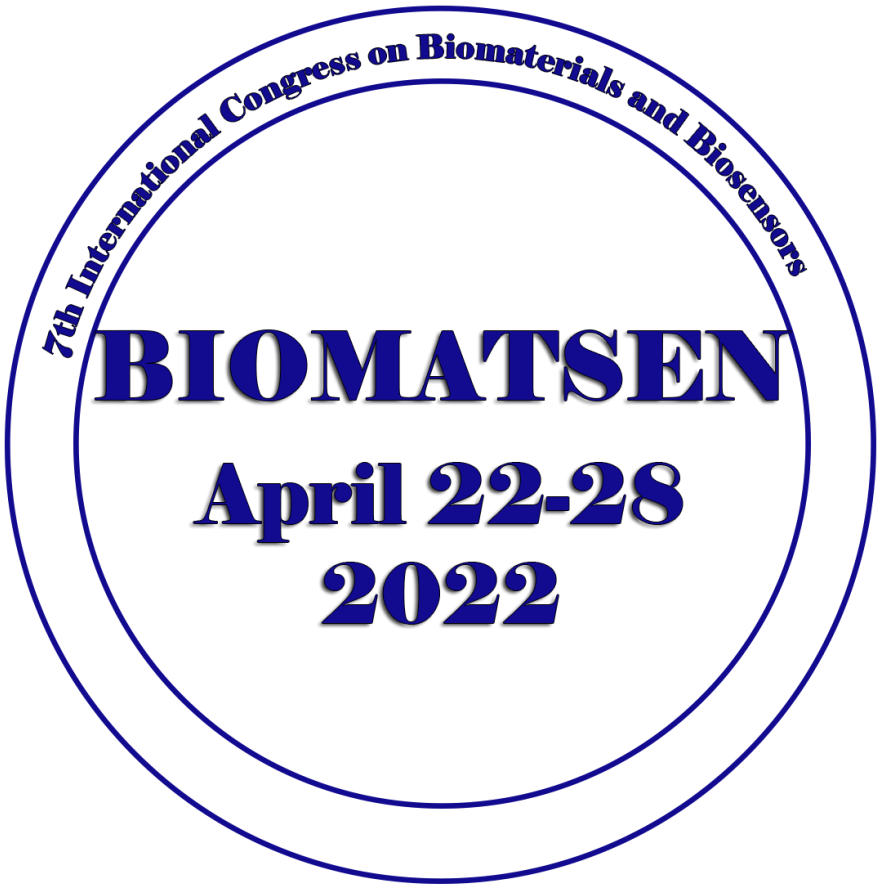
Book of Abstracts

BIOMATSEN 2022



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9th INTERNATIONAL CONGRESS ON BIOMATERIALS & BIOSENSORS (BIOMATSEN 2022)

Oludeniz, Turkey

APRIL 22-28, 2022

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INVITED SPEAKERS

Id-348

STIMULI-RESPONSIVE BIOMATERIALS for DRUG DELIVERY, TISSUE ENGINEERING and REGENERATIVE MEDICINE

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Abstract: Stimuli-responsive instructive biomaterials are particularly attractive for the treatment of a variety of conditions either via the controlled delivery of precise quantities of drugs at specific locations and times, potentially offering control of the chronopharmacology of the drug in line with the condition it is supposed to treat. Materials responding to stimuli such as enzymes, light, pH, temperature, ultrasound and electric/magnetic fields have been developed for use as drug delivery devices, medical devices and tissue scaffolds. Here we report the development of polymer-based materials that enable the delivery of drugs in response to electrical fields, light and magnetism; the tuneable properties of the materials make them attractive components of electroactive/photoresponsive biomaterials that when non-degradable have potential application for long term medical devices (e.g. bioactive coatings, electrodes, tools), and when degradable have potential application for short term applications (e.g. drug delivery or tissue engineering). Here we report the development of polymer-based materials that enable the delivery of drugs in response to electrical fields, light and magnetism; the tuneable properties of the materials make them attractive components of electroactive/photoresponsive biomaterials that when non-degradable have potential application for long term medical devices (e.g. bioactive coatings, neural electrodes, tools), and when degradable have potential application for short term applications (e.g. drug delivery or tissue engineering). An update on recent progress will be presented.

Keywords: Conducting polymer; Electroactive polymer; Photoactive polymer; Drug delivery, Neuromodulation.

INVITED SPEAKERS

Id-405

THIN FILMS of OXIDES GROWN by ATOMIC LAYER DEPOSITION for MEDICAL APPLICATIONS

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Abstract: Thin films deposited by the Atomic Layer Deposition (ALD) show several encouraging properties. The films are very dense, pin holes free, and the ALD method allows control of their electrical and optical parameters. Despite of slow growth rates, several practical applications of the ALD-grown films were demonstrated. Some examples of such applications will first be given in the talk. The ALD technology was applied by us for deposition of thin films of selected wide band gap oxides. Films were deposited on different substrates, including the temperature-sensitive materials, e.g., foils, fabrics, tissues, etc... For example, ALD-grown ZnO was intensively studied by us for applications in transparent electronics, as sensors, in photovoltaics and in optics, as transparent electrodes. Other materials studied by us include Al_2O_3, HfO_2, ZrO_2, TiO_2 dielectrics – for applications as anti-reflection layers, passivation layers of back contacts in silicon-based solar cells, and as so-called gate oxides. Our recent investigations indicate new extremely important areas of biological applications of these wide band gap oxides. We proved that these oxides show effective anti-bacterial (anti-microbal) activity. This fact led us to a new application - coating of hospital equipment, protection masks and very recently of implants. Regarding the latter application, selected oxides not only block spreading of bacteria, but also accelerate tissues regeneration, as will be discussed.

Keywords: Oxides; Biomaterials; Anti-microbal coatings; Implants coatings.

INVITED SPEAKERS

Id-413

ADVANCED FUNCTIONAL MAGNETIC MICROWIRES for MAGNETIC SENSORS SUITABLE for BIO-MEDICAL APPLICATIONS

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Abstract: Sensors play an important role in many industries (microelectronics, security and electronic surveillance, automotive, aerospace and aircraft, home entertainment, computer science, electrical engineering, ...), providing the ability to detect events or changes in the environment and monitor such events through other electronic devices, for example through a computer processor. Many sensor technologies can be quite effective for several biomedical applications, like monitoring the distribution of the ferromagnetic fumes and dusts in human lungs, position tracking and detection of markers, electrical activity of the heart, local heating by AC magnetic field useful for hyperthermia treatments against tumour cells or for drug delivery. As a rule, the use of magnetic sensors in biomedicine is limited by their high cost, special environmental conditions for the procedure and relatively weak biomagnetic signals from organs and tissues. Accordingly, the main trends in the biological systems monitoring are the development of inexpensive, fast, precise and effective diagnostics methods. The performances of the sensors are determined by the properties of the material from which given type of magnetic sensor is made. Much attention is paid to the use of nanomaterials or nanotechnologies (magnetic nanostructures, multilayered nanomaterials, thin-films, nanotags, ...) for biomedical applications. However, nanostructures prepared using sputtering, evaporation, ablation or deposition methods generally present relatively poor magnetic softness (and hence, GMI effect). Accordingly, nanostructured materials are not universal materials for magnetic sensors and devices design. Magnetic properties of crystalline magnetic materials are linked to their crystalline structure and to a great extent are limited by defects, like grain boundaries, dislocations, texture, etc. Therefore, amorphous magnetic materials with excellent soft magnetic properties, which can be observed in as-prepared materials without additional post- processing, have attracted great attention since the 60-s. Among other advantages of amorphous materials are fast and inexpensive fabrication method and superior mechanical and anti-corrosive properties. However, conventional amorphous materials (ribbons, wires) are of larger dimensionality, and therefore devices and sensors made from such materials are larger than those made using nanoscaled materials. One of such materials, that meet several of the requirements, such as reduced dimensionality, excellent magnetic softness, biocompatibility, superior

mechanical and anti-corrosive properties and possibility to present high GMI and even GMR effects are glass-coated microwires. Consequently, in this paper we will provide an overview of the trends related to optimization of magnetic and magneto-transport properties of glass-coated magnetic microwires potentially suitable for biomedical applications.

Keywords: Soft magnetic materials; Biocompatibility; Magnetic wires.

INVITED SPEAKERS

Id-417

PROTECTIVE EFFECTS of ALISKIREN-LOADED POLYMERIC NANOPARTICLES on CARDIOVASCULAR SYSTEM in EXPERIMENTAL HYPERTENSION

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Abstract: Aliskiren, the most recent antihypertensive agent, has been shown to exert cardio-protective, reno-protective, and anti-atherosclerotic effects independent of its blood pressure (BP) lowering activity. However, the limiting factor for the treatment might be the relatively low bioavailability of aliskiren (2–7%). Therefore, we aimed to study the effects of aliskiren-loaded polymeric nanoparticles with gradually released aliskiren on BP, nitric oxide synthase activity (NOS) and structural alterations of the heart and aorta developed due to spontaneous hypertension in rats. Twelve-week-old male spontaneously hypertensive rats (SHR) were divided into the untreated group, group treated with powdered or aliskiren-loaded nanoparticles (25 mg/kg/day) and group treated with nanoparticles only for 3 weeks by gavage. BP was measured by tail-cuff plethysmography. NOS activity, eNOS and nNOS protein expressions, and collagen content were determined in both the heart and aorta. Vasoactivity of the mesenteric artery and wall thickness, inner diameter, and cross-sectional area (CSA) of the aorta were analyzed. After 3 weeks, BP was lower in both powdered and nanoparticle-loaded aliskiren groups with a more pronounced effect in the latter case. Only aliskiren-loaded nanoparticles increased the expression of nNOS along with increased NOS activity in the heart (by 30%). Moreover, aliskiren-loaded nanoparticles decreased vasoconstriction of the mesenteric artery and collagen content (by 11%), and CSA (by 25%) in the aorta compared to the powdered aliskiren group. In conclusion, aliskiren-loaded nanoparticles represent a promising drug with antihypertensive and cardioprotective effects.

Keywords: PLA nanoparticles; Aliskiren; Aorta; Collagen; Heart; Hypertension; Nitric oxide.

INVITED SPEAKERS

Id-426

MONITORING of PHENOL BIOSORPTION by USING a DISPOSABLE ELECTROCHEMICAL SENSOR PLATFORM

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Abstract: Phenol (C_6H_5OH) is not only used as a raw material for industries but also is a by-product of many natural and industrial processes. It can be found in air, soil and water resources. It has colorless or white crystalline solid structure and a strong odor. US Environmental Protection Agency (EPA) listed it as a contaminant and it has toxic, mutagenic and carciogenic effects. It is easily soluble in water or aqueous solutions. Therefore, phenol and phenolic compounds are major water pollutants and their selective and sensitive detection by using reliable and sustainable tools is one of the trend topics in today's world that encounters pollutions in its all environmental resources. The removal of phenol from water resources has been widely studied by researchers due to its high solubility and long-lasting persistency in water. There are numerous types of adsorbents used for the removal processes, but biological ones are defined as biosorbents. The biosorbents should be cheap, eco-friendly and easily applicable for different water resources including wastewaters. In this study, the phenol biosorption was performed and this biosorption process was monitored by disposable pencil graphite electrodes (PGEs) in combination with cyclic voltammetry (CV) technique. The experimental conditions such as pH, biosorption time, temperature and phenol concentration were optimized based on the changes at the phenol oxidation signal measured by CV technique. The applicability of the sensor system was tested in different water samples under optimum conditions and the selectivity was tested against other phenolic compounds. The microscopic characterization results obtained under optimum experimental conditions were consistent with the electrochemical results. Electrochemical monitoring of phenol biosorption was performed as the first time in the literature. It is expected that this study will be pioneering in terms of development of eco-friendly and sustainable monitoring platforms for pollutants. This study was supported by Bilecik Seyh Edebali University Scientific Research Project Coordination (Project number: 2020-01.BŞEÜ.12-02).

Keywords: Phenol; Biosorption; Pencil graphite electrode; Cyclic voltammetry.

INVITED SPEAKERS

Id-433

MICRO/NANOARCHITECTURES INTEGRATED SILICON MICROTECHNOLOGIES BASED SENSING APPLICATIONS

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Abstract: The science of making tiny devices *via* miniaturization of the systems has been an emerging field in the microelectronics industry since 1950s. Since then, continues research and development in the field targets achieving to manufacture the smallest structures in order to meet the necessary criteria required in the microelectronics. Today, these advance systems are capable of providing excellent products of highly complex tiny devices with several layers of lithography and thin film depositions. Therefore, such excellent devices have been gaining attention of the researchers from several research fields including biosensors, microfluidics, photonic crystals, etc. In particular, the miniaturization of the systems has been critical for electrochemical sensing applications due to the benefits of the scaling down approach such as rapid establishment of steady state currents, decreased signal-to-noise ratio, increased sensitivities, etc. In this study, we will demonstrate several routes for successful fabrication of silicon based electrodes and chips. These devices were manufactured in Tyndall cleanroom facilities by microfabrication engineers. The designed fabrication flows are consisted of several repeats of photolithography, deposition, lift-off and etching step. The resulting fabricated electrodes/chips were studied with several morphological characterization techniques in order to evaluate the success of the fabrication. These techniques are Scanning Electron Microscopy (SEM), Focused Ion Beam (FIB) and Atomic Force Microscopy (AFM). This is followed by the electrochemical characterization of the electroactive surface in a redox probe. Figure-1 shows an example of SEM images of two different designs of micro band array gold electrodes (A to D) and corresponding voltammograms of the electrodes in the redox probe (E, F). As a second example, Figure-1H represents ultramicro single band electrode, which is a component of a multiplexed chip design. Due to the fabrication design, we specifically studied the thickness of the deposited metal with FIB (Figure-1I, J and K). The chip consisted of 6-sensing electrode was studied in order to characterize the ultramicroelectrode. Then, we investigated the reproducibility of the electrodes on chip and on wafer. As it is clearly seen in Figure 1L, M and N, the designed and fabricated device showed excellent performance. Then we explored the applications of the electrodes/chips. We investigated the limits of the hydrogen bubble template to miniaturize the foam-deposits. We achieved a deposition of Cufoam by applying *in situ* bubble template size down to 1µm width band electrodes. Figure-2 represents the SEM images of several Cufoam deposited ultra-micro electrodes and arrays; ultramicro single band (A), disk array (B,D), band array (C) and high magnification images of the Cufoam walls (E,F). The resulting microarchitectures were used

for electrocatalysis of glucose. Figure-2G shows the voltammograms of Cufoam deposits in the absence and presence of glucose and calibration study. Each design of highly porous foam microarchitecture showed excellent analytical performance in terms of sensitivity, reproducibility, reusability and lifetime. These systems are highly suitable for further miniaturization and integration with microfluidic devices that we are currently working on.

Keywords: Biosensors; Microfabrication; Microelectrode; Electrochemical biosensing.

INVITED SPEAKERS

Id-434

CHITOSAN IMINATION: An OPPORTUNITY towards BIOMATERIALS with BROAD APPLICATION SPECTRUM

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Abstract: Reversible formation of imine bonds from amines and aldehydes emerged as a great tool of chemistry for building (macro)molecular architectures with specific characteristics, such as pH sensing, pH responsive release of molecules, self-healing, metal coordination and so on. Chitosan is a natural originating polymer, biocompatible and biodegradable, largely used to build biomaterials for application in biomedicine, agriculture and environmental protection. In order to improve its properties for application in such fields, the amine groups are reacted with various aldehydes via reversible imine bonds. This presentation will focus on findings of our group regarding the use of reversible imine bonds for preparation of imino-chitosan biomaterials, such as films, hydrogels and fibers. It will be shown how the imination of chitosan can be exploited for building supramolecular hydrogels, films and fibers with tuned properties (e.g. strong antimicrobial activity, luminescence, super absorbency, chirality, self-healing, ability to bind metals and so on) which address requirements of certain applications. A special attention will be directed to the crosslinking of chitosan with monoaldehydes as a valuable strategy for the design of hydrogels. This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCCDI–UEFISCDI, project number 538PED/2020 within PNCDI III.

Keywords: Chitosan; Hydrogels; Fibers; Natural aldehydes.

INVITED SPEAKERS

Id-435

LACCASES in BIOCATALYSIS and MODIFICATION of BIOMATERIALS

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Abstract: Laccase (benzenediol: oxygen oxidoreductase, EC 1.10.3.2) is a multi-copper-containing enzyme which performs one-electron oxidation of various substrates such as diphenols, methoxy-substituted monophenols, as well as aromatic and aliphatic amines to form radicals and at the same time reduces molecular oxygen to water. Laccase-generated radicals undergo a number of non-enzymatic reactions, which have many potential applications. In the present contribution, applications of laccases in biocatalysis and modification of biomaterials are presented. In biocatalysis, laccase-catalysed the synthesis of potent bioactive compounds (mainly antioxidants) through homomolecular coupling and the efficacy of the compounds was assessed in-vitro and ex-vivo on human skin cells (keratinocytes and fibroblasts). In the modification of biomaterials, the enzyme was used 1. to develop green processes for the surface functionalization of lignocellulose materials mainly for improving hygienic properties (hydrophobicity and antimicrobial properties), and 2. to modify food biopolymers for the production of hydrogels and functional ingredients for gluten-free products. Laccase-catalysed dimerization of phenolic compounds such as ferulic acid, 2,6-dimethoxyphenol, 3-hydroxytyrosol, caffeic acid and silybin led to the production of dimers with high antioxidant capacity in comparison to the corresponding monomeric substrates. The monomers were linked mainly through C-C linkages with the β-5 and β-β linkages predominant in phenolic acids. In the modification of lignocellulse materials, fluorophenols and alkylamines were grafted to improve hydrophobicity while tannins and antifungal agents were grafted to improve antimicrobial properties. Modelling of the grafting reactions showed that functional molecules were coupled to guaiacylglycerol β-guaiacyl ether and dibenzodioxocin mainly through 5-5 linkages while the molecules were coupled to syringylglycerol β-guaiacyl ether through 4-*O*-5 linkages. Modification of food biopolymers improved properties of gluten-free bread and hydrogels produced from underutilised food ingredients. The processes developed have implications in various industries mainly the health and nutraceutical industries and the wood and paper industries.

Keywords: Laccase; Lignocellulose materials; Surface Functionalisation; biocatalysis.

INVITED SPEAKERS

Id-440

BIOSENSORS BASED on AMPHIPHILIC TRIBLOCK COPOLYMERS SELF-ASSEMBLED via MORPHOLOGY-INDUCED IMMOBILIZATION of BIOMOLECULES

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Abstract: Separation into domains is crucial for proper cellular function and numerous biomedical technologies, especially artificial cells. While phase separation in hybrid membranes containing lipids and copolymers is well known, their overall instability due to the lipid part is hindering the technological applications. Synthetic amphiphilic block copolymers have recently emerged as attractive alternatives for amphiphilic biological macromolecules, due to their ability to form artificial membranes. Besides resembling the structure of biomembranes based on phospholipid counterparts, polymer membranes are endowed with chemical versatility, a much higher mechanical stability and improved robustness. While such membrane can be constructed using amphiphilic diblock copolymers (DBCs) in the form a bilayer, amphiphilic triblock copolymers (TBCs) offer a much more straightforward approach. Due to their specific chemical structure consisting of two outer hydrophilic blocks and a longer central hydrophobic block, they can mimic the structure of a biological membrane by forming a monolayer with a higher mechanical stability and robustness. While TBCs of ABA type consist of two identical hydrophilic parts (A) and a longer hydrophobic block (B) that can self-assemble into a symmetric membrane, the asymmetric structure of ABC-type TBCs allows the formation of asymmetric, oriented membranes. Here, the two chemically different water-soluble blocks A and C mimic the hydrophilic heads of lipids forming a bilayer membrane, whereas the hydrophobic part B of the copolymer resembles the domain formed by interdigitation of hydrophobic tails of lipids. Both ABA and ABC TBCs can self-assemble into symmetric (ABA) or asymmetric membranes (ABC) that can serve as a platform for directed insertion of biomolecules. To enhance the preferred orientation and distribution of inserted biomolecules, the membrane thickness and its functionalization can be further tailored by careful selection of polymer blocks and their length, as well as the choice of self-assembly method. In this communication, the formation of polymer membranes based on both triblock copolymers is considered based on their self-assembly method and the resulting morphology, as compared to the respective structures formed by DBCs. Following, their potential to form fluorescent sensors, the membrane in the presence of horseradish peroxidase enzyme was explored. The systems obtained here have been evaluated via a model based on horseradish peroxidase for chemical detection of hydrogen peroxide. Our data suggests that these sensing platforms can be easily tailored and adapted for targeted sensing applications by adequate selection of an enzyme and substrate combination.

Keywords: Self-assembly; Triblock copolymers; Biomimetic membrane; Transmembrane sensing; Biomolecule insertion; Phase separation.

REGULAR SESSIONS

Id-416

Studies on Characteristics, Antimicrobial Behaviour and Cell Viability of DNase I Coated Titanium Surfaces via Alternating Current Electrophoretic Deposition

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Abstract: The demand for metallic biomaterials in the orthopedic and dental implant fields is rapidly increasing due to aging of the world population. Concomitantly, also the incidence of implant-associated infections (IAIs) is rising. The difficult-to-treat nature of IAIs causes a major healthcare burden, resulting in unintended consequences such as hospitalization and even death in severe cases. Many studies have focused on direct prevention of infections using antibiotics or antibiotic-containing coatings on the implant surface. Yet, biofilm-forming bacteria remain protected from the host immunity and present an increased resistance to antibiotics. Recently, a promising strategy is to combat biofilm growth indirectly using the DNA degrading molecule such as deoxyribonuclease (DNase) I that can cleave the extracellular DNA (eDNA) present in the matrix. This indirect approach to inhibit biofilm growth and prevent IAIs, the immobilization of DNase I is being considered as an antimicrobial strategy. In this study, the protective DNase I coatings on polydopamine activated titanium implants was applied using alternating current electrophoretic deposition (AC-EPD). AC-EPD was chosen as the deposition method owing to its versatility and fast processing ability while maintaining the activity of biomolecules. The real-time quantitative qDNase assay was applied to monitor the activity and release kinetics of AC-EPD DNase I coatings. Moreover, DNase I coatings were characterized in-depth in terms of surface topography using scanning electron microscopy (SEM), atomic force microscopy (AFM), in terms of wettability, surface free energy and film thickness using contact angle and spectroscopic ellipsometry, in terms of surface chemistry using time-of-flight secondary ion mass spectroscopy (ToF-SIMS), X-ray photon spectroscopy (XPS). Hereby, it was shown that AC-EPD allows concentrating DNase I at the electrode surface much more rapidly as compared to a simple dipping methodology (immersion), and this while maintaining its activity. The effectiveness of AC-EPD DNase I coatings against biofilm formation was investigated for *Staphylococcus epidermidis and Pseudomonas aeruginosa* biofilms. The AC-EPD DNase I coatings significantly reduced biofilm formation of both strains up to 20 h as compared to DNase I coatings prepared by classic dipping. Furthermore, the biocompatibility of AC-EPD DNase I coatings for human oral keratinocytes (HOK) cells was investigated using a cell viability assay (XTT

assay). AC-EPD DNase coatings showed no significant reduction of cellular activities. Overall, this study indicates that AC-EPD DNase I coatings allow preventing biofilm formation without inducing toxicity.
Keywords: Surface functionalization; Polydopamine; Alternating current electrophoretic deposition; DNase I; Biofilm prevention; Cell viability.

POSTER SESSIONS

Id-403

DEVELOPMENT of DENTAL BONE GRAFTS for THE TREATMENT of ALVEOLAR BONE LOSS by 3D PRINTING TECHNIQUE

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Abstract: Bone has the ability of regeneration in many cases however, infection of the bone or surrounding tissue, systemic diseases, the lack of blood supply, and bone loss are among the limitations of bone regenerations. The alveolar bone loss followed by the gradual deterioration of the jawbone is one of the serious problems, which can be cured by physical stimulation in the form of pressure. Therefore, a bone graft is used to simulate the bone properties, either alone or in combination with other materials. Among the bone graft materials, allogeneic bone grafts have been studied as more suitable bone replacement materials. Besides, 3D printing of allogeneic bone grafts has a great potential for fabricating synthetic bone graft substitutes with enhanced performance over traditional techniques. The design parameters, such as the plasticizer type and the 3D printing pattern, have yet to be optimized to ensure maximal biocompatibility and cell viability with sufficient mechanical properties. This study aims to fabricate a graft made of polycaprolactone (PCL) and allogeneic bone for guiding effective bone regeneration in the mandibula. As a first step to designing an ideal bone graft, the particle size of allogenic bone was reduced to a nano-size by a high-energy ball mill. The average particles size of pulverized allogeneic bones was found as 132nm ± 8.5nm. Then, different filament composites made of PCL and allogenic bone with plasticizers such as triethyl citrate (TEC), triethyl 2-acetyl citrate (ATEC), tributyl citrate (TBC), tributyl 2-acetyl citrate (ATBC) were fabricated using an extrusion technique. To find suitable bone grafts, different models were fabricated using 3D printing technology with different printing patterns including tri-hexagon, zigzag, grid, gyroid from those obtained filaments. After fabricating 16 different 3D printed models, the cell viability and cell differentiation analyses were performed. The model plasticized with ATBC and fabricated with a tri-hexagon pattern exhibited the highest cell viability and cell differentiation capacity in vitro. The 3D printed bone grafts can be prepared as specific to patients with their advantages over the conventional fibular bone graft for surgical mandibular reconstruction. Therefore, these results indicate that PCL and allogenic bone-based grafts have outstanding potential as bone graft substitutes for effective bone regeneration for the mandibula.
This study was funded by the Scientific and Technological Research Council of Turkey (TUBITAK) 1003 - Primary Subjects R&D Funding Program Grant No 218E012.

Keywords: 3D-Printed Graft; 3D-Printing Pattern; Plasticizer; Allogenic Bone; Mandibular Reconstruction; Polycaprolactone.

POSTER SESSIONS

Id-407

CALCIUM PHOSPHATE-BASED BIOMATERIALS MODIFIED with SILICON and A GPTMS

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Abstract: Although a lot of research has been performed, complex bone defects caused by trauma, infection, or tumours still represent challenges for surgeons. Innovative, surgically handy bone substitutes are needed. Many studies have been recently focused on mouldable self-setting biomaterials based on calcium phosphates, mainly due to their mouldability and chemical resemblance to the inorganic component of bone. Self-setting calcium phosphate-based materials consist of a solid and a liquid phase which, when mixed together create a shapeable paste that can conform to complex bone cavities. Calcium phosphate cements (CPCs), as well as biomicroconcretes, are representatives of this group of bone substitutes. Biomicroconcretes are composed of aggregates in the form of granules combined with cementitious matrix, which provides materials with favourable physicochemical and biological properties. In this study biomicroconcretes based on the hybrid hydroxyapatite-chitosan-based granules and a highly reactive α- tricalcium phosphate powder modified with silicon (Si-α-TCP) and a silane coupling agent (GPTMS, (3-glycidyloxypropyl)trimethoxysilane), were developed. Silicon was introduced to improve biological performance of materials whereas silane coupling agent in order to obtain a better connection between granules and cementitious matrix. The 2% solution of sodium hydrogen phosphate (Na_2HPO_4) was used as the liquid phase. The phase composition (XRD), microstructure (SEM), setting times (Gilmore needles), mechanical strength (Instron), and *in vitro* bioactive potential of the composites were examined. The obtained results demonstrated a beneficial effect of the GPTMS coupling agent on the physicochemical properties of the materials. It has been shown that the addition of a GPTMS decreased the setting times and improved the compressive strength of the biomicroconcretes. Biomaterials containing the highest amount of GPTMS (5 wt.%) were characterized by the most favourable properties. Moreover, preliminary *in vitro* tests in simulated body fluid (SBF) demonstrated their bioactive potential. Further physicochemical and biological studies are needed to fully characterize developed biomaterials. Research funded by the National Science Centre, Poland Grant No. 2017/27/B/ST8/01173. Supported by the Faculty of Materials Science and Ceramics AGH UST - University of Science and Technology, Kraków, Poland, Project No. 16.16.160.557 (2022).

Keywords: Calcium phosphates; TCP; Hybrid; Silicon; Coupling agents; GPTMS.

POSTER SESSIONS

Id-408

FOAMED CALCIUM PHOSPHATE BONE CEMENT with the ADDITION of CITRUS PECTIN - An ATTEMPT to IMPROVE MECHANICAL PROPERTIES

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Abstract: Foamed calcium phosphate bone cements (fCPCs) are materials with poor mechanical properties. Polymeric additives often improve the mechanical properties of calcium phosphate cements. However, in fCPC, the application of additive can adversely affect the porosity of the material. In this study, foamed cements were prepared by surfactant-assisted foaming method. As a surface active agent, Tween 80 was used. Surfactant-based liquid phase (1.25 g/L of Tween 80 in 2% (w/v) solution of Na_2HPO_4) was foamed and mixed with α-tricalcium phosphate (α-TCP) at a ratio of 0.7 g/g. In the case of material fTW80_CU, citrus pectin was added to α-TCP powder at a ratio of 0.02 g/g. To confirm the hypothesis that the addition of the polymer improves mechanical properties of the foamed cement, materials with (fTW80_CU) and without (fTW80) the addition of citrus pectin were obtained and analysed in terms of compressive strength (Instron 3345) and porosity (by Mercury Intrusion Porosimetry - AutoPore IV 9500, Micromeritics and X-ray microtomography - Nanotom S). As expected, the addition of the polymer significantly improved the compressive strength of the foamed cement. The compressive strength of material fTW80 was 1.79 ± 0.48 MPa whereas for fTW80_CU - 3.62 ± 0.79 MPa. This effect was achieved by ionic and/or polar interactions between the COO^- group of pectin and Ca^{2+} of calcium phosphate. Taking into account that pectin turns to gel in the presence of divalent ions, the obtained composite material fTW80_CU can be described as cement with a dual setting mechanism. Pectin only slightly reduced the cement porosity from 78.1 ± 2.3 vol% for the cement fTW80 to 71.0 ± 8.4 vol% for the cement fTW80_CU. In conclusion, the use of pectin improves the mechanical properties of foamed cements without significantly lowering their porosity. The favourable changes in material properties achieved by using a polymer can set a future trend in the field of fCPCs. This study was supported by the National Science Centre, Poland (Project No. 2017/27/N/ST8/00913), by the subvention from the Ministry of Science and Higher Education (Poland) for Faculty of Materials Science and Ceramics AGH UST – University of Science and Technology, Krakow, Poland, Project No. 16.16.160.557 (2021). E. C. acknowledges financial support from the National Science Centre, Poland under Doctoral Scholarship No. 2019/32/T/ST5/00207.

Keywords: Calcium phosphate; Bone cement; Surfactant; Pectin.

POSTER SESSIONS

Id-409

CALCIUM PHOSPHATE BIOMICROCONCRETE-TYPE BONE FILLERS MODIFIED with COUPLING AGENT

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Abstract: Although a huge range of bone grafts is available on the market, the problem of effective reconstructive treatment remains challenging and new bone substitutes are needed. An important group of biomaterials is calcium phosphate cements (CPCs), which are characterised by bioactivity and chemical composition similar to the inorganic part of human bone. CPCs consist of a solid phase and a liquid phase which, when mixed, form a plastic paste with self-setting properties. Novel type of CPCs are biomicroconcretes – the composites in which aggregates in the form of inorganic-organic granules within cementitious matrix provides materials with beneficial properties. In this study, the influence of silane coupling agent on the physicochemical properties of biomicroconcrete-type bone fillers was investigated. Highly reactive unmodified α-TCP powder or 1 wt.% / 2 wt.% / 5 wt.% coupling agent modified α-TCP powders and hybrid HAp/CTS granules in the weight ratio 3:2 acted as solid phase of the developed materials. A 2 wt.% aqueous solution of disodium hydrogen phosphate (Na_2HPO_4) was used as a liquid phase. The phase composition, setting times, compressive strength, and microstructure of the obtained materials were studied. Studies have shown that due to the presence of α-TCP powder modifier the biomicroconcrete-type materials were characterized by altered properties if compared with biomaterial without coupling agent. The XRD analysis of obtained materials has revealed two crystalline phases – α-TCP and HAp. The quantitative analysis of phases showed that amount of α-TCP was in the range of 50.7 – 58.6 wt.% and the hydroxyapatite phase in the range of 49.3 – 41.4 wt.%. It was observed that silane coupling agent accelerated α-TCP hydrolysis to non-stoichiometric hydroxyapatite. The setting times of investigated biomicroconcretes were in the range of 5 - 7 ± 1 min (initial setting time IT) and 10 - 16 ± 1 min (final setting time FT). It was confirmed that an increasing amount of coupling agent shortens both, initial and final setting time. In conclusion, developed bone fillers can be interesting candidates for bone tissue substitution. What is more, *in vitro* tests in simulated body fluid (SBF) confirmed their bioactive potential. Research funded by the Faculty of Materials Science and Ceramics AGH UST - University of Science and Technology, Kraków, Poland, Project No. 16.16.160.557 (2022). Supported by the National Science Centre, Poland Grant No. 2017/27/B/ST8/01173.

Keywords: Calcium phosphates; Bone cements; Biomicroconcretes; Coupling agents.

POSTER SESSIONS

Id-410

INFLUENCE of TETRAETHOXYSILANE (TEOS) on the PROPERTIES of CALCIUM PHOSPHATES BASED BIOMICROCONCRETE-TYPE BIOMATERIALS

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Abstract: Increased incidence of osteoporosis-related fractures and bone cancers requires scientists to develop new biomaterials for bone replacement. Calcium phosphate bone cements (CPCs) are widely used in orthopaedic, craniofacial surgery, and dentistry due to their excellent biological properties and chemical composition similar to the inorganic part of the bone. Unfortunately, CPCs based on α-tricalcium phosphate (α-TCP) are fragile and characterised by poor mechanical properties suitable only for low-load bearing applications. Recently, to overcome the above-mentioned issues of CPCs biomicroconcretes have been developed. Biomicroconcretes are composites in which the combination of aggregates in the form of granules with cementitious matrix provides materials with unique physicochemical and biological properties. In this study, the impact of tetraethoxysilane (TEOS) on the physicochemical and biological properties of biomicroconcretes was investigated. The solid phase of the developed materials was composed of highly reactive α-tricalcium phosphate (α-TCP) powder (non-modified or modified with 1 wt.%, 2 wt.%, or 5 wt.% of TEOS), and hybrid hydroxyapatite-chitosan granules (HAp/CTS) in the range of 300 - 400μm. As a liquid phase, a 2 wt.% aqueous solution of disodium hydrogen phosphate (Na_2HPO_4) was used. The phase composition, setting times, compressive strength, and microstructure of the obtained materials were investigated. The conducted research showed that the obtained biomaterials were characterised by unique properties due to the TEOS modification. The compressive strength of obtained materials ranged from 3.91 ± 0.74 MPa to 7.16 ± 1.50 MPa. It was observed that the mechanical properties of biomicroconcretes improved with the increasing TEOS amount. All of the obtained materials possessed a similar microstructure. The hybrid granules were well-visible and the cementitious matrix coherently surrounded the aggregates. The developed biomicroconcrete-type cementitious bone substitutes can be prosperous self-setting and mouldable materials for filling bone tissue defects of any shape and size. Preliminary *in vitro* tests in a simulated environment demonstrated the bioactive potential of obtained CPCs and paves the way for further *in vitro* and *in vivo* studies. Research funded by the Faculty of Materials Science and Ceramics AGH UST - University of Science and Technology, Kraków, Poland, Project No. 16.16.160.557 (2022). Supported by the National Science Centre, Poland Grant No. 2017/27/B/ST8/01173.

Keywords: Calcium phosphates; Bone cements; Hybrid granules; TEOS.

POSTER SESSIONS

Id-415

COMBINED THERAPY of SIMVASTATIN- and COENZYME Q10-LOADED NANOPARTICLES AMELIORATES PI3K-Akt-eNOS PATHWAY in A RAT MODEL of METABOLIC SYNDROME

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Abstract: Besides the LDL-cholesterol-lowering effect, statins have pleiotropic beneficial effects on the cardiovascular system. However, long-term treatment with statins may be associated with serious side effects. With the aim to streamline the statin therapy, we studied the effects of simvastatin- and coenzyme Q10-loaded polymeric nanoparticles on lipid profile and nitric oxide (NO)/reactive oxygen species (ROS) balance in the heart and aorta of adult male obese Zucker rats. The rats were divided into the untreated group, group treated with empty nanoparticles, and simvastatin-, or coenzyme Q10 (CoQ10)-, or a combination of simvastatin-loaded and CoQ10-loaded nanoparticles (SIMV+CoQ10). After 6 weeks, lipid profile was determined in the plasma and concentration of conjugated dienes in the liver. Akt, eNOS, phosphorylated eNOS (p-eNOS), NADPH oxidase, and NF-kappaB protein expressions were measured in the heart and aorta. All simvastatin, CoQ10, and SIMV+CoQ10 treatments decreased plasma LDL levels, but only the combined SIMV+CoQ10 treatment increased the expression of Akt, eNOS, and p-eNOS in both heart and aorta. Interestingly, NADPH oxidase in the heart and NF-kappaB protein expression in the aorta were decreased by all treatments, including nanoparticles alone. In conclusion, only combined therapy with SIMV- and CoQ10-loaded nanoparticles ameliorated PI3K-Akt-eNOS pathway in obese Zucker rats, which may represent a promising tool for the treatment of cardiometabolic diseases.

Keywords: Polymeric nanoparticle; Statin; Reactive oxygen species; Nitric oxide; Cardiometabolic diseases.

POSTER SESSIONS

Id-419

ENDOTHELIUM-TARGETED RAGE-shRNA NANOCARRIERS REDUCE ATHEROSCLEROSIS-ASSOCIATED INFLAMMATION

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Abstract: The receptor for advanced glycation end products (RAGE) plays a central role in the chronic inflammatory process associated with atherosclerosis development. We aimed to develop lipoplexes carrying RAGE-short hairpin (sh) RNA, targeted to the adhesion molecule P-selectin, selectively expressed on the surface of activated endothelium (Psel-lipo/shRAGE) to down-regulate RAGE expression as a therapeutic strategy for atherosclerosis. The P-selectin targeted lipoplexes were obtained by complexing the cationic liposomes surfaced with a P-selectin recognizing peptide with shRNA plasmids DNA targeting mouse RAGE gene (shRAGE). In vitro, Psel-lipo/shRAGE lipoplexes were efficiently taken up by activated endothelial cells (EC), decreased the expression of RAGE protein, and proved to be functional by reducing the monocyte adhesion to activated EC. In ApoE-deficient mice, the targeted lipoplexes accumulated specifically and efficiently transfected the aorta. The repeated administration of Psel-lipo/shRAGE lipoplexes, twice per week for one month: i) reduced the expression of RAGE protein in the aorta by decreasing the expression of NF-kB and TNF-α; ii) diminished the plasma levels of TNF-α, IL6, IL-1β, and MCP-1; iii) inhibited the atherosclerotic plaque development and iv) had no significant adverse effects. In conclusion, the newly developed Psel-lipo/shRAGE lipoplexes reduce the inflammatory processes associated with RAGE signaling and the progression of atherosclerosis in ApoE-deficient mice. Downregulation of RAGE employing these lipoplexes may represent a promising new targeted therapy to block atherosclerosis progression. The work was supported by grants from the Romanian Ministry of Education and Research, CNCS – UEFISCDI (project numbers PNII-RU-TE-2014-4-1837, PN-III-P4-ID-PCCF-2016-0050 and PN-III-P4-ID-PCE-2020-2465).

Keywords: Nanocarriers; Endothelium; Atherosclerosis; P-selectin; shRNA; RAGE.

POSTER SESSIONS

Id-421

DUAL-CROSSLINKED INJECTABLE HYDROGELS BASED on CHITOSAN

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Abstract: Hydrogel materials are often used in tissue engineering because of their advantageous properties such as high water content, swelling ability, porosity, three-dimensional network structure, biocompatibility and the ability to mimic native extracellular matrix. When obtaining hydrogel materials, it is extremely important to select an appropriate crosslinking agent that will enable the formation of a stable and three-dimensional polymer spatial network. This function can be performed by functionalized polysaccharides containing a reactive aldehyde groups in their structure. These groups are able to react with amino groups, present in chitosan, by Schiff base crosslinking, which allows to use the functionalized polysaccharides as crosslinkers. The presence of inorganic ions (e.g. borate, calcium, sodium) affects significantly cross-linking process by interacting with chitosan and/or functionalized polysaccharide. The sources of ions can be bioactive glasses (BGs), which means that the use of them as hydrogel matrix modifiers may provide dual-crosslinking effect. This can be advantageous for injectable hydrogels, for which the possibility to control the crosslinking process is particularly important. The subject of this research are injectable hydrogel materials based on chitosan cross-linked with a functionalized polysaccharide - dextran and bioactive glasses. Sol-gel-derived BGs such as Bioglass 45S5 (45 mol% SiO_2, 24.5 mol% CaO, 24.5 mol% Na_2O, 6 mol% P_2O_5), calcium-rich BG (40 mol% SiO_2, 54 mol% CaO, 6 mol% P_2O_5) and borate BG (54 mol% CaO, 6 mol% P_2O_5, 40% B_2O_3) have a dual function - crosslinking agents and functional components. The aim of the research was to evaluate the impact of the presence of different BGs on the crosslinking process of chitosan-based hydrogels. Materials were incubated in PBS and SBF solutions in order to assess their swelling, degradation, and mineralization processes, while the ICP-OES analysis was held to evaluate the changes of ion concentration in the solutions. Additionally, a rheological measurements and preliminary *in-vitro* studies using Hs680.Tr human fibroblasts were carried out. Freeze-dried materials were analyzed with SEM/EDX microscopy and ATR-FTIR spectroscopy. Based on the conducted research, it was found that by appropriate selection of bioactive glasses it is possible to affect the crosslinking process and modulate properties of hydrogel materials. The obtained materials have promising multifunctional properties and great potential for use minimally invasive strategy towards tissue regeneration. This work

was supported by the National Science Centre, Poland, grant nos. 2017/27/B/ST8/00195 (KCK) and program „Excellence initiative – research university" for the AGH University of Science and Technology.
Keywords: Hydrogel; Chitosan; Crosslinking; Bioglass.

POSTER SESSIONS

Id-429

DETECTION of HELICOBACTER PYLORI in SALIVA by SURFACE PLASMON RESONANCE

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Abstract: *H. pylori* is a gram-negative, spiral, microaerophilic bacterium. Currently, at least half of the world's population is infected with *H. pylori*, making it the most common chronic bacterial infection. After the oral H. pylori infection was detected, it was gradually accepted that the oral cavity is the second major site of H. pylori colonization. In this connection, several major problems are formulated: to what extent is oral infection indicative for gastric? is an oral infection caused by gastric reflux? what function does the oral infection perform - transmission or source of gastric infection? In recent years, these problems have increasingly attracted attention, because of which the results are controversial, revealing the complex nature of the disease. This radically changes the understanding and approach towards these diseases and determine the importance of accessible detection method of *H. Pylori* infection in saliva. The main problem in the detection of *H. pylori* in saliva is the low concentration of *H. pylori* in saliva - about 3 times less than in the stomach. In addition, saliva contains about 1,500 bio-active substances that would interfere with the detection of HP. All this requires the detection method that possess high specificity and sensitivity. In this study we report for such method based on Surface Plasmon Resonance (SPR). The main disadvantage of the method, the low specificity, has been overcome by the deposition of the ligand without the built-in matrix. Matrix-assisted pulsed laser evaporation (MAPLE) has been used for this purpose. As recognition molecules we used the blood antigen Le^b which were deposited on the surface of gilded diffraction grating. Solutions with different concentration of Le^b were prepared and used as a target during MAPLE deposition. The thicknesses of deposited layers were in range 100 nm -200 nm. Thus prepared SPR biochips were used in the experiment.The best sensitivity was achieved with thickness layer about 170 nm. The model experiments for *H. pylori* detection were provided as follows. Solutions with various concentration of *H. Pylori* in range 10^6 – 10^2 CFU/ml were prepared. Saliva from healthy people was infected with *H. pylori* solutions. SPR biochips were treated for 10 min with infected saliva and then were centrifuge. SPR shift was observed as a function of concentrations. The low detection limit in terms of concentration was established. We observed good specificity while the sensitivity is influenced by the compounds in saliva. In conclusion, a detection of *H. pylori* in saliva was provided. The detection method is based on SPR

and the ligand is the blood antigen Le^b. We observed good specificity while the sensitivity should be improved.

Keywords: Biosensor; Surface Plasmon Resonance; Helicobacter Pylori; MAPLE.

POSTER SESSIONS

Id-430

EVALUATION of MODEL SYSTEM BASED on BIMOLECULAR INTERACTION of SARS CoV-2 S- and N-STRUCTURAL PROTEINS and SPECIFIC ANTIBODY by SPR ASSAY

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Abstract: The novel coronavirus disease 2019 (COVID-19) has cause improving methods for testing and diagnostics. Currently, RT-PCR is the gold standard for detection of active or acute infection. However, this is a multi-step technique which involves purification, nucleic acid amplification, and fluorescence detection. Moreover, the process is laborious, requires trained operator and can be obtained in 3 to 4 h or up to a one day. Optical biosensors present an alternative method for rapid detection of surface proteins from the SARS-CoV-2 due to their safe, straight-forward use, and cost effective technology. Surface plasmon resonance (SPR) sensing is a label-free sensing technique that is highly sensitive. However, its drawback is relatively low specificity caused by the the built-in matrix required for ligand immobilization. Our group has successfully overcome this problem by application of matrix-assisted pulsed laser evaporation (MAPLE). This method avoids the built-in matrix and provides directly immobilized ligands what guaranties high specificity of reactions. Here we report for SPR assay, which was used to assess the immunoreactivity of monoclonal (MO) antibody (Ab) after conjugation with S- and N-structural proteins of SARS-CoV-2. Specific anti-SARS-CoV-2 Ab, like ligand with working concentration 1µg/ml was immobilized by MAPLE method on gilded diffraction grating. The thickness of deposited layers was about 110 nm that guaranties high sensitivity. So prepared SPR chips was illuminated by polychromatic light. Spectral read-out was applied for SPR detection and observed resonances were used as reference. Various concentrations of structural SARS-CoV-2 S- and N-proteins in concentration range 2.5 µg/ml – 0.001 µg/ml were prepared in deionized, diethylpyrocarbonate nuclease-free (*DEPC*) water. We observed that SPR shift, caused by MO Ab - SARS-CoV-2 S-protein interaction, was stronger than the interaction of MO Ab – SARS-CoV-2 N-protein with about 30%. The bimolecular interaction of viral structural proteins with MO Ab caused very well pronounced shifts in SPR in range 2 nm - 12nm. However, MO Ab – S protein interaction increases FWHM, which also testifies that it was more effective process of conjugation. Probably, this is due to the type of used as ligand MO Ab that have more than one binding site, which have stabilized the complex and give opportunity to bind more specific and effective with target molecule. In conclusion, we

demonstrate a sensing platform based on SPR assay with MO Ab as a ligand suitable for rapid detection of SARS-CoV-2-associated structural proteins.

Keywords: Biosensor; SARS-CoV-2; Surface Plasmon Resonance; MAPLE.

POSTER SESSIONS

Id-431

INVESTIGATIONS on the LAYER by LAYER MULTI-SHELL GOLD NANOPARTICLES FUNCTIONALIZATION for the DEVELOPMENT of EFFECTIVE NON-VIRAL GENE VECTORS

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Abstract: Gene therapy represents nowadays one of the most challenging promises for the cure of cancer, rare, and severe diseases. The effectiveness of non-viral vector strongly depends on the efficacy and reliability of the molecular tools involved in the manipulation (isolation, reconfiguration, multiplication) and vehiculation (native state preservation, dense packaging, targeted and "stealth" delivery, local protection) of the nucleic acids. In the current investigation we intended to study the ability of small concentrated and stable phosphine coated gold nanoparticles to be functionalized step by step by optimized target, stealth and packing functionalities. The inner shell of the gold was functionalized by using tailored oligomers of poly(ethylene-glycol) for covalent attachment to the gold nanoparticle. Subsequently, short-branched poly(ethylene-imine) were coupled as the second shell, followed by the attempts to attach cell-penetrating peptide using host-guest supramolecular interactions. The functionalized gold nanoparticles were characterized from physico-chemical point of view to establish the degree of functionalization at each step of the preparation. This work was supported by CNCS/CCCDI – UEFISCDI, project number PN-III-P4-ID-PCE2020-1523 (TM-Vector) within PNCDI III.

Keywords: Gold nanoparticles; Non viral vectors; Nucleic acid delivery.

POSTER SESSIONS

Id-432

SOLID PHASE SYNTHESIZED POLYHISTIDINE-BASED COPOLYMERS for the ASSEMBLY of pH-SENSITIVE MICELLES SUITABLE for DRUG DELIVERY in CANCER EXTRACELLULAR ENVIRONMENT

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Abstract: Knowing that most tumor cells have an extracellular pH in the range of 6.5 and 7.2, below the values of healthy cells, an impressive number of chemical systems have been developed in recent decades which have the property of being stable over the normal extracellular pH range (7.4 - 7.2), but exert properties during tumor pH. These systems act as such as inhibitors or target specific receptors for certain overexpressed tumor cells on the cell surface with internalization of the chemical system leading to programmed cell death. The main purpose of this study was to prepare three types of micelles based on copolymers consisting of hydrophilic part given by poly (ethylene glycol) and hydrophobic polyhistidine (polymer that can be protonated and deprotonated), synthesized by solid-phase peptide synthesis. The micelles were subsequently loaded with doxorubicin and used as model systems, which had the property of releasing drug at desired pH values similar to the pH of the cancer extracellular environment. These micelles were characterized from a physico-chemical point of view, while their cytotoxicity was investigated on the human breast cancer cell line (MDA-MB-231), together with the immunofluorescence investigation in the cellular areas where these micelles disassemble and release the model compound. The research leading to these results has received funding from the EEA Grants 2014-2021, under Project contract no. 37/2021.

Keywords: Tumor cells; Polyhistidine copolymers; Micelle; Doxorubicin; Drug release studies.

POSTER SESSIONS

Id-436

SYNTHESIS PROCESSES for BACTERIAL POLYMERS - POLYHYDROXYALKANOATES

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Abstract: Biopolymers represent one of the leading sectors for bio-based products and their expected growth is foreseen to be significant within the next years. They also represent a group of polymers with a broad range of physicochemical properties. One of the representatives, namely polyhydroxyalkanoate (PHA), can be produce *via* microbial fermentation from a range of currently underused environmental resources such as biomass, post processing industrial waste streams (food, wood and biodiesel industries effluents) or wastewaters just to name few. PHAs chemical structure enables easy chemical/enzymatic modifications, which leads to their functionalization and further numerous applications. PHAs represent a class of optically active biodegradable polyesters accumulated by numerous bacteria as discrete intracellular granules. These polyesters serve as a carbon and energy reserve material. The chemical structure of PHA can be described as linear in a head to tail formation of (*R*)-3-hydroxyalkanoic acids with the carboxyl group of one monomer forming an ester bond with the hydroxyl group of the neighbouring monomer. PHAs are biodegradable and biocompatible, thus enabling their direct application in biomedical field. Several products already exist and are used in wound management, implants for tissue engineering and drug delivery. Our research focuses on the development of novel bioprocesses for the efficient production of polyhydroxyalkanoates through bacterial fermentations. Using a combination of renewable energy resources such as glycerol or organic acids (medium and long chain) in combination with appropriately selected bacterial strains, we are able to design processes leading to PHAs of various physicochemical properties. Our laboratory facilities allow us to design and validate microbial fermentation processes on a small scale (mathematical modeling and response surface methodology on a 5L scale). Such optimized bioprocesses are transferred to the quarter-technical scale (30L) and half-technical scale (200L), where they are validated before the implementation process into large-scale production in the contractors' manufacturing line.

Keywords: Polyhydroxyalkanoates; Fermentation; Fermenter; Biopolymer synthesis.

POSTER SESSIONS

Id-437

ZnO@ESENTIAL OILS BASED SODIUM ALGINATE SCAFFOLDS for SKIN TISSUE REGENERATION

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Abstract: Microbial infections are a common medical problem asigned to various internal (prostheses, percutaneous implants) and external (wound dressings, urinary catheters, etc.) biomedical devices, especially those that come in direct contact with affected skin or mucous membranes. The use of active substances (essential oils and nanoparticles) in the composition of antibacterial systems, has a number of advantages, e.g. high efficacy at low doses, simultaneous administration of single or multiple drugs, a stable level of concentration of the drug and a lower occurrence of side effects. This study aims to design and to manufacture a wound dressing containing silk fibroin, sodium alginate and hyaluronic acid that will be functionalized with ZnO and essential oils (clove and oregano), with applications in tissue engineering. The obtained material is designed to heal severe burns and it will have antibacterial properties that will reduce the healing time and will improve the patient's experience. This prototype will develop the innovation regarding the burn treatment therapy. Zing oxide was obtained using a poliol method. The dressings were obtained starting from a solution of 5% sodium alginate over which was added 0.1% hyaluronic acid and 20% silk fibroin. In order to obtain the final composites, the in samples which contain solution of sodium alginate / hyaluronic acid / silk fibroin were added zinc oxide nanopowders coated with essential oils in proportions of 1, 3 and 5%, respectively. The samples thus obtained were then frozen. After lyophilization process, the samples were immersed in 3% calcium chloride solution in order to crosslink the sodium alginate. After immersion process, the samples were left to dry in the air. The obtained samples were characterized in terms of mineralogical composition, morphology, antimicrobial activity using the method of minimum inhibitory concentration (MIC) and the Biofilm method.

Keywords: Composite scaffolds; ZnO nanoparticles; Silk fibroin; Essentials oils.

POSTER SESSIONS

Id-438

ZINC OXIDE NANOPARTICLES USED for ATOPIC DERMATITIS

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Abstract: Due to their antimicrobial properties, zinc oxide (ZnO) nanoparticles has been proposed as a good solution for preventing infectious diseases. In recent years, there was a significant increase in the innovation of ZnO based smart materials. The current study was carried out with the main goal of evolving a simple method for the synthesis of ZnO nanoparticles, designing a method to finish ZnO nanoparticles onto fabrics to confer antimicrobial function and UV protection and finally evaluating the finished fabrics in terms of antibacterial properties. The hydrothermal method used for the synthesis of ZnO is one of the simplest and most environmentally friendly methods reported for zinc oxide because it does not require the use of organic solvents or additional product processing. The morphology of nanoparticles plays an important role in the antimicrobial activity and UV protection and usually its control can be either done by using stabilizing agents or by varying the polar character of the solvent used in the reaction. The complete or partial replacement of water in the solubilization step of the precursors with ethanol and methanol can also lead to a change in morphology. Thus, the use of surfactants, such as cetyltrimethylammonium bromide (CTAB), which is a surfactant with antiseptic and antifungal properties, or hexamethylene-tetra-amine (HMT) are used. Furthermore, after morphological and compositional characterization of all obtained samples, the sample with the smallest particle size distribution was used to be impregnated in the fabric. The ZnO nanopowder was added in distilled water and stirred prior to be pulverized on equal sized cotton patches. X-ray Diffraction, Scanning Electron Microscopy, Energy Dispersive Spectrosopy and Dynamic Light Scattering characterization techniques were used in order to determine the structure, morphology and composition of the obtained materials. Moreover, the ZnO-textiles were supposed to Scanning Electron Microscopy and antibacterial tests prior and after washing.

Keywords: ZnO nanoparticles; Atopic dermatitis; Hydrothermal method; Smart materials.

ALL SUBMISSIONS & TOPICS

Topics	Submissions
Biomaterials	Id 348 - Stimuli-Responsive Biomaterials for Drug Delivery, Tissue Engineering and Regenerative Medicine
	Id 407 - Calcium Phosphate-Based Biomaterials Modified with Silicon and a GPTMS
	Id 408 - Foamed Calcium Phosphate Bone Cement with the Addition of Citrus Pectin - An Attempt to Improve Mechanical Properties
	Id 409 - Calcium Phosphate Biomicroconcrete-Type Bone Fillers Modified with Coupling Agent
	Id 410 - Influence of Tetraethoxysilane (TEOS) on the Properties of Calcium Phosphates Based Biomicroconcrete-Type Biomaterials
	Id 416 - Studies on Characteristics, Antimicrobial Behaviour and Cell Viability of DNase I Coated Titanium Surfaces via Alternating Current Electrophoretic Deposition
	Id 421 - Dual-Crosslinked Injectable YHydrogels Based on Chitosan
	Id 434 - Chitosan Imination: An Opportunity towards Biomaterials with Broad Application Spectrum
	Id 435 - Laccases in Biocatalysis and Modification of Biomaterials
	Id 437 - ZnO@Esential Oils Based Sodium Alginate Scaffolds for Skin Tissue Regeneration
	Id 438 - Zinc Oxide Nanoparticles used for Atopic Dermatitis
Advanced Functional Materials	Id 413 - Advanced Functional Magnetic Microwires for Magnetic Sensors Suitable for Bio-Medical Applications
Biological Response to Nanomaterials	Id 415 - Combined Therapy of Simvastatin- and Coenzyme Q10-Loaded Nanoparticles Ameliorates PI3K-Akt-eNOS Pathway in Metabolic Syndrome Model
Medical Devices	Id 403 - Development of Dental Bone Grafts for the Treatment of Alveolar Bone Loss by 3D Printing Technique
Nano Biomaterials	Id 417 - Protective Effects of Aliskiren-loaded Polymeric Nanoparticles on Cardiovascular System in Experimental Hypertension.
	Id 431 - Investigations on the Layer by Layer Multi-Shell Gold Nanoparticles Functionalization for the Development of Effective Non-Viral Gene Vectors
Materials for Biomedical Applications	Id 405 - Thin films of oxides grown by Atomic Layer Deposition for medical Application
	Id 419 - Endothelium-Targeted RAGE-shRNA Nanocarriers Reduce Atherosclerosis-Associated Inflammation
	Id 432 - Solid Phase Synthesized Polyhistidine-Based Copolymers for the Assembly of pH-sensitive Micelles Suitable for Drug Delivery in Cancer Extracellular Environment

Processes for Biomaterials Synthesis	Id 436 - Synthesis Processes for Bacterial Polymers - Polyhydroxyalkanoates
Biosensors	Id 440 - Biosensors based on amphiphilic triblock copolymers self-assembled via morphology-induced immobilization of biomolecules
Antibodies	Id 430 - Evaluation of model system based on bimolecular interaction of SARS CoV-2 S- and N-structural proteins and specific antibody by SPR assay
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Optical	Id 429 - Detection of Helicobacter Pylori in saliva by Surface Plasmon Resonance
Nanobiosensors and Nanotechnology	Id 433 - Micro/Nanoarchitectures integrated silicon microtechnologies based sensing applications