ingredients (APIs) and excipients may alter APIs bioavailability and stability, or may lead to changes of APIs polymorphic form in the new formulation. Apart from free API molecules, excipient compatibility studies are mandatory for salts and co-crystals APIs forms in the development stage. Our study focuses on excipient compatibility evaluation of Ketoconazole-Adipic Acid (KTZ-AA) co-crystal for which we determined an enhanced aqueous solubility compared to commercial KTZ hereby being a viable alternative for fungal infections treatment. The selected excipients are the ones commonly used in tablet formulations, such as cellulose microcrystalline, corn starch, magnesium stearate, lactose, polyvinylpyrrolidone K90, silicon dioxide and talc. KTZ-AA co-crystal - excipient compatibility assessment was systematically evaluated on binary mixtures (1:1 (w:w) ratio) after preparation, storage at ambient conditions / elevated temperature and relative humidity (40 °C/75% RH for 3 months). In addition to Differential Scanning Calorimetry, thermogravimetric analysis (TGA), Powder X-ray Diffraction and FT-IR spectroscopy were used as complementary characterization techniques. Moreover, since moisture may induce salt disproportionation in binary mixtures with excipients, Karl Fischer titration method was used to determine the moisture content after the storage conditions. The solid-state compatibility study evidence the potential of KTZ-AA co-crystal to be developed as an oral drug.

Keywords: Ketoconazole-Adipic Acid co-crystal; Excipient compatibility; DSC; Powder X-ray diffraction; FT-IR spectroscopy.

Acknowledgment: This work was supported by the Romanian Ministry of Research, Innovation and Digitization, TE Programme, Project PN-III-P1-1.1-TE-2021-0244

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2372

New Fluorescent Polymeric Materials from Benzanthrone Allyl Derivative

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Abstract: The rapid progress of optoelectronics requires the creation of new functional materials. In connection with the development of luminescence using technologies, it is important to develop and introduce new materials with particular optical properties. The optical properties of emissive organic molecules are of great importance in day-to-day science. Among organic compounds, many aromatic conjugated compounds are emissive. One group of such substances is represented by dyes of anthrone group: derivatives of 7*H*-benzo[*de*]anthracen-7-one, which possess pronounced luminescence at a wide spectral range. One of the modern technological directions is the creation of various electroluminescent devices using high molecular weight polymer materials, which have a number of advantages compared to low molecular weight compounds - greater stability, amorphous structure, more intense luminescence, better electrooptical properties, etc. In present research the methods for preparing of new luminescent copolymers have been developed and optical properties of new luminescent copolymers were investigated. Considering the high photostability of benzanthrone dyes and the brightness of their luminescence, 3-N-allylaminobenzathrone (a derivative with a polymerizable allyl group) was used as a raw material for new copolymers. The widely used polyvinylcarbazole polymers have good electrical conductivity and intense green electroluminescence. The new copolymer preparation method was realized by radical polymerization of N-vinylcarbazole and 3-N-allylaminobenzanthrone in various ratios. The developed polymeric materials have luminescent properties, which can be modulated by the composition by changing the content of the benzanthrone luminophore in the copolymers, thereby regulating the fluorescence color from red to white. Modulation of the spectral characteristics of luminescence can find practical application in the formation of OLED structures. Copolymerization of 3-N-allylaminobenzanthrone with methyl acrylate and methyl methacrylate was studied also. As result polymeric materials with a greenish-yellow luminescence were obtained. The results of a study of the optical properties of new luminescent copolymers materials are presented.

Keywords: Fluorescent polymer; Benzanthrone; Luminescence; Copolymerization; Vinylcarbazole.

POSTER PRESENTATION

Id-2376

Lidar Systems for Measuring the Vertical Ozone Distribution in Tomsk, Russia

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Abstract. At the Institute of Optics Institute of Atmospheric Optics. V.E. Zuev of the Siberian Branch of the Russian Academy of Sciences, stationary and mobile lidar systems have been developed and are operating. The stationary measuring complex is located at the Siberian lidar station and operates in the mode of regular ozone monitoring at wavelengths pairs of sensing of 299/341 nm (5-20 km) and 308/353 nm (15-45 km) with a single receiving telescope with a primary mirror diameter of 0.5 m (Newton's scheme). Within the framework of the RSF grant 21-79-10051 in 2021, a mobile ozone lidar was created at wavelengths of 299/341 nm (0.1-12 km) and a receiving mirror 0.35 m (Cassegrain scheme). Joint operation of lidar systems makes it possible to cover the entire ozonosphere in the altitude range of 0.1–45 km. The technical characteristics of lidar systems and sensing results are presented.

Keywords: lidar system; mobile lidar; lidar sensing; atmosphere; ozone profile.
Acknowledgment: This work was supported by the Russian Science foundation (grant no. 21-79-10051).

POSTER PRESENTATION

Id-2378

Crystalline Salt of Amourphous Drug

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Abstract: Statins are the most commonly used group of drugs in the treatment of lipid disorders. Statins belong to class II of the biopharmaceutical classification system (BCS), which means that they are poorly soluble, but they permeate biological membranes well. For low-solubility BCS II drugs, various oral formulation technologies: salt formation, particle-size reduction, the use of lipid vehicles complexation, amorphous solid dispersions – are designed to maximize the bioavailability of the active pharmaceutical ingredient. Pravastatin belongs to the first generation of statins and is administered as its sodium salt. Both Pravastatin and Pravastatin sodium are amorphous, herein we report the design, preparation and structural characterization of a new crystalline solid form of the drug, namely a tert-butyl amine salt. The crystal structure of the salt was determined by single-crystal X-Ray diffraction. Additional structural details were provided by solid state NMR spectroscopy. The stability under accelerated conditions (40^{o}C and 75% relative humidity) was investigated.

Keywords: Active pharmaceutical ingredient; statins; Pravastatin; single-crystal X-Ray diffraction; NMR spectroscopy.

Acknowledgment: This work was supported by a grant of Romanian Ministry of Research, Innovation and Digitization, under Core Program, project number 19 35 02 02 and UEFISCDI projects PN-III-P1-1.1-PD-2019-0701.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2379

Methods and Tools for Remote Monitoring of Methane Concentration in the Atmosphere Using Infrared Sensing Technologies

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Abstract. Methane (CH_4) is one of the most important organic substances in the atmosphere. Monitoring the level of CH_4 concentration in the atmosphere is relevant due to its strong influence on the Earth's climate. An important task is to solve the scientific problem of detecting and monitoring the concentration of methane in the atmosphere using spectroscopic methods and sounding tools to obtain fundamental knowledge about the impact of anthropogenic (coal mining, landfills, biomass combustion, oil and gas industry, rice fields, ruminants) and natural (swamps) of factors increasing the total content of greenhouse gases on the planet and their contribution to climate change. In this work presents the latest topical research carried out at the V.E. Zuev Institute of Atmospheric Optics of Siberian Branch of the Russian Academy of Sciences and aimed at the development and creation of mobile means for remote sensing of methane in the infrared region of the spectrum.

Keywords: atmosphere, methane, infrared region, remote sensing

Acknowledgment: The work was financially supported by the Ministry of Science and Higher Education of the Russian Federation («Mobile complex for remote monitoring of methane concentration in the atmosphere of different climatic zones of Eurasia and Latin America» project, agreement no. 075-15-2023-607).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2383

Evolution of the Dendritic Envelope and Primary Stem Structure in Free Dendritic Growth

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Abstract: This investigationy focuses on the shape of the dendritic tip and the sidebranching behavior in free dendritic growth into a supercooled melt. The main goal is to mathematically describe the shape of the dendrite tip, primary stem and external envelope and test the theory against experimental data on almost pure SCN and SCN-ACE dendrites.

Keywords: Dendritic growth, phase transformations, stem, envelope, microstructure, shape of crystals

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2384

Impact of Initiator Concentration and Irradiation Dose on Structure, Network Parameters and Swelling Properties of Sodium Alginate-G-Acrylic Acid Hydrogels Obtained by Electron Beam Irradiation

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Abstract: The lack of water resources, rainfall, soil desertification through excessive exploitation (massive deforestation, overgrazing), as well as the excessive use of chemical fertilizers, are key factors that have led to the degradation of agricultural land. The sustainability of agriculture is seriously hindered, mainly, by the water deficit due to the reduced amount of precipitation with the irregular spatial and temporal distribution. Is well known the connection between the lack of water and the occurrence of water stress in plants and the consequences arising from this is the impairment of plants general growth and crop productivity. Absorbent polymeric materials of hydrogel type represent a viable solution for reducing the water stress of crops in drought conditions, making water use more efficient by reducing losses, but also for restoring soil quality. The purpose of this study is to present the results obtained in cross-linking and grafting experiments by irradiation with a 5.5 MeV electron beam carried out to obtain semi-synthetic hydrogels based on sodium alginate and acrylic acid. Hydrogels were using the linear accelerator ALID 7, built in the Electron Accelerators Laboratory from the National Institute for Lasers, Plasma and Radiation Physics, Bucharest, Romania. The irradiation process performance depends on the rigorous control of the irradiation dose and dose rate. In our experiments, the process dose rate was of 0.9kGy/min. The primary standard graphite calorimeter was used for radiation dosimetry. For irradiation, has prepared a solutions that containes 0.5% sodium alginate, 20% acrylic acid and 0.1% poly(ethylene oxide) in which the initiator (potassium persulfate) concentration was of 0.1 %, 0.2% and 0.3%. The monomeric solutions were places in medical syringes with a diameter of 1.5 mm and irradiated using electron beam doses of 5 kGy, 10 kGy, 15 kGy and 20 kGy in atmospheric conditions and at a room temperature of 25 °C. The effect of irradiation dose and initiator concentration on the gel fraction, network and structural parameters and sol-gel analysis of hydrogels have been investigated. The radiation cross-linking processes of sodium alginate and acrylic acid can be highlighted using the sol-gel analysis. This is an easy and available tool to estimate the radiation cross-linking yield (G_X) and scission (G_S), as well as the gelation dose (Dg). Usually, the radiation cross-

linking process is followed by concomitant cross-linking and degradation reactions as a consequence of the absorbed dose, polymer concentrations and their nature. The parameters, Dg, Gx and Gs can be accurately estimated using a modified equation of Charlesby-Pinner, namely the Charlesby-Rosiak. Also, the hydrogel samples were investigated by FTIR technique using the Spectrum 100 instrument to confirm the presence of functional groups of sodium alginate and acrylic acid in the hydrogels. The FTIR spectra were collected in ATR mode at a resolution of 4 cm^{-1} in the range of 4000–650 cm^{-1} with 30 scans per sample. All spectra were analyzed using Spectrum v. 6.3.2 software.

Keywords: sodium alginate, hydrogels, electron beam irradiation, potassium persulphate

POSTER PRESENTATION

Id-2385

Swelling Kinetics of Sodium Alginate-G-Acrylic Acid Hydrogels Obtained by Electron Beam Irradiation

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Abstract: To be used in agriculture, hydrogels must meet certain characteristics, including high water absorption capacity, low soluble content, durability and stability during swelling, biodegradability and reusability in several swelling-desorption cycles. To be permanent, with mechanical stability and potentially usable as water stress reducer for plants for long time, hydrogels obtained by grafting acrylic acid on the sodium alginate chain may be obtained by cross-linking or chemical grafting through covalent bonds. Being semi-synthetic hydrogels, they have the potential of a high degree of biodegradation, which can reach up to 90% in 60 days (through the composting method) Considering the purpose for which these hydrogels were developed, namely, to maintain soil moisture in the rooting area of crops, and reduce the water stress of plants, we studied their swelling degree in three types of water: distilled water, tap water and rainwater. Distilled water was chosen because it is usually used for laboratory analyses. We chose to carry out the same experiments in tap water and rain water because the latter represents the most used source of water supply. For these reasons, the swelling capacity, swelling kinetics, and swelling power of sodium alginate-*g*-acrylic acid-based hydrogels obtained by electron beam irradiation have been determined separately on these four types of water and in two different aqueous solutions with nutrients. The swelling degree depends on the chemical composition of the waters used in the experiments. Thus, distilled water is a type of purified water, free of salts, minerals and other organic materials. The pH of distilled water varies from 5.8 to 7. Pure distilled water in a sealed system has a pH of 7, but as soon as it is exposed to air it begins to absorb atmospheric gases including CO_2 and begins to become acidic. Tap water contains salts and minerals, and their concentration differs from one area to another, depending on the geological, meteorological conditions or soil content. Some of them are called macroelements (salts of calcium, magnesium, potassium, chlorides, nitrites, nitrates, etc.) and are found in relatively large quantities of the order of mg/l, and others are called microelements (fluorine, iodine, zinc, etc.) and is found in small quantities of the order of µg/l.. Precipitation/rainwater, even if it is very important for the growth and development of plants, also represents a process in the removal and transport of various ionic compounds, pollutants and soluble gases from the

atmosphere to the earth's surface. The composition of rainwater varies from one place to another and from one region to another due to the difference between local and emission sources and reflects all the local characteristics of atmospheric pollutants. Comparing the three types of water used in the swelling experiments, we notice that for the hydrogels containing 0.5% sodium alginate, the order of swelling decrease was as follows: tap water > distilled water > rainwater.

Keywords: hydrogels, electron beam irradiation, cross-linking, swelling kinetics

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2386

Micro-Bulges Formation on Laser Modified Copper Surface

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Abstract: Recently, a phenomenon called the optoplastic effect has been discovered. Under the influence of a nanosecond UV laser radiation on the surface of copper and its alloys at subthreshold values of energy density, noticeable changes in the structure of the metal without changing the phase state, as well as manifestations of a regular microrelief on the near-surface layer of copper or its alloy, were revealed. In this study, we used Nd:YAG pulse-periodic laser (third harmonic, wavelength λ = 355 nm, the pulse energy was up to 8 mJ, the pulse duration was 10 ns, and the frequency was 10 Hz). The radiation was focused on the surface of a copper mirror (Cu-OF). The energy density of laser radiation was up to 1,1 J/cm², and the number of pulses was up to 30. The samples were studied using a Zygo New View 7300 optical profilometer. The profilograms of the copper surface in the zone of laser radiation exposure were obtained and the volume of micro-bulges was measured. It is concluded that the volume of micro-bulges is proportional to the number of pulses as well as the energy deposited in the surface layer. The height of the micro-bulges was up to 1.3 μm. And their volume is up to 13000 μm³. Crystallographic slip occurred inside the grains. Micro-bulge arises, presumably, due to mass transfer as a result of diffusion of nonequilibrium interstitial atoms formed to the surface. This method of surface modification can be used to improve efficiency of diffusion welding.

Keywords: Laser, Copper, Plastic deformation, Optoplastic effect, Polished surface, Near-threshold fluence, Thermal deformation

Acknowledgements: The research was funded by the Ministry of Science and Higher Education of the Russian Federation (contract No. 75-03-2022-056 dated 14.01.2022).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2393

Some Environmental Aspects of Laser Technology

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Abstract: Recently, more and more attention has been paid to the problem of ecology. In particular, data on the concentration of defects in the structure of metals and semiconductors are usually an important characteristic of the material and are indicated in the product passport. They are usually detected by chemical etching. Working with chemicals and recycling spent reagents is quite difficult, including from an environmental point of view, and an expensive task. Therefore, various methods are currently proposed that reduce the use of methods for etching materials using aggressive chemical reagents. It has been found that laser exposure to pre-threshold energy density radiation (0.1 – 1.0 J/cm^2), in which the material is still in a solid state, is capable of detecting structural defects, which is capable of replacing chemical etching technologies of metals and semiconductors to solve the problem of this detection of defects. The work reports on successful experiments to identify dislocations in germanium single crystals and grain boundaries in brass blanks when the material is exposed to nanosecond UV laser radiation at pre-threshold energy density.

Keywords: Laser technology, ecology, chemical reagent, structural defect

POSTER PRESENTATION

Id-2394

Organosilicon Self-Assembled Surface Nanolayers On Zinc. Formation and Effect On The Electrochemical And Corrosion Behavior Of The Metal

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Abstract: The objective of this work was to examine the adsorption of vinyltrimethoxysilane on Zn as well as study the structural and protective properties of an organosilane films on its surface.

Adsorption of vinyltriethoxysilane (VS) on the surface of zinc from an aqueous solution has been examined with the use of a quartz nanoobalance. Upon adsorption of silane molecules, adsorbed water is found to be displaced from the surface. For the interpretation of adsorption data, Langmuir, BET, Flory-Huggins, multisite Langmuir, Temkin, Frumkin, and Freundlich adsorption approaches were used. The surface orientation of adsorbed molecules is determined. The heats of adsorption of silanes have been calculated in different ways and it was shown that silane molecules are found to be chemisorbed on the surface of zinc. It was determined that at the initial stage of the formation of organosilane films on Zn, the VS molecules are chemisorbed monomolecularly and then polymolecularly. The capacitance of the monolayer, the magnitude of the “landing area” of vinylsilane molecules and other main adsorption characteristics of the adsorbate molecules were determined. The use of infrared spectroscopy, atomic-force microscopy, and scanning electron microscopy in the work made it possible toassess the interactions of organosilanes with the metal surface, as well as to determine the structural features of the films. It was established that the adsorption of vinyl silane on a zinc surface from an aqueous solution results in formation of a uniform, self-organizing protective siloxane layer covalently bound with surface metal by Zn-O-Si bonds with layer thickness 0.5–0.8 μm. Film thickness can be controlled by variation of deposition conditions. The mechanism of formation of surface self-assembled layers on zinc is proposed.

Electrochemical and corrosion research methods made it possible to study the protective properties of organosilane films on zinc. The effect of a siloxane nanolayer on dissolution of the metal have been studied in chloride-containing solutions.

It is found that an ordered vinyl siloxane nanolayer with a thickness of up to 5 molecular layers causes efficient inhibition of uniform and local corrosion of zinc.

Electrochemical and corrosion test results demonstrated that the presence of vinilsilane films on Zn led to the inhibition of its dissolution. The magnitude of local depassivation potential was 70 mV The exposure of metal samples with films for 720 h in the climatic chamber(RH 95%, t=60^{o}C) illustrated the best protective capacity of the Zn + VS system. For this system, the proportion of corrosion damage of surface was 3% and the time before the appearance of the first defect was 242 h.

An infrared spectroscopy study carried out after electrochemical and corrosion tests showed a high resistance of surface organosilicon layers to the action of corrosive electrolytes. It is shown that the vinyl siloxane nanolayer is preserved on the surface of zinc after 30 days of orrosion tests, which indicates its stability at exposure to water and corrosive components.

Keywords: Adsorption, quartz nanobalance, corrosion inhibition; aluminum;; organosilanes, coupling agents, adhesion, self-assembled layers, metal corrosion

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POSTER PRESENTATION

Id-2395

Morphological Characterization of Quercetine@Polydopamine Coated Surfaces

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Abstract. Polydopamine (PDA) is a surface modification agent with a strong adhesion to virtually any substrate, also having the capacity to bind functional molecules. PDA is obtained in high yields by facile oxidative polymerization of dopamine hydrochloride (D). Quercetin (Quer) is a natural flavonoid found in vegetables, leaves, fruits, exhibiting a strong antioxidant function. A systematic Atomic Force Microscopy (AFM) study of PDA decorated with Quer coating layers on glass substrates was performed. The study aimed to determining the morphology of the deposited Quer@PDA layers under different pH conditions (5.5 and 8.5), and different molar ratios D:Quer:oxidation agent ($KMnO_4$). The polymeric film thickness, roughness and homogeneity were monitored. The results were used to relate the film morphology and thickness with the polymerization experimental parameters, a necessary step in the perspective of developing surfaces with antioxidant character.

Keywords: polydopamine; quercetin; antioxidant: AFM; thin films.

Acknowledgment: Financial support from the UEFISCDI (Project PN-III-P4-ID-PCE-2020-1463) is gratefully acknowledged.

POSTER PRESENTATION

Id-2397

Substituents' Effect on the Ultrasound Assisted Homodimerization of Coumarins – Methodology and Properties

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Abstract: Coumarins are an important class of heterocyclic compounds with an application in the optoelectronics, fluorescent markers, lasers and etc. Representatives of dimeric benzopyran structures with extended π-systems are determined as biscoumarins. Even though that they are a relatively new class of compounds, they have shown same interesting photophysical and light emission properties.

A large number of biscoumarins and bis-3,4-dihydrocoumarins, differing the nature, the length and the locations of the linkage, have been isolated, characterized and synthesized. Very few synthetic approaches for the synthesis of biscoumarin structures are known in the literature. Most of the presented methods include multi-stage synthesis, electrochemical reduction, or electroreduction/hydration. The inconvenience of the methods is the long reaction time, the unsatisfactory yields, or the necessity of complex equipment for the reactions.

Here we present our investigations on the development of a new strategy for the synthesis of biscoumarins from coumarin-3-carboxylates during a homodimerization process. Evaluation of the effects of the substituent in the benzene ring on the reaction rate was also studied.

Keywords: Biscoumarins, coumarins, photophysical properties

Acknowledgments: This work was supported by National Science Fund project - KP-06-N-39/15 from 17.12.2019.

POSTER PRESENTATION

Id-2398

Fine Tuning of the Optical Properties of Phosphorous Containing Coumarin Systems by Altering the Substituents

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Abstract: The photophysical properties of coumarins are diverse and largely studied. Their applications as fluorescent dyes have shown the advantage of using the benzopyran moiety as a fluorogenic scaffold in the target structures. Various coumarins have been reported to be of use as laser dyes, cell-imaging biomarkers and optical brighteners. In the present study an efficient method for the synthesis via palladium cross-coupling reactions of fluorescent phosphorous containing coumarins were reported. Both Suzuki and Sonogashira reaction were applied successfully to obtain the structures in good to quantitative yields. The optical properties of the arylated and alkynylated products were experimentally determined. The visible absorption properties of the compounds were altered by introducing various C-3 and C-6 substituents directly to the heteroaromatic structure. It was found that fine tuning of the fluorescent properties could be achieved by altering the substituent in C-6. Introducing an electron donating groups in para-position in the aryl moiety has most noticeable effect leading to bathochromic shift in the absorption and fluorescence spectra. Moreover, the photophysical properties of the synthesized compounds were studied in different solvents. It was found that the type of the media has little or no effect on both absorption and fluorescence maxima. Quantum-chemical calculations on the spectral properties of some aryl substituted 3-phosphonocoumarins were performed and the effect of the substituents in the aryl moiety was evaluated. The experimental data are in good agreement with the theoretically predicted photophysical properties of the compounds.

Keywords: Coumarins, photophysical properties, cross-coupling reactions

Acknowledgments: This work was supported by National Science Fund project - KP-06-N-39/15 from 17.12.2019. A.K. and R.L. are also grateful to National Science Fund project – KP-06-M-59/6 from 19.11.2021.

POSTER PRESENTATION

Id-2399

The Effect of Preliminary Laser Treatment of Metal Surfaces on Joint Strength And Temperature During Diffusion Welding

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Abstract: Diffusion welding is widely used in high-tech industries such as aerospace and nuclear power. The actual problems of further development of diffusion welding technology include improving the quality of the joint and reducing the temperature of diffusion welding. The proceeding presents the results of research aimed at solving these problems. It has been experimentally shown that preliminary heat treatment of the welded surfaces of steel blanks CHS57 by nanosecond pulses of laser UV radiation with a wavelength of 355 nm, a duration of 10 ns, following at a frequency of 100 Hz with an energy density of 2 J/cm^2 improved the mechanical properties of the welded joint. Tensile strength increased by more than 10% and elongation - by more than 20%. In addition, laser heat treatment made it possible to reduce the temperature of the hot isostatic pressing process by 160° C with maintaining of the mechanical properties of the welded joint.
Keywords: laser treatment, microstructures, diffusion bonding

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2400

Influence of 3D Printing Parameters on Coc Bıocompatible Material Thz Optical Properties

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Abstract. The dynamic development of terahertz (THz) technologies requires new, well-performing materials with appropriate optical properties to manufacture passive optical components. Considering the variety of available materials as well as the low cost of prototyping, additive manufacturing fused deposition modeling (FDM) technology is at the forefront. This study presents research on the influence of 3D printing FDM technology parameters on the optical properties of cyclic olefin copolymer (COC) biocompatible material in the THz radiation range. Measurements of optical properties were performed with THz Time-Domain Spectroscopy (THz TDS). COC exhibits a low absorption coefficient and refractive index of approximately 1.51 in the 100 GHz to 2 THz radiation range. Thus, it is a suitable transmissive material for optical components in various THz technological applications like telecommunication, security devices, or non-destructive testing. Moreover, COC's biocompatible properties allow applying COC to medical instruments where in vivo contact with vital tissue is necessary. Polymer samples from COC material were manufactured using different printer settings of FDM technology. Samples were examined with THz TDS technology. Significant refractive index and absorption coefficient changes were observed for samples with different cooling levels, extrusion width, and extrusion multiplier parameters. Obtained results are presented in this study.

Keywords: THz optics; THz TDS; COC material; FDM 3D printing; Biocompatible polymer.

Acknowledgment: The research was funded by the National Science Centre, Poland under the OPUS-18 program (2019/35/B/ST7/03909).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2401

Antitumor Effects Induced by Magnetic Hyperthermia Using Functionalised Magnetic Nanoclusters Linked with Doxorubicin

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Abstract: Background: Doxorubicin is a powerful chemotherapeutic drug, but its efficiency is limited by severe side effects and reduced tumor selectivity. Magnetic hyperthermia (MH) requires tumor exposure to magnetic nanoparticles, followed by an external alternating magnetic field (AMF). This induces hyperthermia leading to selective apoptosis of tumor cells. MH efficiency in vivo is decreased by multiple factors such as: nanoparticle toxicity, tumor accumulation and reduced tolerable intensity of AMF. Objective: We synthesized biocompatible iron oxide nanoclusters linked with doxorubicin, to increase efficiency and selectivity of chemo-magnetic hyperthermia and tested their antitumor efficacy in vitro against breast cancer cells MDA-MB-231 and MDA-MB-231DOX, resistant to doxorubicin. Materials and Methods: Fe3O4 magnetic nanoclusters (MNC), stabilized with 3.4-dihydroxybenzhydrazide (DHBH) were synthetized by solvothermal method and were further linked with doxorubicin in a ratio 1:100. Morphology and elemental composition (TEM, surface chemical composition (XPS), SAR magnetic measurements were done. Biological studies tested cell toxicity by colorimetric MTS assay, cellular uptake of the nanoparticles by TEM, apoptosis induction by flowcytometric analysis and caspases assessment, oxidative stress induction by spectrophotometry. Results and discussion: MNC were packed into clusters, with well-defined spherical shapes and size ~ 200 nm, with high SAR value. Biological tests showed a good biocompatibility of the MNC w/wt doxorubicin up to 50 µg/ml. MH mediated by MNC (50 µg/ml) and AMF of 30Hz for 40 minutes induced significant apoptosis, compared to control. Hyperthermia using MNC linked with doxorubicin, further increased apoptosis and overcame the resistance of MDA-MB-231DOX to doxorubicin. Immersed in FPCS solution, equal amounts (0.7mg/ml) and subsequently placed at 37°C for 30min. In order to remove excess of protein each sample was magnetic separated and rinsed three times with PBS. Afterwards they were dried in air and the obtained powders were analysed by FTIR.

Keywords: magnetic hyperthermia, breast cancer, apoptosis, chemotherapy, oxidative stress

Acknowledgement: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, Romania, CNCS - UEFISCDI, project number PN-III-P1-1.1-TE-2021-0498, within PNCDI III.

POSTER PRESENTATION

Id-2404

Patterned Interdigitated Electrodes Covered with ZnO Nanowire Arrays: Preparation, Characterization and Optoelectronic Applications

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Abstract: In the recent years, an increased research interest was focused on the development of high performance optoelectronic devices based on metal oxide nanowires with novel properties and functionalities given by their large surface-to-volume ratio related to their one-dimensional morphology. One example of metal oxide nanowires, ZnO nanowires have gained popularity due to their wide band gap (3.3 eV), high electron mobility, good exciton binding energy and low cost preparation routes using different chemical or physical methods. Consequently, ZnO nanowire arrays are the perfect candidates for integration in applications such as photodetectors, light emitting diodes, nanowire based FETs, sensors, photocatalisys, etc.

In this work, patterned interdigitated electrodes covered with ZnO nanowire arrays were obtained using a straightforward route using photolithography, electrochemical deposition and thermal oxidation in air. Moreover, the experimental parameters involved in the electrodeposition and thermal oxidation in air processes were explored in order to control the nanowire's geometry and fine-tune it to optimize the ZnO nanowires optical and electrical properties. The structural, morphological, compositional and optical properties of the patterned interdigitated electrodes covered with ZnO nanowire arrays were analyzed and discussed in detail using X-ray diffraction, field emission scanning electron microscopy, energy dispersive X-ray spectroscopy, cathodoluminescence, photoluminescence and reflectance. Additionally, electrochemical impedance spectroscopy, electroluminescence and current-voltage measurements were performed to assess their potential use in optoelectronic applications.

Keywords: Nanowires, Photolitography, ZnO

Acknowledgement: This work was supported by two grants of the Romanian Ministry of Research, Innovation and Digitalization CNCS/CCDI-UEFISCDI., Project code: PN-III-P2-2.1-PED-2021-3984 and Project code: 35PFE/2021.

POSTER PRESENTATION

Id-2405

A Comparison of Electric Properties Nanowire FET Fabricated on 2 Electrode System vs 4 Electrode System

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Abstract: Nanowires are among the most intriguing nanostructures utilized in sensing devices, particularly because the manufacturing of nanostructures with regulated morphology is quite practicable when following specific applications. Controlling essential characteristics like as chemical composition, diameter, length, dopping, and electrical properties is critical for producing a sensing device with specific qualities. The purpose of this research was to determine the effect of contact architecture (more precisely 2 metal contacts vs 4 metal contacts), on the electrical properties of single nanowire FETs. This research is critical in order to differentiate the electric signals related to nanowire/substrate defects from the electric signals related to the final device and so establish the actual properties of our device. Single nanowires were electrochemically produced utilizing polycarbonate membranes as templates. The membranes are first bombarded with heavy ions before being immersed in a NaOH-based solution to generate cylindrical pores with sizes ranging from 100 to 200 nm. The same fabrication procedure was followed in both cases: same substrate, same metal deposition conditions for electrodes and contacts, and same type of nanowires were used for each configuration. Scanning electron microscopy and energy-dispersive X-ray spectroscopy were also used to characterize the obtained nanowires/devices. As a result, we now have a better understanding of how fabrication settings affect the physical and chemical properties of FETs.

Keywords: Nanowires, Photolitography, EBL

Acknowledgment: This work was funded the Project to Support Institutional Excellence contract 35PFE/2022 (funded by the Romanian Ministry of Research, Innovation and Digitization).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2409

Biodegradability and Ecotoxicity Assessment of New Agricultural Hydrogels Based on Acrylic Acid, Carboxymethyl Cellulose and Sodium Alginate

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Abstract: Water availability is one of the principal challenges faced by the world, especially in semiarid and low precipitation regions, in respect to agriculture [1]. Therefore, many research has been conducted in order to find solutions for this problem, hence super absorbent polymers (hydrogels) were developed. Agricultural hydrogels have the ability to absorb water up to 400 times their own weight, releasing it gradually into soil, reducing this way the leak of fertilizers and herbicides and improving soil quality by reducing the frequency of irrigation [2]. In order to comply with safety and sustainability principles, the use natural biopolymers present more advantages [3], like availability and biodegradability. Therefore, the aim of this study was to characterize eight formulations of hydrogels (based on acrylic acid, carboxymethyl cellulose and sodium alginate) in respect to their biodegradability and ecotoxicity. The biodegradability of the developed hydrogels was tested through burial in natural soil, and the results showed that a higher biodegradation rate was obtained for the samples containing a higher amount of sodium alginate. The ecotoxicity on seeds (*Lactuca sativa* and *Raphanus sativus*) was conducted using the soil resulted from the biodegradation process. Following the ecotoxicity tests, it was observed that the germination rate and rootlet length was close or higher for the tested samples, compared to control. Therefore, the results are promising showing that the tested hydrogels present biodegradability properties and have no negative influence on the germination and development of the studied seeds.

Keywords: hydrogels, biodegradation properties, ecotoxicity assessment, sustainability.

POSTER PRESENTATION

Id-2410

Antimicrobial and antioxidant effects of liposome-encapsulated functional compounds from some forest berry leaf extracts on mayonnaise

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Abstract: Mayonnaise represents one of the sauces most used and bought by consumers and has multiple utilization in ready-to-eat food processing. Oil-in-water emulsion lipid peroxidation delay and microbiological spoilage prevention are some major concerns and challenges for food producers. Plant functional compounds have been shown to play an important role in improving the shelf life of many foods and improving the functional status of the products to which it is added. Forest berry fruit leaves are considered wastes, but they contain an important concentration of antioxidant compounds.

The aim of this study was to encapsulate the forest berry fruit leaf extracts rich in antioxidant compounds in a constructed liposome and to determine the effect of added liposomes on the shelf life and antioxidant capacity of mayonnaise.

In order to prepare the forest berry fruit leaf extracts rich in functional compounds, *Rosa canina*, and *Sambucus nigra* leaves of spontaneous flora of Câmpulung, Argeș, România (45°16'14.2" N 25°03'11.2" E) were collected. The leaves were dried in the dark at 25 °C, milled into a fine powder, and subjected to extraction with a hydro-alcoholic solution (ethanol 60% v/v), 1/10 plant/solvent ratio (m/v) for 3 h under continuous stirring. The mixture was filtrated and centrifuged at 10000 rpm for 10 minutes and supernatants were concentrated using a rotary evaporator.

Liposomes were prepared from food-grade hydrogenated phosphatidylcholine, named Proliposome H (Pro-lipo H). Pro-lipo H was converted to liposomes by mixing them with the concentrated forest berry fruit leaf extracts rich in functional compounds. After washing, the liposomes were added to mayonnaise in different concentrations. Treated and untreated mayonnaise samples were subject to refrigeration for 7 weeks at 4 °C. During the shelf-life, pH, antioxidant activity, conjugated dienes and triens (CD, CT), thiobarbituric reactive substances (TBARS), and microbiological spoilage were evaluated.

The results showed that liposomes of forest berry fruit leaf extracts added to mayonnaise protect it against the oxidative process and microbiological contamination. TBARS, total bacteria loads, *Staphylococcus aureus, Bacillus subtilis, Bacillus vulgatus,* and *Lactobacillus fructivorans* levels were lower in the samples treated with liposomes-encapsulated forest berry fruit leaf extracts, compared with non-treated

mayonnaise. In conclusion, encapsulating forest berry fruit leaf extracts into lipid nanoparticles can be used to extend the shelf life and antioxidant activity of mayonnaise.

Keywords: forest berry leaf extract, liposomes, mayonnaise, antioxidant activity, TBARS, and total bacteria loads.

Acknowledgement: This work was supported by the Romanian UEFISCDI project PN-III-P2-2.1-PED2021-2001, no. 631PED/2022.

POSTER PRESENTATION

Id-2411

Formulation of Natural and Synthetic Polymers Hydrogels with Colloidal Silver Solutions

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Abstract: Hydrogels are used in various biomedical applications, in drug delivery, storage, management, controlled drug release systems, tissue engineering. Due to the easy availability of a wide range of polymers with desired properties there is high interest in research area, for the development of modern health care products. Hydrogel is a super-absorbent polymer that can be modified to acquire some physical properties similar to those of human tissues. Hydrogels are cross-linked polymer networks, which have the ability to retain water in the spaces available between the polymer chains. Usually hydrogels are water-containing gels made with natural and synthetic polymers. The antimicrobial and antifungal properties of silver, known since ancient times, are still used in medicine. The electrochemical method used to obtain the colloidal silver solution consists in detaching microfragments from metal electrodes immersed in a liquid when the electric current is passed. The novelty elements consist of preparation operations through ultrafiltration and structuring of the water used in the process, as well as a final restructuring of the solution. The electrodes used in the process are made of silver with a very high purity of 99.99%. Following the technological process, silver particles of nanometer size are obtained. In this work, we used silver colloidal solutions (110 ppm, 100 ppm, and 70 ppm) and natural (xanthan gum) and synthetic (Carbopol 940) polymers for gel preparation. Comparison of the results obtained for the monitored parameters (appearance, pH, viscosity, homogeneity) showed superior properties for the gels formulated with the natural polymer for all concentrations. This work opens a new idea to formulate hydrogels that can be used in medical applications, due to the antimicrobial and antifungal properties of silver.

Keywords: silver, colloidal solution, hydrogel, natural polymer, synthetic polymer

Acknowledgment: This paper has been financed through the POR/2022/1/1.1/OS 1.2/2 – PROOF OF CONCEPT, SMIS 156608, Contract no. 8081/26.01.2023, AGNES ITARA SRL

POSTER PRESENTATION

Id-2412

Formulation of Natural and Synthetic Polymers Hydrogels with Colloidal Silver Solutions

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Abstract: Hydrogels are used in various biomedical applications, in drug delivery, storage, management, controlled drug release systems, tissue engineering. Due to the easy availability of a wide range of polymers with desired properties there is high interest in research area, for the development of modern health care products. Hydrogel is a super-absorbent polymer that can be modified to acquire some physical properties similar to those of human tissues. Hydrogels are cross-linked polymer networks, which have the ability to retain water in the spaces available between the polymer chains. Usually hydrogels are water-containing gels made with natural and synthetic polymers. The antimicrobial and antifungal properties of silver, known since ancient times, are still used in medicine. The electrochemical method used to obtain the colloidal silver solution consists in detaching microfragments from metal electrodes immersed in a liquid when the electric current is passed. The novelty elements consist of preparation operations through ultrafiltration and structuring of the water used in the process, as well as a final restructuring of the solution. The electrodes used in the process are made of silver with a very high purity of 99.99%. Following the technological process, silver particles of nanometer size are obtained. In this work, we used silver colloidal solutions (110 ppm, 100 ppm, and 70 ppm) and natural (xanthan gum) and synthetic (Carbopol 940) polymers for gel preparation. Comparison of the results obtained for the monitored parameters (appearance, pH, viscosity, homogeneity) showed superior properties for the gels formulated with the natural polymer for all concentrations. This work opens a new idea to formulate hydrogels that can be used in medical applications, due to the antimicrobial and antifungal properties of silver.

Keywords: silver, colloidal solution, hydrogel, natural polymer, synthetic polymer.
Acknowledgment: This paper has been financed through the POR/2022/1/1.1/OS 1.2/2 – PROOF OF CONCEPT, SMIS 156608, Contract no. 8081/26.01.2023, AGNES ITARA SRL.

POSTER PRESENTATION

Id-2417

Remote Sensing of Greenhouse Gases in the Atmosphere using Methods and Means of Laser Absorption Spectroscopy

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Abstract: An important task is to solve the scientific problem of detecting and monitoring the concentration of greenhouse gases in the atmosphere using spectroscopic methods and sounding tools to obtain fundamental knowledge about the impact of anthropogenic and natural factors increasing the total content of greenhouse gases on the planet and their contribution to climate change. From the point of view of remote gas analysis of the atmosphere, special attention is now paid to the infrared (IR) region of the spectrum, due to the location in it of a large number of vibrational, vibrational-rotational lines and absorption bands of greenhouse gases (methane - CH4, carbon dioxide - CO2, water vapor - H2O). Laser detection and measurement of concentrations of gaseous impurities (greenhouse gases, in particular) in the IR range of the spectrum is based on the principle of laser absorption spectroscopy (LAS). Among the methods of gas analysis based on LAS, one can distinguish the differential absorption method (DIfferential Absorption Lidar (DIAL), Integrated-Path Differential Absorption (IPDA)) and Diode Laser Absorption Spectroscopy (DLAS). The report discusses the lidar technologies being developed and modernized at the V.E. Zuev Institute of Atmospheric Optics for remote sensing of greenhouse gases in the atmosphere, both natural and anthropogenic.

Keywords: atmosphere, greenhouses gases, lidar, laser absorption spectroscopy, infrared region.

Acknowledgment: The work was financially supported by the Ministry of Science and Higher Education of the Russian Federation («Mobile complex for remote monitoring of methane concentration in the atmosphere of different climatic zones of Eurasia and Latin America» project, agreement no. 075-15-2023-607).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2425

Study of Concentration Series of Li^+ Codoped Yb: $ZnWO_4$ Laser Crystals

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Abstract: $ZnWO_4$ single crystals both undoped and doped with various concentrations of Yb^{3+} and Li^+ ions have been grown. The actual concentrations of dopants have been measured by atomic emission spectroscopy with inductively coupled plasma, as well as by polarized optical absorption spectroscopy. The segregation coefficients of the dopants between the crystal and melt have been evaluated. Hardness and fracture toughness of the crystals were measured by indentation method. The dependencies of the measured values on the dopants concentrations were analyzed. The optimal dopants concentrations, providing the best mechanical strength of Yb,Li:$ZnWO_4$ crystal have been found.

Keywords: zinc tungstate, crystal growth, segregation coefficient, hardness.

Acknowledgment: This work has been supported by Russian Scientific Fund (grant # 23-22-00416).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2433

Resistive Switching Property of Aloe Vera: A Possible Bio-ReRAM for Green Computing

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Abstract: Green computing is one of the emerging sustainable technologies. Development of biodegradable ReRAM is an important component of green computing. Several ReRAMs with biomaterials such as Chitosan, Gelatin, plant and animal milk extracts incorporated with suitable nano particles have been reported earlier. Here we report on resistive switching property of aloe vera sandwiched between two electrodes. The novelty of our study lies in the use on silver and aluminium electrode combination which makes our device different from the ones already reported in the literature. The reported device showed switching and very low (0.1 V) voltage. Furthermore, multilevel switching was also observed only in the negative voltage bias. In the same negative bias, the system also exhibited a combination of threshold and bipolar memory switching. The shortcoming of this device is the evolution of the hysteresis, which led to the disappearance of the multiple switching. The conduction mechanism analysis showed that conduction filament formed due to voltage induced degradation of the aloe vera active layer take place leading to the resistive switching. Overall, resistive switching memory based on aloe vera shows strong electrode dependence, and thus careful consideration of electrode combination is needed to optimise this device.

Keywords: aloe vera, bio-ReRAM, green computing.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2437

ESR and Low Field Microwave Absorption in Metal Shell and Magnetic Core Nano Particles

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Abstract: The resonant microwave absorption which is the electron spin resonance (ESR) and the low field microwave absorption (LFMA) [1, 2] were studied in well characterized magnetic core and metal shell nano particles (cobalt and Nickel as magnetic core and Ag, Au as metal shells) [3-4]. LFMA is essentially a non-resonant microwave absorption, centered around zero field. We found that the spin system is effected by the pinning between shell and core interface, which showed through the g-factor and anisotropy factor extracted through the ESR measurements. The LFMA hysteresis was found to be effected by the core-shell interfacial pinning of the spin system. LFMA signal intensity is strongly affected by the eddy current losses on the metallic shell of the core-shell nano particle.

Keywords: electron spin resonance, low field microwave absorption, metal shell.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2442

Quarter Turn Compression Lock Design with Opening Indicator for Railway Applications

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Abstract: In the compression locks there are opening and closing signs , but they could not be seen easily by the operator because they are too small to realize if the lock is locked or unlocked. The operator can forget locking the lock. This brings about work safety accidents while the vehicle is in motion so some people may get injured because of this problem. Taking into account all these risks the new lock was designed with opening indicator. Thanks to its special coating it can be realized easily even if the environment is dark. Even though the other locks provides IP65 , the new design provides IP66. The chance will be high to compete compared with others.

Keywords: lock, quarter, railway, compression, indicator.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2447

Effects of Doping on Structural and Electrical Properties of Bi(Pb)-2212 Superconducting Ceramics

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Abstract: In this works, the effect of doping by Titanium on Cu site of the superconducting Bi(Pb)-2212 phase is presented. Samples with nominal composition of Bi1.6Pb0.4Sr2CaCu1-xMxO8 δ where M= Ti and x = 0-0.06 are prepared by the solid state reaction method. The samples are characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and resistivity measurements. The study shows that the crystalline lattice structure of the prepared samples belongs mainly to the tetragonal Bi(Pb)-2212 phase (Table). The obtained cell volume decreases progressively with x for the Titanium doped one. For the undoped sample, the SEM micrographs show that the form and grain size have a random distribution. A quite different microstructure is obtained for the doped samples. The grains are more connected and have a flat shape which is characteristic of the Bi based superconductors. In the normal state, all samples exhibit a metallic like character. This resitivity decreases when x increases.

Keywords: Bi(Pb)2212, dopage, subsitution.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2461

Effect of Microplasma Spraying Parameters on Surface Roughness, Adhesive Strength and Biocompatibility of Titanium Coatings on Titanium Implants

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Abstract: Currently, titanium alloys are widely used for orthopedic implants, and various surface treatments, including coating with commercially pure titanium (CP-Ti), are employed to enhance implant biocompatibility. The optimal surface roughness of titanium orthopedic implants is a topic of active discussion. On one hand, increased roughness expands the implant's surface area in contact with the bone, facilitating osteoblast attachment and improving implant fixation. On the other hand, in vitro tests suggest that beyond a certain roughness threshold, cell adhesion becomes more challenging, and cell proliferation decreases. The recommended average surface roughness for orthopedic titanium implants spans a wide range, from 0.07 μm to 100 μm, but no systematic study on the impact of surface roughness on biocompatibility has been conducted. Evaluating the effect of surface roughness on coating biocompatibility necessitates considering the specific manufacturing process alongside a crucial coating characteristic—its adhesive strength. This approach enables providing specific recommendations regarding parameters for producing coatings from a particular material with desired adhesion strength and biocompatibility characteristics.

The objectives of this study were to determine the effect of microplasma spraying (MPS) parameters on the surface roughness, adhesive strength, and biocompatibility of CP-Ti coatings on a titanium alloy substrate and to offer practical recommendations for choosing MPS parameters to achieve optimal coating performance.

MPS of CP-Ti wire coatings on Ti6Al4V titanium alloy substrates was performed using the MPS-004 unit manufactured by EWI, Kyiv, Ukraine. The MPS parameters were selected based on a fractional factorial experiment design to produce two different surface roughness levels for the coatings (Group 1 and Group

2). The substrates underwent gas-abrasive treatment prior to MPS. Adhesion strength was evaluated using a static tensile experiment in accordance with ASTM F1147. A non-contact optical profilometer (Huvitz HDS-2520, Gyeonggi, Republic of Korea) was used to measure the average areal roughness (Sa) with a standard deviation of ± 0.1 μm. In vitro assessment of rat mesenchymal stem cells (MSCs) viability and proliferation was conducted using the Cell Counting Kit 8 proliferation assay (96992, Sigma Aldrich).

The main findings and accomplishments of this study were as follows: CP-Ti coatings in Group 1 exhibited the highest average roughness values (Sa) of 38.51 μm, while Group 2 CP-Ti coatings had lower values of 14.61 μm, and gas-abrasive treated substrates displayed the lowest roughness of 9.03 μm. The adhesive strength of the coatings was as follows: 38.7±5.2 MPa (Group 1) and 41.23±6.5 MPa (Group 2). Thus, titanium coatings with lower surface roughness demonstrated better adhesion to the titanium substrate. However, both Group 1 and Group 2 CP-Ti coatings showed a positive effect (40%) on cell proliferation rate, while no negative effects were observed for the Ti alloy substrate. This suggests that the material has a more significant impact on biocompatibility than surface roughness. Consequently, by adjusting the MPS parameters, it is possible to obtain CP-Ti coatings with an average roughness 1.5 or even 4 times greater than that of a titanium alloy base after gas-abrasive treatment, while still achieving a 40% increase in biocompatibility with respect to MSCs.

Keywords: microplasma sprayed coatings, biocompatibility, surface roughness, titanium implants.

Acknowledgement: This research is funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP14869862).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2462

In-vitro Testing of Microplasma Sprayed Ti, Zr, Ta Coatings on Ti Alloy Substrates: Effect of Coating Material on Implant Biocompatibility

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Abstract: Nowadays, the choice of materials for coating medical implants, such as endoprostheses, as well as the optimal porosity and roughness of these coatings, are topics of discussion among researchers. These considerations are closely linked to the selection of coating manufacturing technology to achieve desired coating characteristics from the chosen material and ensure good adhesion to the substrate. While titanium alloy remains the primary material for orthopedic implants, unalloyed titanium (Ti), tantalum (Ta), and zirconium (Zr) are gaining relevance for implant coatings.

The objective of this study was to utilize microplasma spraying (MPS) to apply biocompatible coatings on a titanium alloy substrate while selecting MPS parameters to produce three types of coatings from different materials. These coatings were aimed at achieving a similar porosity of approximately 20% and a pore size of up to 300 μm—parameters currently recommended by many researchers as acceptable for endoprosthetic implant coatings. Subsequently, the surface roughness of the coatings would be measured, and in vitro testing would determine which material exhibits the best biocompatibility. This approach would enable establishing which coating material offers superior biocompatibility and recommending specific MPS parameters that yield coatings with the desired porosity and surface roughness characteristics.

MPS of Ti, Zr, and Ta wire coatings on Ti6Al4V titanium alloy substrates was conducted using the MPS-004 microplasmatron (E.O. Paton EWI, Kyiv, Ukraine). To achieve the specified porosity for the coatings, the following MPS parameters were varied and then selected: current (I, A), plasma gas flow rate (Q, slpm), spraying distance (H, m), and wire flow rate (Vw, m/s). Adhesion strength testing was performed through a static tensile experiment following the ASTM F1147 standard. An optical profilometer (Huvitz HDS-2520, Gyeonggi, Republic of Korea) was used to measure the average area roughness (Sa) with a standard

deviation of ± 0.1 μm. Porosity and pore sizes were measured from digital images of the coatings using a scanning electron microscope JSM-6390LV (JEOL, Tokyo, Japan). The viability and proliferation of rat mesenchymal stem cells were evaluated in vitro using the Cell Counting Kit 8 (CCK-8) proliferation assay (96992, Sigma Aldrich).

The main results and accomplishments of this study were as follows: By adjusting the MPS parameters, the specified values of porosity and pore size could be attained. All three types of coatings achieved a porosity of up to 20% and pore sizes of up to 300 μm. Among the coatings, Ti coatings exhibited the highest average roughness values (Sa) of 38.51 μm, followed by Ta coatings with a lower Sa value of 22.09 μm and Zr coatings with the lowest Sa value of 16.09 μm. The adhesive strength of the coatings was as follows: Ti - 38.7±5.2 MPa, Ta - 35.0±4.9 MPa, and Zr - 26.9±4.7 MPa. During the three-day in vitro testing, a significant increase in cell proliferation rate was observed for Ta coating (approximately 45%) and Ti coating (approximately 40%), while no negative effects were observed for Zr coating or the Ti alloy substrate. These differences were statistically significant. Therefore, all coatings exhibited satisfactory adhesion to the substrate and were biocompatible. However, the Ta coating appeared to have the most significant potential for enhancing the biocompatibility of the titanium implant. The MPS parameters for Ta coating were as follows: I=31 A, Q=4.0 slpm, H=30 mm, and Vw=3.2 m/min. In the future, it would be promising to further investigate the effects of MPS parameters on adhesion strength and surface roughness of coatings, as well as the influence of surface roughness on coating biocompatibility.

Keywords: biocompatible coatings, in-vitro test, microplasma-spraying (MPS), titanium implants.

Acknowledgement: This research is funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP14869862).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2464

Ultrasonic Photoacoustic Emitter of Graphene-nanocomposites Film on a Flexible Substrate

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Abstract: Photoacoustic devices generating high-amplitude and high-frequency ultrasounds are attractive candidates for medical therapies and on-chip bio-applications. Here, we report the photoacoustic response of graphene nanoflakes – Polydimethylsiloxane composite. A protocol was developed to obtain well-dispersed graphene into the polymer, without the need for surface functionalization, at different weight percentages successively spin-coated onto a Polydimethylsiloxane substrate. We found that the photoacoustic amplitude scales up with optical absorption reaching 11 MPa at ~ 228 mJ/cm^2 laser fluence. We observed a deviation of the pressure amplitude from the linearity increasing the laser fluence, which indicates a decrease of the Grüneisen parameter. Spatial confinement of high amplitude (> 40 MPa, laser fluence > 55 mJ/cm^2) and high frequency (Bw-6db ~ 21.5 MHz) ultrasound was achieved by embedding the freestanding film in an optical lens. The acoustic gain promotes the formation of cavitation microbubbles for moderate fluence in water and in tissue-mimicking material. Our results pave the way for novel photoacoustic medical devices and integrated components.

Keywords: photoacoustic devices , graphene, PDMS.

POSTER PRESENTATION

Id-2470

Modified Colloid Lithography for Amphiphilic Surface Creation

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Abstract: Amphiphilic surfaces play a crucial role in controlling the interaction of solid materials with biomolecules and microorganisms. In this study, we propose a novel method for designing and fabricating of amphiphilic solid surfaces using colloid lithography and vapor annealing. By deposition of a monolayer of colloid polystyrene spheres on a gold surface and subsequent utilization of organic vapor annealing, we reached the deformation of the microspheres-based colloid mask. In particular, the degree of vapor annealing determines the extent of surface screening. Subsequent surface grafting with hydrophilic or hydrophobic functional groups was performed using a two-step process with utilization of diazonium salts. The resulting amphiphilic chemical patterns were utilized for selective entrapment of micelles from solutions, including drug-loaded micelles, and their subsequent detection. The effectiveness of the proposed approach was confirmed by atomic force microscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy, and Fourier-transform infrared spectroscopy. The controlled creation of periodical amphiphilic surfaces provides a versatile platform for various applications, including biomaterials, drug delivery systems, and biosensors.

Keywords: colloid lithography, amphiphilic surface, detection, diazonium chemistry.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2471

Covalent Grafting of MXene Flakes for Humidity Sensing

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Abstract: In recent years, there has been significant interest in the utilization of 2D materials, particularly MXenes, as promising candidates for flexible sensor design and realization. The primary objective of this work is the preparation and testing of highly sensitive and stable sensors based on MXene 2D flakes, aimed on monitoring human health. We propose the surface modification of the flakes, for addressing of a critical challenge faced by sensors used in practical applications, namely, the need to increase their longevity and stability. In particular, we developed a method to enhance the sensitivity of commonly used MXene flakes to humidity and improve their stability against oxidation through plasmon-assisted surface modification and termination tuning. Using this approach, the hydrophobic or hydrophilic chemical groups were grafted MXene surface. Proposed surface modification results in a significant change in the flakes' affinity towards water molecules. Moreover, the modification predominantly targets the less stable sites on the MXene surface where oxidation typically occurs. By effectively blocking these vulnerable and chemically active regions, the stability of MXene was enhanced. We also performed in situ GIWAXS measurements to explore the effects of surface modification on water molecule penetration and the consequent changes in created sensor sensitivity. In summary, our research emphasizes the advantages of plasmon-assisted surface modification in optimizing the MXene flakes functionality and longevity.

Keywords: MXene, humidity, plasmon-assisted modification, flexible sensor.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2473

Europium Doped Carbon Dots for Selective and Sensitive Detection of Tetracycline

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Abstract: The widespread use of the tetracycline (TC) antibiotic in farming, both as supplements and treatments greatly pollute nearby water bodies, which in turn has adverse effects on the ecosystems and human health. Hence, the main goal of this study is to develop a cost-effective, rapid, highly responsive, and selective optical detection method of TC in water. In this context, europium-doped carbon dots (Eu-CDs) were prepared and extensively tested as highly selective and sensitive optical detection agents for TC monitoring. The optimized sample has been found to have a linear range of TC detection from 0.01 to 5 μM with an effective limit of detection of 6.5 nM. According to the selectivity analysis, Eu-CDs are only selective to TC antibiotic and have insignificant optical responses to other TC derivatives. These findings suggest that Eu-CDs have the high potential to serve as a quick and efficient colorimetric agent to detect TC in water samples.

Keywords: carbon dots, tetracycline detection, selective and sensitive optical agent.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2474

Mesoporous Silica Particles for Removal of Toxic and Heavy Metal Cations from Water Samples

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Abstract: Pollution of terrestrial and aquatic ecosystems with toxic and heavy metals is a major environmental concern with serious public health implications. In this study, we investigated the size effects of synthesized mesoporous silica particles (~ 50 nm, ~ 200 nm, ~ 500 nm) on the removal rate of toxic and heavy metals in tap and river water. Chemical analysis before and after adsorption experiments revealed that mesoporous silica particles can effectively remove the As, Cd, Bi, Co, Zn, Al, and Cu elements from water. In particular, 200 nm SiO_2 particles (surface area ~ 748.46 m^2/g) showed the highest As (91.4%) and Al (98.5%) removal rates after 30 min. Other factors, such as water pH and contact time, were investigated as well. The results showed that fabricated mesoporous silica particles can be used for effective removal of some toxic and heavy metals from water.

Keywords: silica particles, adsorbent, toxic and heavy elements removal.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2475

Fabrication of Two-layered Porous TiO_2 Thin Films with Improved Photoelectrochemical Activity

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Abstract: Solar-powered photoelectrochemical water splitting has recently emerged as a promising technology for converting solar energy to hydrogen fuel. In this study, we investigated the photoelectrochemical activity of two-layered TiO_2 thin films prepared by spin coating and dip coating processes. Different porosity of the films was produced during the controllable incorporation of polystyrene beads as templating agents into titanium dioxide paste during the deposition of the second layer. The optimal porous sample had a photocurrent density of 0.140 mA/cm^2 at 1.23 V vs. RHE when compared to a nonporous reference sample (0.06 mA/cm^2 at 1.23 V vs. RHE). Extensive physicochemical analysis revealed that higher photocurrent density was associated with decreased charge recombination and improved light scattering effects. In conclusion, surface-modified two-layered porous TiO2 films with better photocurrent density may be employed to develop photocatalytic systems for green hydrogen generation.
Keywords: porous TiO2, thin films, photoelectrochemical activity, photocurrent density.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2476

Iodine-doped Carbon Dots for Potential Use as Contrast Agent in Computed Tomography

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Abstract: The most commonly used imaging technique for noninvasive disease diagnosis is computed tomography (CT). Various iodine-based molecular contrast agents, such as iopromide, iohexol, iobitridol and others, are commonly utilized as CT contrast agents. However, these molecular contrast agents are frequently linked to a variety of side effects, including contrast-induced acute kidney injury. Hence, in this study, we proposed a novel biocompatible iodine-doped carbon dots (I-CDs) for potential use as CT contrast agent. It is important to note that prepared I-CDs have excellent colloidal stability and excitation-dependent fluorescence emission, making them suitable for cellular bioimaging. Furthermore, we found that prepared I-CDs have better X-ray attenuation properties than commercial iopromide contrast agent. These findings clearly demonstrate that I-CDs have the potential to be used as a promising CT contrast agent and for cell bioimaging.

Keywords: carbon dots, contrast agent, X-ray attenuation, computed tomography.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2487

Pair Breaking Effects as Probed by Non-Resonant Microwave Absorption in a $Ba_{0.34}K_{0.64}Fe_2As_2$ Single Crystal

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Abstract: Non-resonant microwave absorption was studied very close to Tc in a single crystal of $Ba_{0.34}K_{0.64}Fe_2As_2$. The derivative absorption signals are linear in the applied field (H) indicating a H^2 dependence. This dependence is due to pair breaking effects. Further we also observed anisotropy for two configurations 1. Field parallel to and 2. Field perpendicular to the superconducting plane of the crystal. We believe that while the pair breaking effects are intrinsic in nature, a small hysteresis anisotropy observed related to the weaklinks. The Weaklinks could be due to the intrinsic Josephson junctions or due to the defects in the crystal.

Keywords: single crystal, iron pnictide, non-resonant microwave absorption.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2488

$YBa_2Cu_3O_{7-\delta}$ Nanoparticles Doped by Ferromagnetic Nanoparticles of $Y_3Fe_5O_{12}$

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Abstract: Present and future industrial uses of high critical temperature superconductors require high critical temperatures T_C and strong current densities J_C. These two aims constitute the two motivations of the scientific research in this domain. The most significant feature of any superconductor, from the viewpoint of uses, is the maximum electrical transport current density that this superconductor is capable of withstanding without loss of energy. In this work, vortices pinning in conventional and high-T_C superconductors will be studied. Our experiments on vortices pinning in single crystals and nanoparticles of $YBa_2Cu_3O_{7-\delta}$ and $La_{1.85}Sr_{0.15}CuO$ will be presented. It will be given special attention to the study of the $YBa_2Cu_3O_{7-\delta}$ nanoparticles doped by ferromagnetic nanoparticles of $Y_3Fe_5O_{12}$. The ferromagnetism and superconductivity coexistence in this compound will be demonstrated, and the influence of these ferromagnetic nanoparticles on the variations of the critical current density J_C in $YBa_2Cu_3O_{7-\delta}$ nanoparticles as a function of applied field H and temperature T will be studied.

Keywords: ferromagnetism, superconductivity, vortices pinning, ferromagnetic nanoparticles, critical current density.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2502

Optical Characterization of $MgAl_2O_4$ Single Crystals Irradiated by 220 MeV Xe Ions

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Abstract: In this work optical characteristics of alumina-magnesium spinel irradiated with fast heavy xenon ions modelling the effects of nuclear fuel fission fragments were investigated. In the course of the experiments, the following were measured: transmission spectra in the IR region (240-12,500) cm^{-1}, optical absorption spectra in the range (2-8) eV, Raman spectra were measured along the depth of ion penetration, from the surface to 30 μm. In the optical absorption spectrum of irradiated spinel crystals, a broad with a peak around 5.3 eV is observed. This band is associated with electronic color centers of F+ and F, while hole color centers are responsible for band with maximum at ~ (3-4) eV. In the near infrared region, the irradiated crystal retains transparency. In addition to the characteristic Raman modes of an ideal crystal, additional modes, A_{1g}* (720 cm^{-1}), and E_g* (385 cm^{-1}), manifested mainly as an asymmetric shoulder of the main E_g mode are also observed. The ratio A_{1g}*/E_g increases with increasing depth, reaching a maximum value of 0.05 at 6 μm remains almost unchanged until the end of the xenon ion's 14 μm range and with a further decrease to 0.045 at a depth of 30 μm. The irradiation with 220MeV ions leads to cation mixing along the ion pathway. The 408 cm^{-1} peak gradually broadens along the depth of ion penetration, indicating amorphization of the structure along the ion trajectory.

Keywords: single crystals $MgAl_2O_4$, absorption spectra, swift heavy ions, radiation defects, raman spectra.

Acknowledgment: The work was carried out within the framework of the grant project AR09258669 of the Ministry of Higher Education and Science of the Republic of Kazakhstan.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2503

Identification and Thermal Stability of Defects in ZrO_2 Irradiated with Xe Ions

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Abstract: The ESR spectra of monoclinic ZrO_2 ceramic samples with a nanoparticle size of 80–140 nm irradiated with a beam of Xe ions (220 MeV) were studied. It was found that irradiation with an ion beam (fluences of 10^{12}–10^{13} ions/cm^2) leads to the F+-centers formation in the samples, as well as paramagnetic defects with g = 1.963 and 1.985 of unknown nature. The intensity of the ESR signal with g = 1.963 and 1.985 decreases monotonically in the temperature range 400–550°C. The concentration of F+-centers varies with the annealing temperature in a complex nonmonotonic manner, which may be due to a change in F+-centers charge state due to the capture of electrons or holes released upon thermal emptying of the traps. The results obtained also confirm the general regularity of the increase in the radiation resistance of zirconium dioxide with a decrease in the size of nanoparticles.

Keywords: ZrO_2 ceramics, nanoparticle, ESR, fast Xe ions, defects.

Acknowledgment: The work was carried out within the framework of the grant project AP09260057 of the Ministry of Higher Education and Science of the Republic of Kazakhstan.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2512

Defining a Workspace without Singular Configuration of the 3-PRRS Tripod Type Parallel Manipulator

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Abstract: The 3-PRRS tripod type parallel manipulator is formed by connecting the moving and fixed platforms through three legs of the PRRS type, where P,R,S denote the prismatic, revolute and spherical kinematic pairs, respectively. The 3-PRRS type has three active and three passive joints. This paper presents a workspace without singular configurations of the 3-PRRS type tripod. The restrictions on the movement of the moving platform are derived. Dependent and independent parameters for determining the movement of the moving platform are determined. Jacobi matrices relating the velocities of the moving platform and input links are derived, and a workspace outside the singular configurations is determined.
Keywords: parallel manipulator, tripod, workspace, singular configuration.

POSTER PRESENTATION

Id-2515

Radon Contribution on the Response of the Sensitive Passive Dosimeters used in the Personal Dose Monitoring

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Abstract: The contribution of the 222Rn radiation on the passive personal dosimeters with high sensitivity was studied in this work. The natural isotope radon gas with a short half-life of 3.823 days but with a long rate of decays releases alpha radioactive particles and further the alpha and beta particles through its descendants. The thermoluminescence dosimeter are used for the personnel occupationally exposed monitoring and environmental monitoring and records x-ray, gamma and beta radiation. The thermoluminescent detectors are placed in a dosimetric badge and it is hard to believe that the detector registers alpha radiation. The information recorded by the detectors is generally caused by the 222Rn descendants beta radiation emitters.

At the moment, the most used passive detectors for personnel occupationally monitoring exposed to ionizing radiation are made of materials with high sensitivity luminescent properties, such as: thermoluminescent detectors, OSL, BeOSL, RPL. The separating of the ambiental radon contribution from individual doses of the person occupationally exposed requires a documented process specific to each type of detector or personal dosimetric monitoring system. The contribution of radon to the individual occupational doses can be considered only if the radon radiation measured is above the radon measured among the population.

In the present work, the effect of the radiation caused by 222Rn and its descendants on the thermoluminescent dosimetric system response was studied. The thermoluminescent detector is type LiF:Mg,Cu,P widely used for Hp(10) dose monitoring for personnel occupationally exposed to ionizing radiation as well as for Hp(10)* environment monitoring. Additionally, the BeOSL system has been used in this study. In this sense, groups of detectors closed in specific dosimetric badges used for personal or environmental dose measurements were exposed for 30 ÷ 150 days in research laboratories, industrial areas, homes and the surrounding environment. Simultaneously with the LiF:Mg,Cu,P detectors and following the same exposure conditions the CR-39 track detector and BeOSL were used.

The results recorded with the LiF:Mg,Cu,P dosimetric system show that the environmental doses are between 0.07 mSv and 0.09 mSv while the indoors doses are between 0.11 mSv and 0.15 mSv. There are

no significant differences between the doses recorded in homes and those recorded in laboratories or enterprises where the personnel occupationally exposed are radiological monitored.

It is concluded that the doses smaller than 0.15 mSv recorded with the dosimetric system containing LiF:Mg,Cu,P type detector and estimated under the procedural conditions of the dosimetric laboratory that developed the present study, cannot be considered as doses caused of occupational exposure and cannot be attributed to the personnel occupationally exposed.

Keywords: personal doses, radon, radiation protection.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2519

Ultraviolet Transmittance of Daily and Monthly Disposable Contact Lenses with UV Filters and Compliances with American National Standard Institute (ANSI) Classification

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Abstract: Ultraviolet (UV)-blocking contact lenses (CLs) may limit the exposure to UV radiation and prevent UV-associated adverse effects. However, the effectiveness of daily disposable CLs (DDCLs) and monthly disposable CLs (MDCLs) in blocking UV radiation and how well they conform to the American National Standard Institute (ANSI) Z80.20 standard are not fully understood. This study aimed to determine the UV-blocking effectiveness of DDCLs and MDCLs available in Jordan and examine their compliance with the criteria specified by the ANSI. Visible and UV light transmittances of the CLs (DDCLs: 1-DAY ACUVUE® MOISTTM, Bausch + Lomb Biotrue®ONEday, ACUVUE® OASYSTM; MDCLs: Avaira VitalityTM, CooperVision® Biomedics® 55 sphere, Clear 58TM) were evaluated using a spectrophotometer. The data were analyzed using a one-way analysis of variance ANOVA followed by Tukey's pairwise comparison test. One-way ANOVA showed a significant difference between UV transmission from three DDCLs of different brands in the UVA, UVB, and UVC regions ($P < 0.001$). In the case of MDCLs, a significant difference was also observed in the UV transmission characteristics. Most importantly, all three DDCLs met the class 2 criteria of ANSI for UV-blocking CLs; however, only one MDCL met these criteria. These findings suggest that the Acuvue Oasys is the best daily contact lens for blocking UV radiation. However, Avira and Biomedics Sphere 55 are recommended as MDCLs for protection against UV radiation. All DDCLs met ANSI class 2 criteria for UV blockage.

Keywords: ultraviolet, radiation, protection, CLs, spectrophotometry.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2525

Tin-doped Titanium Dioxide Film for Hydrogen Production from Wastewater

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Abstract: Achieving high-efficiency materials-coated electro catalysts for water splitting is crucial to produce and store renewable energy. Herein, pure titanium dioxide (TiO_2) and tin-doped titanium dioxide (Sn-doped TiO_2) films were synthesized using the sol-gel dip coating technique. The doping mechanism between the Sn and the TiO_2 films was confirmed through Fourier-transform infrared (FTIR) spectroscopy and X-ray fluorescence, which revealed characteristic absorption bands associated with the doping process. Additionally, X-ray diffraction (XRD) patterns confirmed that all films maintained an anatase phase, indicating the preservation of the desired crystal structure. Moreover, the presence of Sn in the TiO_2 film contributed to a smoother film surface, thereby enhancing the hydrophilicity of the films. The optical bandgap of the TiO_2 films decreased with the introduction of Sn, exhibiting value 3.15 eV, compared to the original value of 3.33 eV. Additionally, the electrical conductivity (σ-value) increased upon the introduction of Sn, reaching values of 2.5 $mS.cm^{-1}$. Finally, the water-splitting efficiency of TiO_2 film increased from 69.02% to 78.65% after doping with Sn.

Keywords: titanium dioxide (TiO_2), tin-doped titanium dioxide (Sn-doped TiO_2), wettability properties, optical bandgap, electrical conductivity, electrochemical water splitting.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2527

The Antibacterial Activity of Fe_3O_4 Nanoparticles and Magnetite /Silver Core-Shell Nanoparticles Against Drug Resistant Bacteria

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Abstract: The rapid evolution of antibiotic-resistant bacterial strains is a significant issue affecting the treatment of bacterial infections**.** This study represents a successful synthesis of Fe_3O_4, Ag, and Fe@Ag Nanoparticles through chemical reduction and co-precipitation methods. The synthesized NPs were characterized by X-ray diffraction (XRD), Scanning electron microscopy (SEM), and Fourier transform infrared (FTIR) spectroscopy analysis. Physical characterization proved that the synthesized NPs were small and highly pure in nature. The antibacterial activity of Fe@Ag and Fe_3O_4 Nanoparticles was evaluated by Minimum Bactericidal Concentration (MBC) against pathogenic bacteria strains: *S. typhimurium*, *P. aeruginosa*, and *S. aureus*. The results showed that Fe_3O_4 and Fe@Ag Nanoparticles in this study can inhibit the high concentration of bacteria (approximately 10^6 CFU/ml). This indicates that the studied NPs showed an excellent antimicrobial effect. On the other hand, our results revealed that the Fe@Ag Nanoparticles are more effective than Fe_3O_4 Nanoparticles at inhibiting the selected pathogenic bacteria strains: S. *typhimurium, P. aeruginosa*, and *S. aureus*.

Keywords: Fe_3O_4 Nanoparticles, magnetite /silver core-shell nanoparticles, minimal bactericidal concentration, antimicrobial activity, colony forming unit, drug resistant bacteria.

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2528

Concentration of Radon and Physicochemical Parameters in Hot Springs Water, Jordan

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Abstract: The correlation between radon activity concentration and physicochemical parameters in hot springs in Jordan, including shounah al-shamalyah, Abu Dhablah, hammamat Ma'in, hammamat Zara, and Jordanian Hamma was investigated. The concentration of the dissolved Radon 222Rn in the water samples will be determined using Cr 39 detectors. The physicochemical parameters in hot springs: pH, total dissolved solids, temperature, conductivity, and salinity were measured using Portable Multi-Parameter Meter. The influence of physicochemical parameters and geographical location on radon gas in hot spring water was investigated using the multiple regression method. The average radon concentration was 4.53 (Bq/l) with 0.747 std deviation, with the highest concentration in Ma'in, with an average of 4.89 (Bq/l) with .333 std deviation, and the lowest concentration in the Jordanian hamma well no.9, with an average of 4.29 (Bq/l) with 1.496 std deviation. The levels of radon activity found in this study are significantly lower than the 100 Bq/l World Health Organization (WHO) recommended range.

Keywords: radon, CR-39 detectors, radon in water, physicochemical parameters.

POSTER PRESENTATION

Id-2533

The Use of Electron Microscopy for the Characterization of Biocompatible Materials and Robotic Microplasma-Sprayed Coatings

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Abstract: Currently, the problem of increasing the biocompatibility of the surface of metal medical implants is in the focus of research around the world, since the quality of endoprosthesis replacement and the quality of life of the patient after surgery depend on this. An excellent way to increase the biocompatibility of an implant is to modify its surface, in particular by applying coatings. The unique advantage of this modification is that the surface properties, including biocompatibility, can be selectively improved while the bulk mechanical properties of the implant material remain unchanged. Thus, existing materials and technologies can be used to produce implants with increased surface biocompatibility. However, despite such advantages of the thermal plasma spraying technology as a sufficiently high efficiency and the possibility of spraying biocompatible refractory metals (Ta, Zr, etc.) and ceramics onto substrates of various materials, its application for the manufacture of coatings for medical implants has not yet become widespread. This is mainly due to the high heating temperatures of the substrate as a result of the thermal spraying process. Microplasma spraying (MPS) avoids the problem of overheating, as it has a very small thermal effect on the volume due to the low power of the process (up to 4 kW). The results of previous studies by the authors proved the possibility of obtaining coatings from biocompatible metals and ceramics with controlled porosity and satisfactory adhesion to a titanium implant using robotic MPS. The new robotic MPS method resulting from this research represents a promising solution for medical implant manufacturing technology, along with a method for the combined use of transmission electron microscopy (TEM) and scanning electron microscopy (SEM) to characterize plasma sprayed materials and their coatings.

The objective of the work was to develop a combined (TEM and SEM) research technique, which makes it possible to establish the regularities of the effect of MFS parameters on the structural-phase composition and porosity of coatings made of biocompatible metals and ceramics.

MPS of ceramic powders and metal wires was carried out by microplasmatron MPS-004 (E. O. Paton Electric Welding Institute, Kyiv, Ukraine) installed on an industrial robot-manipulator (RS010L, Kawasaki Heavy Industries, Japan). To assess the shape and size of sprayed particles and the porosity of biocompatible coatings, images obtained with a scanning electron microscope JSM-6390LV (JEOL) were

processed using software. Electron diffraction patterns of ceramic powder and titanium substrates were obtained by TEM on JEM-2100 (JEOL).

The main results and achievements of this study were as follows: an experimental technique for using SEM and TEM to characterize the coating and its constituent particles was developed and tested. The application of this technique made it possible to obtain regression equations for assessing the effect of MPS parameters on the coating porosity and to select the parameters that allow the most efficient MPS of hydroxyapatite coatings with a purity and crystallinity that meets the requirements of the international medical standard ISO 13779-2:2018.

Keywords: robotic Microplasma Spraying, biocompatible coatings, transmission electron microscopy (TEM), scanning electron microscopy (SEM).

Acknowledgement: This research is funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19679327).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2559

Enhancing Organic Thermoelectric Materials: The Role of Sorbitol and Graphene in PEDOT:PSS Thick Films

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Abstract: Conductive polymers have been popular choices for organic thermoelectric materials due to their low thermal conductivity. Among them, PEDOT:PSS stands out for its impressive electrical conductivity, but it has limited stretchability. This limitation is addressed by blending with plasticizers such as D-sorbitol, a biocompatible plasticizer that enhances both stretchability and conductivity. Recent advances focus on combining organic polymers with graphene to improve electrical conductivity, flexibility, and processability. Graphene, known for its exceptional thermoelectric performance, is non-toxic, lightweight, and highly conductive. Laser-induced graphene (LIG) is an efficient, cost effective and scalable production technique for graphene. This study introduces a two-step process, beginning with the addition of sorbitol to PEDOT:PSS, followed by the incorporation of laser-induced graphene, enabling a comprehensive analysis of alterations in structural and electrical properties. The findings underscore the potential of this composite material in advancing thermoelectric applications. In this study, the electrical conductivity of the PEDOT:PSS/LIG film was measured as 514 S cm^{-1}, marking it as the highest among the materials examined. However, it is noteworthy that the s-PEDOT:PSS/LIG (2 wt%) film, which incorporates sorbitol for enhanced mechanical flexibility, also demonstrated significant promise with a conductivity of 422 S cm^{-1}. This findings suggest that, depending on the specific application and requirements, s-PEDOT:PSS/LIG films may also present a viable and advantageous alternative.

Keywords: laser-induced graphene, sorbitol, PEDOT:PSS.

POSTER PRESENTATION

Id-2562

Fabrication of Antibacterial Thin Cu-Ti Coatings by Magnetron Sputtering

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Abstract: Currently, the development of new technologies for treating the surface of medical implants in order to increase their bioactivity is the focus of attention of scientists and specialists in the production of endoprosthesis implants. The occurrence of periprosthetic bacterial infections significantly limits the use of modern implants. Various approaches are being developed to impart antibacterial properties to implant surfaces, including magnetron sputtering of thin metal films such as Ag, Cu, Cu-Ti (or Nb-Ti), etc. The current trend in obtaining antibacterial coatings is the magnetron sputtering of thin Cu-Ti films varying from 20 wt.% to 80 wt.% Cu contents, demonstrating pronounced antimicrobial activity against S. aureus and E. coli bacteria. It was shown that Ti(Al, Cu)N coated with 9.2 wt.% Cu exhibited significant antibacterial activity against E. coli, S. aureus, and P. aeruginosa . It is noted that further research is needed to select both the optimal composition of thin films and their deposition parameters.

The objective of the work was to select the parameters of magnetron sputtering, providing a given composition and thickness of Cu-Ti coating and to analyze the antibacterial activity of the resulting coatings. Bacterial cultures of Staphylococcus aureus (gram-positive) and Pseudomonas aeruginosa were used for in vitro study of the antibacterial properties of Cu-Ti thin coatings and the surface of an uncoated titanium alloy.

Magnetron sputtering of Cu and Ti on titanium alloy disks was carried out using an EPOS-PVD-440 (Beams&Plasmas, Russia) equipped with three DC magnetrons. The concentration of Cu released from Cu-Ti films deposited on Ti-6Al-4V alloy was measured using an inductively coupled plasma mass spectrometer ICP-MS Agilent 7500cx (Agilent Scientific Instruments, USA). Microstructure study, film thickness estimation, and elemental analysis were performed using a scanning electron microscope JSM-6390LV (JEOL, Japan) with EDX INCA ENERGY (Oxford Instruments, UK). The phase analysis was carried out by the X'Pert PRO diffractometer (PANalytical, Netherlands).

The main results and accomplishments of this study were as follows: the composition of Ti-Cu films which provides the maximum antibacterial effect against Pseudomonas and Staphylococcus bacteria has been established and the parameters of DC magnetron sputtering of these films on a titanium alloy have been selected. Certain pretreatment parameters for the titanium alloy have been recommended. The results are

of significance for a wide range of researchers developing technologies of magnetron sputtering of antibacterial thin coatings on medical implants.

Keywords: magnetron sputtering, antibacterial thin coatings, endoprosthesis implants.

Acknowledgement: This research is funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP13268737).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2563

Effect of Titanium Doping on the Porosity and Optical Properties of ZnO Thin Films Prepared by Sol-Gel Method

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Abstract: Incorporating titanium oxide into zinc oxide is crucial for modifying and enhancing surface properties. However, the presence of titanium in the ZnO lattice can induce strain, flaws, and lattice distortions, thereby impacting the crystallinity, grain size, and surface morphology of the material. To investigate these effects, Ti-doped zinc oxide thin films were synthesized in this study using the sol-gel method. For zinc source zinc acetate dihydrate and for titanium source titanium isopropoxide used. Precursor solutions with four different molar ratios and aging times were produced and deposited on glass substrates. Following the coating process, coated glass substrates were annealed at 550°C for 30 minutes. The surface morphology and microstructure of the Ti-doped ZnO thin films were investigated using scanning electron microscopy. A prism coupler device was used to calculate the refractive indices of the obtained films. By comparing the obtained refractive index results with the theoretical refractive indices, a porosity calculation was made in volumetric scale. Afterwards, Using the Imagej software, the surface porosity of the films with varied molar ratios was calculated from scanning electron microscopy images and compared with volumetric counterparts. In conclusion, incorporation of titanium oxide to the zinc oxide matrix has a considerable impact on the surface properties of the resulting thin films. The full evaluation and understanding of Ti-doped ZnO thin films can help to further their potential applications in optoelectronics, sensors.

Keywords: ZnO, sol-gel, TiO_2, thin film.

POSTER PRESENTATION

Id-2564

Development of Additive Technology for Robotic Microplasma Spraying of Biocompatible Coatings

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Abstract: Nowadays due to the automation of thermal plasma spraying processes, it has become possible to apply these technologies for the additive production of multilayer functional coatings. This is a very prospective direction that let to gain a coating layer after layer for medicine or electric heating elements with the desired composition and microstructure according to a given 3 D-model of the product. In meantime, a number of challenges still exist to improve scientific recommendations that would allow the introduction of thermal spraying technologies directly into the production of additive coatings. However, the main challenge remains the complexity of the coating formation process during thermal spraying. In order to scientifically substantiate the choice and recommend spraying parameters, it is necessary to expand the understanding of the plasma spraying process and expand the range of materials under study, it is necessary to check the fundamental possibility of microplasma spraying coatings of products of complex shape, including products obtained by 3D printing of metals.

The objective of the work was to develop an additive technology for robotic microplasma spraying of biocompatible coatings onto medical implants of complex shapes, including 3D printed titanium implants.

Microplasma spraying (MPS) of multilayer coatings from ceramic powders and metal wires was carried out by microplasmatron MPS-004 (E. O. Paton Electric Welding Institute, Kyiv, Ukraine) installed on an industrial robot-manipulator (RS010L, Kawasaki Heavy Industries, Japan). Implant parts were fabricated according to their 3D computer models by selective laser melting (SLM) of certified Ti6Al4V titanium alloy (powder) using an additive manufacturing system for metal products Mlab cusing R CUSING (Concept Laser, Germany). The study of the microstructure and assessment of coating thickness were performed using a scanning electron microscope JSM-6390LV (JEOL, Japan).

The main results and achievements of this study were as follows: it has been demonstrated that by combining additive manufacturing and microplasma spraying, it is possible to obtain the multi-layer coatings from biocompatible metals and ceramics by gradual and accurate spraying of materials layer-by-layer according to a digital 3D model of the coated part. By providing specially selected MPS parameters, it is

possible to obtain coatings with a given composition of layers of controlled and uniform thickness of zirconium, titanium, tantalum and hydroxyapatite on parts of titanium implants.

Keywords: robotic microplasma spraying, biocompatible coatings, additive technology.

Acknowledgement: This research is funded by the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP13068317).

13th International Advances in Applied Physics & Materials Science Congress & Exhibition (APMAS 2023)

POSTER PRESENTATION

Id-2568

Preparing Process of Thin Film Sensor Substrate as a Buffer Layer by Magnetron Sputtering

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Abstract: Year by year thin film studies and products go widely using areas in our life. They became very useful and thin according to their properties, epecially thickness and surface rougness. So, in this study we aimed that different flexible and transparet wafer instead of Silicon and crystalline wafers. Another point that we studied on them is having alternate substrate for magnetic sensors. The reason for this is that polymer substrates have been used in many academic and industrial applications in last decades. Polyethylene Terephthalate (PET) structures which we worked on it, are one of the most notable among the flexible polymer substrates that have been widely used. The widespread use of these polymers on flexible and organic electronic studies has paved the way for them to come to life in many sensor applications. In this study, we worked on cleaning process of PET substrates. After that, we coated Platinium at 10W to each other (all of their thickess are about 10 nm) in Ultra High Vacuum by Magnetron Sputtering Deposition Techniques. After that, we analysed stoichiometry analysis by XPS in-situ system. Finally, we used SEM, XRD and AFM for surface analysis.

Keywords: surface analysis, thin film, PET, magnetron sputtering deposition, buffer layer.

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