The Academy of Romanian Scientists

Accademia Tiberina già pontificia

National Center of Micro and Nanomaterials

National University of Science and Technology Politehnica Bucharest

Virtual International Scientific Conference on

"Applications of Chemistry in Nanosciences and Biomaterials Engineering"

NanoBioMat 2023 – Winter Edition

22-24 November 2023

Book of Abstracts (Applications of Chemistry in Nanosciences and Biomaterials Engineering)

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Program

The program will be published on the official webpage of AOSR on 20.11.2023, as well as in the TEAMS Class. The link for the TEAMS Class will be provided in due time, on or before 20.11.2023.

The topics for the conference include, but are not limited to:

- novel materials;
- surface chemistry;
- air and soil bioremediation;
- composite materials and biomaterials;
- applications of natural compounds and chemical products;
- nanomaterials and bionanomaterials for the controlled release of biologically active molecules;
- bionanoproducts for tissue engineering and regeneration;
- advanced techniques for material processing.

Deadlines:

1. Registration: 15.10.2023
2. Extended registration: 12.11.2023
3. Abstract submission: 12.11.2023
4. Acceptance Notification: 15.11.2023
5. Final Program announcement: 19.11.2023
6. Conference: 22-24.11.2023

Registration:

Registration should be done using the link: https://nanobiomat.eu/registration/.

Registration is free for all students and postdoctoral researchers (or equivalent).

Abstract submission:

Abstract should be submitted in MS Word document using the link https://nanobiomat.eu/registration/ on or before 12.11.2023. The abstract should be 150 – 300 words and it must contain the title, authors, and their full affiliation.

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Program (GMT +2)

Wednesday, 22 November 2023

9:00-9:15 – **Opening Ceremony** link	Chair: Ecaterina ANDRONESCU
9:15-11:30 – **Plenary Session (I)** link	Chairs: Fergal J. O'BRIEN Anton FICAI
11:30-12:30 – **Poster Session (I)** link	Chairs: Luigi CALABRESE Denisa FICAI
11:30-12:30 – **Poster Session (II)** link	Chairs: Durmus Alpaslan KAYA Radu Claudiu FIERASCU
12:30-13:30 – **Lunch Break**	
13:30-16:05 – **Session I.** Biomaterials for medical applications link	Chairs: Domenico LOMBARDO Simion ASTILEAN
13:30-16:25 – **Session II.** Environmental and food packaging applications of materials link	Chairs: Pietro CALANDRA Ovidiu OPREA

Thursday, 23 November 2023

10:00-12:40 – **Session III.** Advanced material processing and applications (I) link	Chairs: António Torres MARQUES Ioana DEMETRESCU
10:00-12:15 – **Session IV.** Novel bioactive compounds link	Chairs: Cem Bulent USTUNDAG Maria GAVRILESCU
12:40-13:30 – **Lunch Break**	
13:30-16:25 – **Session V.** Tissue engineering and regenerative medicine link	Chairs: Viorel NACU Maria TOMOAIA-COTISEL
13:30-16:25 – **Session VI.** Advanced material processing and applications (II) link	Chairs: Jörg OPITZ Lenuța PROFIRE

Friday, 24 November 2023

10:00-12:20 – **Session VII.** Materials with antioxidant, antimicrobial, and anticancer properties link	Chairs: Serguei SAVILOV Madalina ALBU-KAYA
12:20-13:30 – **Lunch Break**	
13:30-14:45 – **Plenary Session (II)** link	Chairs: Jose Manuel García FERNÁNDEZ Dan Cristian VODNAR
14:45-15:15 – **Closing Ceremony** link	Chair: Ecaterina ANDRONESCU

22 November 2023

9:00-9:15 – OPENING CEREMONY

Chair: Ecaterina ANDRONESCU

Prof. Ecaterina ANDRONESCU – President of the Scientific Committee

Prof. Doru DELION – Vice-President of The Academy of Romanian Scientists

Prof. Tudor PRISECARU – President of the National University of Science and Technology Politehnica Bucharest Senate

9:15-11:30 – PLENARY SESSION (I)

Chairs – Fergal J. O'BRIEN; Anton FICAI

9:15-9:45 *Heterotrispin Complexes in Molecular Magnetism. Synthetic Strategies*. **Marius Andruh**

9:45-10:15 *Engineered Scaffolds for the Delivery of Gene Therapeutics for Enhanced Tissue Repair*. **Fergal J. O'Brien**

10:15-10:45 *Challenges to Nanomagnetic Composite Systems*. **António T. Marques,** Maria I. Barros, Maria João Rodrigues, Guilherme Melo, Nicolae Crainic, Ladislau Vekas, Raquel Santos, Nuno Correia, Paulo Nóvoa, Nicolae C. Popa

10:45-11:15 *Cyclodextrins: Programming Sugars at the Nanoscale for Biomolecular Recognition and Delivery*. **Jose Manuel García Fernández**

11:15-11:30 Q & A Session

11:30-12:30 – POSTER SESSION (I)

Chairs – Luigi CALABRESE; Denisa FICAI

1. Antibacterial Packaging Films from Cellulose with ZnO Nanoparticles Loaded with Orange Essential Oil. **Ludmila Motelica**, Ovidiu Oprea, Denisa Ficai, Georgiana-Madalina Lemnaru (Popa), Anton Ficai, Liliana Marinescu, Roxana Trusca, Ecaterina Andronescu
2. Copper Ions Detection in Water and Wheat Leaves Using a Fiber Optic Based Plasmonic Sensor. **Iulia Antohe,** Luiza-Izabela Toderaşcu, Oana Gherasim, Vlad-Andrei Antohe, Gabriel Socol
3. Extraction of Calcium Carbonate from Oyster Shell and its Application to Synthesize a Biodegradable Film. **Lee Sangheon**, Lee Jin Hyung, Kim Sunjin, Shim Woncheol, Ko Euisuk, Lee Hakrae
4. Nanosensor for Phytopathogen Detection. **Rabiu Garba Ahmad**, Vineet Kumar
5. Synthesis of a Highly Sensitive Al-Doped ZnO Thin-Film Sensor for H_2S Gas Detection. **Brahim Ydir**, Amine Ajdour, Mouad Soumane, Iulia Antohe, Gabriel Socol, Luiza-Izabela Toderascu, Mohamed Boussetta, Houda Lahlou

6. Camel Milk Casein as a Natural Emulsifier Agent. **Bachir Bensalah,** Kamel Acem
7. Versatility of Cold Plasma Technique for Starch Processing. **Felicia Iacob**, Monica R. Nemțanu, Mirela Brașoveanu, Dorina Ticoș
8. Effect of Recycled Carbon-Based Additives on Electromagnetic Shielding and Acoustic Properties of Polyether Based Semi Integral Polyurethane Foams in Electric Vehicle Industry. **Ethem Gokhan Ozcelik**, Tuce Fidan, Cem Yigit
9. Total Concentration of Phenolic Compounds and the Antioxidant Activity of Grape Must after Treatment with Hydroalcoholic Extracts from Plant Waste Enhanced with Silver Nanoparticles. **Daniela-I. Toma (Sărdărescu)**, Radu C. Fierăscu, Diana E. Vizitiu, Irina Fierăscu, Anda M. Baroi, Alin Din
10. Customized Nanoplatform for Electrochemical Detection of Cortisol. **Maria-Bianca Irimes**, Alexandra Pusta, Mihaela Tertis, Radu Oprean, Cecilia Cristea
11. Cu(II) Complexes of N-cyclohexylthiosemicarbazone of 3-ethoxysalicylaldehyde, Molecular Docking Simulations and Antitumor Activity. Andrei Ciursin, **Roman Rusnac**
12. Hyperbranched Structure Formation via Self-Assembly of a De Novo Designed Peptide. **Stefania-Claudia Jitaru**, Brindusa-Alina Petre, Vasile-Robert Gradinaru, Andra-Cristina Enache, Gabi Drochioiu
13. Green Synthesis of MIL-100 (Fe) for Hydrogen, Carbon Dioxide, and Water Vapor Sorption. **Muhtadi Idrees**, Giulia Calabrese, Emanuela Mastronardo, Luigi Calabrese

11:30-12:30 – POSTER SESSION (II)

Chairs – Jin Hyung LEE; Radu Claudiu FIERASCU

1. The Role of the Zinc Oxide Nanoparticles Biofunctionalized by Sulfated Polysaccharides on the Human Immune Cells in Patients with Pulmonary Tuberculosis. **Evelina Lesnic,** Serghei Ghinda, Tatiana Chiriac
2. Preparation of Alginate-Based Nanocomposite Wound Dress with Anti-Inflammatory and Antibacterial Effect. **Yasmina khane**, Bachir Bensalah, Fares Fenniche, Djaber Aouf, Imene Benoudina, Fairouz Amieur, Lakhdari Abdelhakim
3. Loading and Release of Amoxicillin in Cage-Type Mesoporous Silica Nanoparticles FDU-12 and Release of It in SGF. **Dan Adrian Vasile,** Ludmila Motelica, Maria Memecica, Ana-Maria Albu, Ovidiu Oprea, Denisa Ficai, Anton Ficai
4. Polysaccharide-derived Hybrid Formulations for Full-Thickness Skin Wound Healing. **Gianina Dodi,** Andreea-Mihaela Lungu, Aurelian Rotaru, Florina-Daniela Cojocaru, Marcel Ionel Popa, Ioannis Gardikiotis
5. *In Vitro* Study of Biocomposites Based on Natural Hydroxyapatite and Modified by Magnetite and Chitosan for Medical Use. **Anna Synytsia,** Olena Sych, Tatiana Babutina
6. Predictive Model for Universal Stress Proteins (USPs) in Mycobacterium Tuberculosis (Mtb). **Onyewuchi Njoku**

7. The Influence of Boron Precursor on Borate Bioactive Glasses Properties: Structural and Bioactivity Investigation. **Szymon Salagierski**, Michal Dziadek, Katarzyna Cholewa-Kowalska
8. Valence and Coordination States of Cu Transition Metal Ions in a View of the Borate Bioactive Glass Structure. **Patrycja Gaćkowska**, Michał Dziadek, Katarzyna Cholewa-Kowalska, Wojciech Błachucki
9. Gradient Biomaterials Based on Compounds of Plant Origin vor Fibrocartilaginous Enthesis Tissue Engineering. **Weronika Gura**, Anna Lis-Bartos
10. Modification of Magnesium Potassium Phosphate by Alginate Hydrogel Addition to Obtain a Novel Injectable Bone Cement with Improved Functional Properties. **Maryia Khamenka**, Rafał Jesiołkiewicz, Anna Ronowska, Aleksandra Mielewczyk-Gryń, Justyna Kozłowska, Marcin Wekwejt
11. FTIR-ATR Characterization of the Bioglass and Magnetite Nanoparticles Before and After Soaking in SBF And pH Monitoring of SBF. **Marian Rașcov**, Anton Ficai, Ovidiu Cristian Oprea, Otilia-Ruxandra Vasile, Ecaterina Andronescu
12. The Evolution of the Activity of Corneal Sampling and Transplantation During the Period 2013-2022 in the Republic of Moldova. **Adrian Cociug**, Olga Macagonova, Valeriu Cușnir, Viorel Nacu
13. The Effectiveness of the Tissue Engineering in the Obtaining of the Biological Materials from the Extracellular Matrix. **Olga Macagonova,** Adrian Cociug, Tatiana Taralunga, Vladimir Ciobanu, Tudor Braniste, Viorel Nacu

12:30-13:30 – LUNCH BREAK

13:30 - 16:05 – SESSION I. BIOMATERIALS FOR MEDICAL APPLICATIONS

Chairs – Domenico LOMBARDO; Simion ASTILEAN

13:30-13:50 *Analytical Method Development and Validation for Determination of Assay of Antibacterial Drugs Besifloxacin Hydrochloride and Phenoxyethanol in Gel Formulation*. **Pradeep Kundu,** Neelam Pawar, Neha Minocha, Asha Poonia

13:50-14:05 *Synthesis to Solution: Chemistry's Role in Advancing Nanoscience and Biomaterials*. **Iruthaya Kalai Selvam**

14:05-14:20 *Broadening the Landscape of Cyclodextrin-Based Vectors for Cell-Selective Nucleic Acid Delivery.* **José López-Fernández**, Gonzalo Rivero-Barbarroja, Juan M. Benito, Inmaculada Juárez-Gonzálvez, Carlos Fernández-Clavero, Itziar Vélaz, María J. Garrido, Carmen Ortiz Mellet, Francisco Mendicuti, Conchita Tros de Ilarduya, José M. García Fernández

14:20-14:35 *Silver Nanoparticles Induce an Increased Production of Intestinal Inflammatory Cytokines via NF-κB Pathway: An In Vivo Study*. **Adelaide Sousa,** Rui Azevedo, Vera Marisa Costa, Sara Oliveira, Inês Preguiça, Sofia Viana, Flávio Reis, Agostinho Almeida, Paulo Matafome, Patrícia Dias-Pereira, Félix Carvalho, Eduarda Fernandes, Marisa Freitas

14:35-14:50 *Development of PVA-Based Electro-Spin Nanofiber Mats and Its Characterization*. **Karanjit Kapila,** Sushen Kirtania

14:50-15:05 *Vitamin B12-Loaded Nanoparticle-Embedded Scaffolds Produced by the 3D Printer for Controlled Drug Delivery*. **Fatima Abobakr,** Humeyra Betul Yekeler, Ece Guler, Muhammet Emin Cam

15:05-15:20 *Biological Performances of High Entropy Alloys to Be Used in Dental Restorations and Oral Health Prevention.* **Andrei Mihai**, Radu Nartita, Ioana Demetrescu, Andreea Cristiana Didilescu, Anisoara Cimpean, Daniela Ionita

15:20-15:35 *Green Synthesis and Characterization of ZnO Nanoparticles and its Application in Preservation of Fresh Produce.* **Akuleti Saikumar,** Laxmikant S. Badwaik

15:35-15:50 *Biocompatible Hybrid Scaffolds Based on Functionalized Gelatin for Soft Tissue Engineering*. **Isabella Nacu,** Lidia Nedelcu, Loredana Elena Niţă, Liliana Vereştiuc

15:50-16:05 *Antibacterial 3D Meringue-Like Scaffolds for Bone Tissue Engineering Application.* **Büşra Oktay,** Ayşe Betül Bingöl, Cem Bülent Üstündağ

13:30 - 16:25 – SESSION II. ENVIRONMENTAL AND FOOD PACKAGING APPLICATIONS OF MATERIALS

Chairs – Pietro CALANDRA; Ovidiu OPREA

13:30-13:50 *Biocatalyst and Nano Catalyst Based Approaches for the Efficient Remediation of Organophosphate: A Notional Conceptional Review*. **Rupak Kumar**

13:50-14:10 *Ecotoxicological Behavior of Functionalized Magnetic Nanohybrids in Water Flea Daphnia Magna and Their Recovered Physicochemical Properties*. **Juan A. Ramos-Guivar,** Noemi-Raquel Checca-Huaman, Edson C. Passamani

14:10-14:25 *Aspects of Electrodeposition from NADES Electrolytes.* **Radu Nartita**, Florentina Golgovici, Ioana Demetrescu

14:25-14:40 *New Approaches Regarding the Development of Advanced Nuclear Reactor Systems.* **Daniel Petrescu**, Manuela Fulger, Ioana Demetrescu, Florentina Golgovici

14:40-14:55 *Influence of Effective Film-Forming Factors on The Solubility, Permeability, and Physical Nature of Chitosan Film*. **Dariush Khademi Shurmasti,** Maryam Sarvarian, Charles Odilichukwu R. Okpala

14:55-15:10 *An Environmentally Sustainable Wool Dyeing Approach Via the Application of Millettia Laurentti Natural Dye*. **Luqman Jameel Rather,** Shazia Shaheen Mir

15:10-15:25 *Visible-light-active Ag-, Cu-, and Bimetallic Ag/Cu-TiO_2 Photocatalysts Prepared by Eco-Friendly Reducing Agent.* **Abdul Wafi**, Liszulfah Roza, Nurfina Yudasari, Gerald Ensang Timuda

15:25-15:40 *Performance of Based Photocatalytic Activity of Vanadium Doped Titanium with RGO for Waste Water Treatment*. **Kiran Zahra,** Zhicheng Zhang, Muhammad Salman Habib

15:40-15:55 *Efficient Decontamination of Large Fluids Fluxes: Packed Metamaterials Under UVC Irradiation*. **Sinziana Andreea Anghel,** Ion N. Mihailescu, Carmen Ristoscu, Anita Visan, Gianina Popescu-Pelin, Nicolae A. Enaki, Ion Munteanu

15:55-16:10 *Metal-Organic Frameworks (MOFs) as Efficient Ethylene Absorbers in Active Food Packaging for Prolonging Shelf Life of Fruits.* **Pir Mohammad Junaid**, Sadaf Zaidi

16:10-16:25 *Tailoring Novel Eco-Friendly Magnetic Nanostructures for Mining Wastewater Treatment.* **Iolanda-Veronica Ganea**, Alexandrina Nan, Călin Baciu

23 November 2023

10:00 - 12:40 – SESSION III. ADVANCED MATERIAL PROCESSING AND APPLICATIONS (I)

Chairs – António Torres MARQUES; Ioana DEMETRESCU

10:00-10:20 *Polymeric Nanosystems for Drug Delivery in Diabetes Management*. **Ali Rastegari**

10:20-10:40 *New Nanostructured Materials for Large-Scale, Reversible and Durable Direct Air Capture*. **Cataldo Simari,** Isabella Nicotera

10:40-10:55 *Preparation of an Innovative and Sustainable Metal Plating Method*. **Aysun Gençtürk,** Bahar Aşılıoğlu, Akio Kobayashi, Türkan Özger, Muhammet Uzun

10:55-11:10 *Synthesis of New Lipopeptide Green Surfactants from Silk by Mechanochemistry*. **Lara Wehbe,** Erwann Guénin, Alla Nesterenko

11:10-11:25 *Comparative Evaluation of the Corrosion Performance of Two Chromium Coatings Deposited on Zy-4 Substrate*. **Diana Diniași,** Florentina Golgovici, Manuela Fulger, Aurelia Tudose, Alexandru Anghel, Ioana Demetrescu

11:25-11:40 *Intergranular Corrosion Behavior Assessment of Uncoated and CrNx-coated 310 H Stainless Steel by Sensitization Heat Treatments*. **Aurelia Elena Tudose,** Ioana Demetrescu, Florentina Golgovici, Manuela Fulger, Diana Diniași, Alexandru Anghel

11:40-11:55 *Nanosilica Impregnation of Wood: Investigating Structural Transformations via FTIR Spectroscopy and Assessing Fire Reaction Properties.* **Diana Talau,** Ludmila Motelica, Denisa Ficai, Anton Ficai

11:55-12:10 *Investigation of the Electrical Properties of Polypropylene-Based Composites Melt-Processed with As-Grown Carbon Nanofibers.* **Najoia Aribou**, António Jose Paleo, Zineb Samir, Yassine Nioua, Joaquim Agostinho Moreira, Mohammed Essaid Achour

12:10-12:25 *The Comparison Study: Different Pretreatment of Cellulose Nano Fiber Production from Kenaf Biomass*. **Ghita Firsty Virginia,** Zahra Audrey, Soo-Jeong Shin, Jin Hyung Lee

12:25-12:40 *Pilot Scale Continuous Biogenic Silica Extraction from Rice Husk by One-Pot Alkali Hydrothermal Treatment and Ball Milling.* **Ji Yeon Park,** Jinyoung Chun, Byoung-In Sang, Jin Hyung Lee

10:00 - 12:30 – SESSION IV. NOVEL BIOACTIVE COMPOUNDS

Chairs – Cem Bulent USTUNDAG; Maria GAVRILESCU

10:00-10:15 *The Antioxidant Character of the BGR 0.3 Molecule (Retinol Impregnated On Bioactive Glass).* **Ioana Lavinia Lixandru Matei**

10:15-10:30 *Suberin from Cork – Isolation and Characterization.* **Elaine Gabutin Mission**, Maria Jose Cocero

10:30-10:45 *Mathematical Modelling of the Drying Kinetics of Spanish Cherry (Mimusops Elengi) Seed and Physicochemical Properties*. **Prashant Kumar Srivastava,** Nandan Sit

10:45-11:00 *Extraction of Bioactive Compounds Using Green Solvent*. **Manaswini Barik,** Amit Baran Das

11:00-11:15 *Action of Enzyme Complex on Bioactive Components Extracted from Soy Residue.* **Yeit Haan Teow**, Yuan Jie Tan, Zhen Hong Chang

11:15-11:30 *Olive Derivates as Antioxidants and Rheological Modifiers.* **Valeria Loise**, Michele Porto, Pietro Calandra, Innocenzo Muzzalupo, Paolino Caputo

11:30-11:45 *Evaluation of Neurohormonal Dynamics After Administration of Probiotic Microbial Strains in a Murine Model of Hyperthyroidism*. Marina-Ionela Nedea, **Miruna-Maria Apetroaei**, Andreea Letiția Arsene

11:45-12:00 *Calabrian Citrus Fruits: from Peels to Essential Oils; Characterization of Their Nano-Emulsions*. **Madalina Lorena Medeleanu,** Anca Fărcaș, Cristina Coman, Loredana Leopold, Sonia Socaci, Giancarlo Statti, Filomena Conforti

12:00-12:15 *Quercetin and Curcumin Encapsulated into a Cyclodextrin-Metal Organic Framework (CD-MOF-1): Characterization, Solubility and Kinetics Studies of the Release Process*. **Saurelle Kenfack**, Azura Tuan, Patrice Tsobnang, Muhammad Alif, Bimo Tejo, Haslina Ahmad, Jean Ngoune, Mohd Basyaruddin Abdul Rahman

12:40-13:30 – LUNCH BREAK

13:30 - 16:25 – SESSION V. TISSUE ENGINEERING AND REGENERATIVE MEDICINE

Chairs – Viorel NACU; Maria TOMOAIA-COTISEL

13:30-13:50 *Design and Characterization of Magnesium Phosphate/p(HEMA) Composite Cement Dedicated for Biomedical Applications*. **Marcin Wekwejt,** Maryia Khamenka, Anna Ronowska, Uwe Gbureck

13:50-14:10 *Nanomaterial as Emerging Trend for Dental Applications: Opportunities and Challenges*. **Che Azurahanim Che Abdullah,** Mohamed Abdelmonem

14:10-14:25 *PRP-Loaded Composite Scaffolds for Bone Tissue Engineering Applications*. **Tufan Arslan Tut,** Sumeyye Cesur, Oguzhan Gunduz

14:25-14:40 *Wound Dressing Materials Based on Nanocellulose*. **Gabriela Mădălina Oprică,** Radu Claudiu Fierascu, Catalina Diana Uşurelu, Adriana Nicoleta Frone, Denis Mihaela Panaitescu

14:40-14:55 *Strategies to Improve the Flow Behavior and Antimicrobial Properties of Pluronic® F127-Based Injectable Hydrogels*. **Alexandra Lupu,** Irina Rosca, Vasile-Robert Gradinaru, Maria Bercea

14:55-15:10 *Fabrication and Characterisation of GelMA/Keratin and GelMA/KerMA Hybrid Tissue Scaffolds by 3D Bioprinting*. **Zekiye Akdag,** Dilruba Baykara, Oguzhan Gunduz, Songul Ulag

15:10-15:25 *Therapeutic Potential of Metallic Ion-Loaded Silica Mesoporous Nanoparticles and Bioactive Glass Nanoparticles.* **Andreea - Luiza Mîrț,** Anton Ficai

15:25-15:40 *Production of Individualized Symblepharon Rings*. **Musa Ayran,** Yeliz Goyuk, Aysegul Tiryaki, Songul Ulag, Oguzhan Gunduz

15:40-15:55 *CBD and Colostrum, a Combination with Anti-Inflammatory and Wound-Healing Potential*. **Denisa-Teodora Niță,** Emma-Adriana Ozon, Andreea-Letiția Arsene

15:55-16:10 *Calcium and phosphorous-doped Doped Zinc Oxide Nanorods Enhanced Antibacterial Ability And Osteoinductivity On Titanium Surface*. **Ihsan Ullah**, Peiyan Ou, Lingxia Xie, Huaiyu Wang, Liping Tong

16:10-16:25 *Formulation and Evaluation of Microspheres Loaded Patch of Metformin*. **Rahul Pawar,** D N Mishra, Manisha Rani, Neelam Pawar, Asha Poonia, Kavita Bahmani, Mamta Rani, Reena Sheoran, Nitish Lamba

13:30 - 16:25 – SESSION VI. ADVANCED MATERIAL PROCESSING AND APPLICATIONS (II)

Chairs – Jörg OPITZ; Lenuța PROFIRE

13:30-13:50 *ToF-SIMS Analysis of Nanostructured Layers: An Effective Approach for Assessing Functionalization*. **Anca Mazare**

13:50-14:10 *Nanocellulose Production Technologies at Industrial Level: Status and Bottlenecks*. **Mahendra Patel**

14:10-14:25 *Green Synthesis of Selenium Nanoparticles and its Various Applications.* **Mittal Thakkar,** Sneh Chudasma, Hemant Talpada

14:25-14:40 *The Actualities and Perspectives of 3D-Printing Technologies in Radiotherapy.* **Eugeniu Valic**, Vladimir Valic, Ion Mereuță, Grzegorz Bielęda

14:40-14:55 *Bioactive Surface Modification of Titanium Implants by Ultrasonic Micro-Arc Oxidation Process.* **Balbina Makurat-Kasprolewicz**, Marcin Wekwejt, Anna Ronowska, Grzegorz Gajowiec, Stefan Dzionk, Agnieszka Ossowska

14:55-15:10 *Cyclodextrin-azobenzene Hybrids: Photoresponsive Self-assembly and Co-assembly with DNA.* **Gonzalo Rivero Barbarroja**, Carlos Fernández Clavero, Cristina García-Iriepa, Gema Marcelo, M. Carmen Padilla-Pérez, Tania Neva, Juan M. Benito, Stephane Maisonneuve, Carmen Ortiz Mellet, Joanne Xie, José M. García Fernández, Francisco Mendicuti

15:10-15:25 *Features of Adsorption Immobilization of Ru(bpy)2(nic)2]2+ on the Surface of X-Ray Luminescent Nanoparticles LaF3:Tb/Citr*. **Andrii Kusyak**, Alla Petranovska, Oleksandr Shchehlov, Petro Gorbyk

15:25-15:40 *Power Generation and Utilization from Piezoelectric Materials*. **Muhammad Asif Rafiq,** Adnan Maqbool

15:40-15:55 *Nanoparticle Based Drug Delivery to Manage Cardiovascular Disease Risk in Arthritic Rat Model*. **Vikas Shukla**

15:55-16:10 *Synthesis of Nanoparticles Using Green Method and Application*. **Luu Thi Lan Anh,** Pham Van Thang, Tran Thanh Thai, Le Manh Cuong, Nguyen Tuyet Nga

16:10-16:25 *Nanodiamond-Functionalized Stable Suspension for the Development of Oral Implants Surfaces*. **Aidee Itandehui Garcia-Zintzun,** Sascha Balakin, Katharina Ekat, Jörg Opitz, Bernd Kreikemeyer

24 November 2023

10:00 - 12:20 – SESSION VII. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES

Chairs – Serguei SAVILOV; Madalina ALBU-KAYA

10:00-10:20 *The Main Alkaloid of Piper Species: Piperine as an Effective Bioenhancer*. **Sunita Singh,** Avanish Chandra Sharma

10:20-10:35 *Green Synthesis of Biocompatible Core-Shell (Au-Ag) and Hybrid (Au-ZnO and Ag-ZnO) Bimetallic Nanoparticles and Evaluation of their Potential Antibacterial, Antidiabetic, Antiglycation and Anticancer Activities*. **Sumaira Anjum,** Khadija Nawaz, Bushra Ahmad, Christophe Hano, Bilal Haider Abbasi

10:35-10:50 *Production of Biomaterials with a Controlled Drug Release System Developed with a Hybrid System for Use in the Treatment of Larynx Cancer*. **Yaren Inal,** Fatma Özdemir, Yağmur Kazancıoğlu, Sude Toptaş

10:50-11:05 *Magnetic Nanoparticles Based on Iron Oxide and Biotin-Functionalized Chitosan for Breast Cancer Therapy*. **Stefan Sandu,** Andreea Luca, Florina Daniela Cojocaru, Liliana Verestiuc, Vera Balan

11:05-11:20 *Polyurethane Coatings for Wooden Heritage Preservation Based on Environmentally Friendly Polyols.* **Sorin-Viorel Dolana,** Anamaria Zaharia, Tanţa-Verona Iordache, Andrei Sârbu, Toma Fistoș, Anton Ficai

11:20-11:35 *Ovalbumin-Loaded Paramagnetic Nano-Triangles for Enhanced Dendritic Cell Stimulation, T1-MR imaging, and Antitumor Immunity.* **Yike Hou,** Zhe Tang, Ruibo Zhao, M. Zubair Iqbal, Xiangdong Kong

11:35-11:50 *Flow and Kinetic Studies of Photocatalytic Ciprofloxacin Degradation in a Falling Film Microreactor*. **Bíborka Boga,** Kevin Baur, Vasile-Mircea Cristea, Norbert Steinfeldt, Norbert Kockmann

11:50-12:05 *Physicochemical Characterization of Amino Acid-Modified Magnetite Nanoparticles for Oncologic Drug Delivery*. **Paul Adrian Tărăbuță,** Ludmila Motelica, Vasile Adrian Surdu, Ovidiu Cristian Oprea, Anton Ficai

12:05-12:20 *Docetaxel-PLGA Nanoparticles Coated with Folic Acid-Chitosan for Targeting Cancer*. **Nusaiba K. Al-Nemrawi,** Rowaida Altawabeyeh, Ruba Darweesh

12:20-13:30 – LUNCH BREAK

13:30-14:45 – PLENARY SESSION (II)

Chairs – Jose Manuel García FERNÁNDEZ; Dan Cristian VODNAR

13:30-14:00 *Sustainable Active Food Packaging*. **Dan Cristian Vodnar**

14:00-14:30 *Plasmonic and Hybrid Nanoplatforms for Biomedical Applications*. **Simion Astilean**

14:30-14:45 Q & A Session

14:45-15:15 – CLOSING CEREMONY

Chair: Ecaterina ANDRONESCU

Book of Abstracts

Plenary Sessions

Heterotrispin Complexes in Molecular Magnetism. Synthetic Strategies

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ABSTRACT

The combination of different spin carriers is a valuable synthetic strategy to obtain molecular magnetic materials. Indeed, most of the 3-D molecule-based magnets and Single Chain Magnets (SCMs), as well as numerous Single Molecule Magnets (SMMs) are 3d-nd, nd-4f, 2p-nd, and 2p-4f heterobispin complexes. As far as the heterotrispin systems are concerned, they are less numerous. Such compounds contain either three different paramagnetic ions,1 or two different paramagnetic ions and an organic radical (2p).2 We currently develop new synthetic strategies leading to SMMs and SCMs, which are based on the combination of three different spin carriers (nd and 4f transition metal ions, as well as 2p or 3p radicals). The synthetic approach consists of self-assembly processes involving high spin anisotropic oligonuclear complexes (nodes) and various paramagnetic metalloligands (spacers).

In this lecture I will present our recent and most representative examples of heterotrimetallic complexes with relevance in molecular magnetism (3d-3d'-3d'', 3d-3d'-4f, 3d-4d-4f, 3d-5d-4f, 2p-3d-4f). They show a rich structural variety (discrete polymetallic entities, as well as coordination polymers) and interesting magnetic properties.

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Engineered Scaffolds for the Delivery of Gene Therapeutics for Enhanced Tissue Repair

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ABSTRACT

The COVID-19 pandemic has shown how revolutionary treatments based on gene therapeutics has helped overcome a once-in-a-century pandemic and has given new momentum to gene therapy research for a myriad of applications. The field of regenerative medicine is well placed to be a beneficiary whereby, for example, gene therapy might be a valuable tool to avoid the limitations of local delivery of growth factors. While non-viral vectors are typically inefficient at transfecting cells, our group have had significant success in this area using a scaffold-mediated gene therapy approach for regenerative applications[1, 2]. These gene activated scaffold platforms not only act as a template for cell infiltration and tissue formation, but also can be engineered to direct autologous host cells to take up specific genes and then produce therapeutic proteins in a sustained but eventually transient fashion. Similarly, we have demonstrated how scaffold-mediated delivery of siRNAs[3] and miRNA[4, 5] can be used to silence specific genes associated with reduced repair or pathological states. This presentation will provide an overview of ongoing research in our lab in this area with a particular focus on gene-activated biomaterials for promoting bone, cartilage, nerve and wound repair. Focus will also be placed on advances we are making in using 3D printing of gene activated bioinks to produce next generation medical devices for tissue repair.

Acknowledgements: European Research Council Advanced Grant, ReCaP (agreement n° 788753)

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Challenges to Nanomagnetic Composite Systems

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ABSTRACT

The development of new materials in the context of nanomagnetic composite systems, poses important challenges regarding the type of base materials, the type of fillers, the dispersion process and the manufacturing technology for a given product/application or set of products. The idea has been to explore the possibility of developing a new category of magnetic nanocomposite materials based on magnetic nanofluids MNFs and thermosetting resins as well as to develop epoxy based nanocomposites containing iron oxide nanoparticles (IONPs) and/or carbon nanotubes (MWCNTs) to achieve synergistic effects while acquiring better mechanical properties. MNF, also known as Ferro fluids, are ultra-stable colloidal suspensions of ferric/or ferromagnetic particles – e.g. magnetite (Fe_3O_4) – in various carrier liquids.

An introduction to nanomagnetic materials, particularly MNFs, and their different applications will be made, followed by some of the dispersion mechanisms and effects of nanofillers on composites. Then, an overview of the epoxy, Fe_2O_3 and Fe_3O_4 nanocomposites will be made and the calendering process explained. An overview of the nanofluid production, as well as the curing process and the characterization tests (mechanical, DMA, hardness, magnetic permeability, industrial tomography, optical and electronic microscopy, industrial tomography) will be presented. The experimental procedure, the difficulties and the results obtained will be presented.

Some future challenges can be considered such as optimizing the dispersion techniques for each type of fillers, changing the electric conductivity of the nanocomposite by applying a constant magnetic field to the resin during cure and observing the effects on mechanical properties of the composite system, and magnetic heating of the particles to determine if higher temperatures and faster curing can be achieved. With that, a process for composite systems is envisaged “Magnetic Assisted Resin Transfer Moulding” in which cure and orientation properties will be optimized.

Finally, challenges will be presented regarding the development of a sustainable transtibial prosthesis using appropriate technologies and smart orthoses for children.

Cyclodextrins: Programming Sugars at the Nanoscale for Biomolecular Recognition and Delivery

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ABSTRACT

Cyclodextrins (CDs) constitute a group of cyclic oligosaccharides obtained by enzymatic conversion of starch, characterized by a macrocyclic ring composed of glucose monomers connected by α-1,4 glycosidic bonds. Typically, these rings consist of 6, 7, or 8 sugar units, and they are respectively referred to as α, β, and γCD. The widespread use of CDs in industrial applications, encompassing food, pharmaceuticals, chemical processing, agriculture, and environmental engineering, is fundamentally rooted in their unique structural and physico-chemical attributes. CDs adopt a truncated-cone shape, pictured by a toroidal structure with a larger and a smaller opening. The larger opening exposes the toroid to the surrounding solvent, and it is lined with secondary hydroxyl groups, while the smaller opening is adorned with primary hydroxyl groups. The interior of the CD cavity is notably hydrophobic, making it an ideal host for molecules of similar polarity, while the exterior exhibits significant hydrophilicity, imparting remarkable aqueous solubility. These features render CDs with a duality of hydrophobic and hydrophilic properties, making them exceptionally suitable for a wide array of requests.

CDs serve as valuable tools in pharmaceutical science, primarily aimed at enhancing drug solubility, chemical stability and bioavailability, in some cases alleviating their unwanted side-effects or facilitating precise dosage control. This is achieved through their remarkable ability to encapsulate predominantly hydrophobic small drugs or hydrophobic segments of drugs, forming host-guest complexes. Beyond their "in-out" amphiphilic nature, cyclodextrins offer distinct advantages through the differentiation of faces and varying reactivity of hydroxyl groups. These features can be harnessed to incorporate functional elements with precise orientations, enabling the deliberate programming of specific behaviors, rather than merely passively accommodating cavity-fitting motifs. Through the application of precision chemistry techniques, cyclodextrins can establish selective interactions with molecular and biomolecular partners, making them a unique platform for designing active pharmaceutical ingredients (APIs). An iconic example of this is Sugammadex (Bridion™), an antidote for the neuromuscular blocker rocuronium used in anesthesia.[1]

This presentation aims to provide an insightful overview of cyclodextrin chemistry and their wide-ranging applications. It places a particular focus on exploring the intricate relationships between molecular structure, supramolecular properties, self-assembly behavior, and biological activity. Furthermore, the discussion will feature examples from our laboratory, encompassing the development of targeted drug delivery,[2] antitoxins,[3] and nonviral molecular nanovectors for nucleic acid therapeutics.[4,5]

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Sustainable Active Food Packaging

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ABSTRACT

Food packaging is a subject of interest for food producers and marketers and for increasingly conscious consumers who recognize its significant influence on food product quality and environmental sustainability. Commonly used materials for food packaging include plastic, glass, metal, and paper. Nevertheless, edible films have gained popularity and are now widely employed for various food categories like meat, vegetables, and dairy products. Proteins, in particular, have emerged as excellent materials for creating edible and non-edible coatings and films. This presentation will provide an overview of the utilization of biopolymers in food and edible packaging, highlighting their functionalization, antioxidant, antimicrobial, and antifungal properties and examining the economic aspects. Additionally, mechanical properties, thickness, moisture content, water vapor permeability, sensory characteristics, and environmental suitability play significant roles in using biopolymer-based packaging materials.

Plasmonic and Hybrid Nanoplatforms for Biomedical Applications

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ABSTRACT

In this presentation, we give an overview on our current approaches in design and fabrication of plasmonic-based and hybrid nanoplatforms and their implementation in a large variety of applications from cell imaging, drug delivery and light-activated nanotherapeutics. For instance, several classes of biopolymer-coated plasmonic nanoparticles were implemented as versatile nanoprobes for spectroscopic investigation of cells by intracellular imaging *via* surface-enhanced Raman scattering (SERS), localized surface plasmon resonant scattering (LSPR-S) and steady-state and fluorescent lifetime imaging (FLIM). Scanning confocal Raman microscopy combined with dark-field and confocal fluorescence microscopy were used to record relevant intracellular information as nanoparticle localization, local chemical interaction and intracellular pH mapping. In recent years, our research group has implemented several "proofs of concept" for light-activated nanotherapies against cancer by integration plasmon-induced photothermal therapy (PTT), plasmon-enhanced photodynamic therapy (PE-PDT) and delivery of chemotherapeutic drugs (doxorubicin, cisplatin). Currently, we focus on the development of fluorescent and luminescent near-infrared (NIR) contrast agents for real-time image-guided surgery of ovarian cancer.

Acknowledgements: This work was supported by several grants of CNCS-UEFISCDI within PNCDI II and III.

Session I. Biomaterials for Medical Applications

Analytical Method Development and Validation for Determination of Assay of Antibacterial Drugs Besifloxacin Hydrochloride and Phenoxyethanol in Gel Formulation

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ABSTRACT

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Broadening the Landscape of Cyclodextrin-Based Vectors for Cell-Selective Nucleic Acid Delivery

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ABSTRACT

Lipid nanoparticles (LNPs) have emerged as a prominent non-viral delivery system for nucleic acids and have recently demonstrated their effectiveness in the development of mRNA-based COVID-19 vaccines. Nevertheless, LNPs face various challenges that impede their broader clinical adoption, encompassing issues related to stability, cargo size limitations, lack of cell specificity, and potential immunological side effects. The complex, multicomponent nature and polydisperse characteristics of LNPs, along with an incomplete understanding of the distribution of constituents within the nanoparticle structure, represent significant obstacles to optimization efforts. To overcome these limitations and advance nucleic acid therapies, it is imperative to explore innovative strategies centered on precision chemistry, molecular engineering, and novel design principles.

Previous research has indicated that carbohydrates, specifically cyclodextrins (CDs), offer promising avenues for addressing the above challenges.[1] The precision and accuracy of CD molecules in terms of composition, sequence, spatial relationships, and functionality make them an exceptional platform for investigating the interplay of diverse molecular parameters involved in the hierarchical assembly processes responsible for forming CD-nucleic acid nanocomplexes (CDplexes). Our previous investigations have unveiled how subtle modifications in the molecular architecture can lead to distinct assembly behaviors, resulting in diverse nanocomplex topologies with selective affinities for particular organs and cells.[2,3] Most reported examples typically exhibit a Janus-type architecture with separate cationic and lipophilic domains. In this study, we introduce a novel nucleic acid delivery prototype based on βCD, where the conventional orientation of hydrophilic and lipophilic components is intentionally disfavored due to geometric constraints, which we refer to as "geometrically frustrated amphiphiles" (GFAs). We will present the design, synthesis, and supramolecular properties of sequence-defined βCD-based cationizable GFAs. Computational simulations, including molecular mechanism and molecular dynamics (MM and MD), in conjunction with transmission electron microscopy (TEM), were employed to examine the preferred interaction modes and resulting arrangements. In vitro transfection experiments showcase the potential of βCD-based ionizable GFAs to surpass the conventional Janus archetype in encoding topological information, highlighting their applicability in the development of cell-selective nucleic acid therapeutics.

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Silver Nanoparticles Induce an Increased Production of Intestinal Inflammatory Cytokines *via* NF-κB Pathway: An *In* Vivo Study

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ABSTRACT

Silver nanoparticles (AgNP) have been extensively used in the food industry to improve the quality, safety and nutritional properties of foods, at all stages of the process chain, from food cultivation to industrial product manufacturing, including processing and packaging. The widespread use of AgNP implies an increase in human oral exposure, which raises questions about possible effects on human health, particularly at the gastrointestinal level. It is therefore essential to carry out a comprehensive assessment of the potential pro-inflammatory effects of AgNP at the intestinal level. The present study was conducted to evaluate the biodistribution patterns and potential pro-inflammatory effects of subacute oral administration of 5 nm polyvinylpyrrolidone (PVP)-AgNP in C57BL/6J mice. AgNP were administered at doses of 1 mg/kg bw or 10 mg/kg bw, once daily for 14 days, using a novel technology called HaPILLness, designed to allow voluntary, stress-free and accurate oral dosing. This evaluation included an examination of the AgNP biodistribution profile, as well as intestinal histopathological analysis and the quantification of a panel of cytokines and intestinal nuclear factor-κB (NF-κB) activation [1].

Our results suggest that the intestinal accumulation of orally administered AgNP, at both doses, has the potential to trigger an inflammatory response. This response was mainly characterized by significant vascular and cellular changes, as associated with the activation of the NF-κB inflammatory pathway, ultimately leading to the production of several cytokines and chemokines [1].

Our study provides new and important insights into *in vivo* subacute intestinal toxicity and biodistribution of AgNP, which can have an important impact on population health [1].

Acknowledgements: This work was supported by the national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIBD/50006/2020 and UIDP/50006/2020 and also by Portuguese Foundation of Science and Technology (Strategic Projects UIDB//04539/2020, UIDP//04539/2020, and LA/P/0058/2020: CIBB). AS thanks FCT and ESF her PhD grant-SFRH/BD/150656/2020. MF acknowledges her CEEC contract-

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Development of PVA-Based Electro-Spin Nanofiber Mats and Its Characterization

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ABSTRACT

In this study, development of poly (vinyl alcohol) (PVA) based nanofiber mat was performed by electrospinning a blend of PVA and carboxymethyl cellulose (CMC). The developed nanofiber mats have been characterized and evaluated its physicochemical, morphological and mechanical properties. The resulting nanofiber mat exhibits uniform and bead free structure, as revealed by scanning electron microscopy (SEM). The compatibility of CMC and PVA facilitated the formation of strong hydrogen bonds between their molecules. An increase in mechanical properties of PVA/CMC mat was observed as compared to neat PVA mat. The water vapor permeability of the nanofibrous hybrid mats was increased with the incorporation of CMC polymer. As a result, the hybrid PVA/CMC nanocomposite mat produced via electrospinning process demonstrates considerable potential as compared to neat PVA nanofiber mat for the applications in the biomedical and food packaging sectors [1,2].

Keywords: polyvinyl alcohol; carboxymethyl cellulose; electrospinning; mechanical properties; water vapor permeability

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Vitamin B12-Loaded Nanoparticle-Embedded Scaffolds Produced by the 3D Printer for Controlled Drug Delivery

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ABSTRACT:

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Biological Performances of High Entropy Alloys to Be Used in Dental Restorations and Oral Health Prevention

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ABSTRACT

Dental alloys are metallic biomaterials used mainly in dental prosthetics to restore the morphology and functions of teeth lost due to various pathologies. CrNi and CoCr alloys are among the most widely used alloys due to their good mechanical properties and low price. Given the EU Medical Devices Regulation (MDR) Directive (2017/745) [1], which classifies Co as a harmful element to health and has to be eliminated from dental practice, a gap will occur in the dental alloys market.

Dental alloys must be safe in use, so that in the long term they have to be stable in the oral cavity environment and do not cause local or systemic health issues. Dental alloys often come into direct long-term contact with oral anatomical structures [2]. The oral cavity is an environment that can be affected by changes in pH, temperature variations or contact with beverages, food or drugs that contribute to the degradation of these metal parts, favouring the acceleration of corrosion processes and the release of metal ions that will migrate either locally or systemically, inducing allergic reactions or toxic effects [1,3].

High entropy alloys (HEAs) represent a relatively new generation of materials containing in their formula elements of Ti, Nb, Zr, Ta, Nb or Mo, which offer good mechanical strength, increased corrosion and wear resistance, thus ensuring good thermal stability and biocompatibility [4]. Such a class of alloys could become the proposal for replacing Co-based alloys in dentistry, overcoming the disadvantages of the old alloys in the future [5].

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Green Synthesis and Characterization of ZnO Nanoparticles and its Application in Preservation of Fresh Produce

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ABSTRACT

Dillenia is a small genus of trees with a widespread distribution across various regions in South and Southeast Asia, including China, India, Indonesia, Malaysia, and Thailand . Within this genus, the elephant apple (Dillenia indica L.) stands out as an underutilized fruit and a significant member of the Dilleniaceae family. This unique fruit is predominantly cultivated in the northeastern parts of India. The natural therapeutic attributes found in different parts of these plants, such as leaves, bark, and fruits, have contributed to their incorporation into traditional medicine practices. Furthermore, the fruit is abundant in glucose, tannins, malic acid, flavonoids, betulin, and betulinic acid. Its noteworthy antibacterial, antioxidant, analgesic, anti-inflammatory, and anti-diabetic properties have positioned the fruit as possessing considerable medical significance. Despite its numerous benefits, the fruit is still deemed underutilized and non-commercialized, primarily owing to traditional processing methods, limited awareness of its health-promoting benefits, and inadequate post-harvest processing technology. These factors contribute to substantial losses, resulting in accumulated waste during seasons when the trees yield abundantly.

There is a need for the exploration of applications for these fruits. This study involves the synthesis of ZnO nanoparticles using an extract derived from Dillenia indica sepals. The application of ZnO nanoparticles as antibacterial agents in edible coatings for the purpose of safeguarding food from viral, fungal, and bacterial degradation has been widely explored. The produced nanoparticles were subsequently subjected to several characterization techniques, including X-ray diffraction(XRD), Fourier transform infrared spectroscopy(FTIR), Field emission scanning electron microscopy(FESEM), and Energy dispersive X- ray analysis(EDX). Furthermore, the antibacterial properties of ZnO-NPs were assessed through determination of minimum bactericidal concentration against E. coli and S. aerus. Further, the effect of ZnO NPs on quality attributes of fresh produce were studied.

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Biocompatible Hybrid Scaffolds Based on Functionalized Gelatin for Soft Tissue Engineering

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ABSTRACT

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Antibacterial 3D Meringue-Like Scaffolds for Bone Tissue Engineering Application

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ABSTRACT

Bone tissue engineering is an important field that focuses on the development of new and innovative approaches to effectively repair damaged or lost bone tissue. In this context, scaffold construction for the repair of bone grafts has the potential to provide a biocompatible and functional solution. Tissue scaffold construction begins with the selection of biocompatible materials. These materials often contain natural bone components such as hydroxyapatite, thus providing a structure compatible with the body. The tissue scaffold is designed to provide support to the graft site and encourage the formation of new bone tissue. Hydroxyapatite is a mineral containing calcium and phosphorus and is one of the main building blocks of bones. This feature makes it a material that is compatible with the body and biocompatible. Silver nanoparticles, on the other hand, have the ability to effectively kill microbes, which can provide antimicrobial protection on the tissue scaffold. Egg whites are a rich source of proteins and may have properties that may support cell growth and regeneration. Using these materials together allows the repair of damaged bone structure. The gland-like structure involves creating a scaffold with a porous and interconnected network that mimics the natural extracellular matrix of bone tissue. This architecture provides a large surface area for cell attachment, proliferation, and nutrient exchange.

This study aims to successfully repair bone grafts by combining tissue scaffolds produced in a gland-like structure, hydroxyapatite, which is a natural bone component, and silver nanoparticles with antimicrobial properties. This scaffold can accelerate the bone repair process, help the graft integrate harmoniously with the body, and also minimize the risk of infection after surgery. The resulting tissue scaffold, in addition to having biocompatible properties, offers improved mechanical strength and the potential to reduce the risk of infection. Therefore, this innovative approach is poised to play an important role in the future in the field of bone tissue engineering.

In conclusion, these advances in bone tissue engineering represent a promising step towards the effective repair of bone grafts. Tissue scaffold construction may offer more successful and sustainable solutions for bone repair in the future, using biocompatible materials and advanced production technologies.

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Session II. Environmental and Food Packaging Applications of Materials

Biocatalyst and Nano catalyst Based Approaches for the Efficient Remediation of Organophosphate: A Notional Conceptional Review

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ABSTRACT

Pesticide poisoning mainly from organophosphates (OPs) is the most common mode of fatalities to insects and vertebrates. OPs are diverse group of xenobiotic pesticide widely used both in agriculture and industrial setting like warfare nerve agent (acetylcholinesterase inhibitor), flame retardants, fuel additives, lubricants, plasticizers, and pharmaceuticals; however, they are unstable or nonpersistent. To address the environmental and clinical problem of OPs, Phosphodiesterase (PTEs; EC 3.1.8.1) or in general called organophosphate acid hydrolases (OPH) originally isolated from soil bacteria that were able to hydrolyze and detoxify a wide variety of OPs insecticides and nerve toxins. The enzyme is considered it an unusual or unique because it has no naturally occurring substrates and encoded by the organophosphate degradation (opd) gene found in species of Brevundimonas diminuta (Pseudomonas diminuta), Flavobacterium sp., Agrobacterium radiobacter [1], and Pseudomonas pseudoalcaligenes [2] and genes similar to opd were also located in archaea [3]. Herein, the combination of purified wild-type OP hydrolase, that has been extensively used as a catalytic bioscavenger for paraoxon- a common Ops along with bacterial culture namely Arthrobacter sp., having natural ability to consume paraoxon hydrolysis product called 4-Nitrophenol (pnitrophenol-PNP), jointly remove the paraoxon and PNP completely. The OP hydrolase itself degrade the paraoxon but not its intermediate PNP. However, the said bacterium cannot degrade the paraoxon but consumed the PNP. In a study by Okello, Veronica A., et al. 2022, zero valent iron (Fe°/ZVI NPs) nanoparticles has been synthesized and investigated for the degradation of paraoxon. Batch experiments demonstrated that 15 mg L−1 of Paraoxon was mineralized at degradation efficiencies of 75.9%, 63.9% and 48.9% after three-hour treatment with 6.0, 4.0 and 2.0% w/v Fe°, respectively [4]. Further, for the degradation of another OP namely parathion has been repoted by using silver nanoparticle (Au NPs) that lead to water-soluble products thereby reducing the toxicity of methyl parathion by disrupting the thiophosphate-ester linkage [5].

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Ecotoxicological Behavior of Functionalized Magnetic Nanohybrids in Water Flea *Daphnia Magna* and Their Recovered Physicochemical Properties

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ABSTRACT

Magnetic nanoremediation is quite advantageous due to its fast kinetic adsorption response, high specific surface area, catalitic response, and multifacetic surface adsorption mechanism [1]. However, their industrial application will require the spread of the magnetic nanohybrids into the environment. Specifically, water effluents are the main target for the magnetic nanoadsorbent final cycle. In that sense, ecotoxicological evaluation of nanomaterials' lines and derivatives is mandatory. The main worry is the possible source of contamination that these nanomaterials mean, despite their potential applications.

In this work, the 24-hour lethal dose concentration (24h-LC_{50}) and morphological effects have been studied in the *Daphnia magna* (*D. magna*) biomarker. For that purpose, culture optimization was carried out first. Then, the 24h-LC_{50} values have been determined for various magnetic nanohybrids and compared to other parent systems in the literature. The morphological damage was compared to the negative control for duplicate experiments, and the statistical significance value was also evaluated.

In addition, the after-exposure properties of magnetic nanohybrids will be discussed by means of various physicochemical techniques, and it has been observed that their entire featured properties remain unchanged.

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Aspects of Electrodeposition from NADES Electrolytes

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ABSTRACT

Natural Deep Eutectic Solvents (NADES), a type of solvent formed by mixing certain natural compounds at specific ratios, has garnered attention due to its eco-friendly nature, low toxicity, and biodegradability, making it a viable alternative to conventional techinques [1].

The process of electrodeposition from NADES involves the use of an electric current to drive the deposition of materials onto a conductive substrate. This technique allows for the precise control of coating thickness and morphology, crucial for tailoring material properties [2]. Characterization of the electrodeposited materials from NADES entails a comprehensive analysis of their physicochemical properties, including surface morphology, chemical composition, and structural characteristics. Techniques such as scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR) are commonly employed to evaluate the quality and integrity of the deposited materials [3].

The emergence of electrodeposition from NADES as a promising biomaterial synthesis technique has offered an efficient and sustainable method for drug incorporation [4] becoming possible to achieve controlled and sustained drug release, facilitating localized and targeted drug delivery [5].

The versatility of electrodeposition from NADES extends beyond drug delivery, finding applications in diverse fields such as sensor technology, corrosion protection, and energy storage devices [6] and has paved the way for the development of advanced functional materials for various industries.

With its ability to yield well-characterized coatings and enable precise control over drug release kinetics, this technique holds significant promise for the advancement of biomedical applications, fostering the development of next-generation implantable devices and therapeutic solutions.

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New Approaches Regarding the Development of Advanced Nuclear Reactor Systems

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ABSTRACT

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Visible-light-active Ag-, Cu-, and Bimetallic Ag/Cu-TiO_2 Photocatalysts Prepared by Eco-Friendly Reducing Agent

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ABSTRACT

Titanium dioxide (TiO_2) is the most frequently utilized photocatalyst for decades due to its beneficial properties such as large surface area, high chemical stability, high catalytic activity, and low cost [1]. TiO_2 has been widely used in several applications such as water remediation, anti-bacterial, self-cleaning, and biomedical wound healing. However, one of the drawbacks of TiO_2 that it can only be activated by UV illumination, due to its wide band-gap energy (3.0 eV for rutile phase and 3.2 eV for anatase phase). This problem can be solved by noble metal modification such as silver and copper to extend the light absorptions into the visible range by narrowing the band gap and surface plasmon resonance (SPR) effect [2,3].

This work has successfully demonstrated a green synthesis of Ag-, Cu-, and Ag/Cu-TiO_2 nano-catalysts via precipitation-sonication method. Titanium (IV) isopropoxide was used as TiO_2 precursor and an eco-friendly ascorbic acid was utilized as a reducing agent to convert silver and copper ions (from their respective nitrates) into nanoparticles [4]. Then, the prepared photocatalysts were physico-chemically characterized using various instruments. FE-SEM images exhibited a porous material of the prepared samples and EDX elemental composition clearly detected the silver and copper content of the Ag/Cu-TiO_2. The XRD patterns showed that all samples were in anatase phases except pure TiO_2 in which it had a small brookite. The crystallite size of TiO_2 increased from 7.35 to 16.45 nm upon the silver and copper modifications. The band-gap energy of TiO_2 declined from 3.08 to 2.79 eV after modifications. Subsequently, the photocatalytic activity was examined in the presence of salicylic acid as a model pollutant under visible irradiation. The results showed that salicylic acid could be decomposed about 58%, 54%, and 60% in the presence of Ag-TiO_2, Cu-TiO_2, and Ag/Cu-TiO_2, respectively. Our result indicated a synergic effect of silver and copper modifications could enhance the photocatalytic activity of TiO_2.

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Efficient Decontamination of Large Fluids Fluxes: Packed Metamaterials Under UVC Irradiation

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ABSTRACT

New results are reported on pathogens annihilation via UVC (100-280) nm irradiation during contaminated fluids transit through packed-metamaterials elements (small spheres, optical fibres and/or crushed fragments). A packing scheme of smaller in-between large metamaterial spheres and fibres was proposed for obtaining enhanced depollution. We chose yeast, Saccharomyces cerevisiae, fungi for biological test because of its resemblance and sometimes superior resistance to important pathogens (as e.g. Candida SP). UVC radiation picking at (240–260) nm, emitted by 6 Hg lamps, was directed to a tubular structure of 3.0 cm diameter and 90 cm length, filled up with either (i) (0.1–0.5) mm quartz spheres, (ii) (2–5) mm crushed quartz particles or (iii) 1 mm diameter optical fibre fragments. The tubular structure was placed inside an aluminum cylinder of (1.5–2.0) cm diameter to protect the environment and minimize losses outside the cylinder. If a good contact between the metamaterial elements (spheres, optical fibres and/or crushed elements) is reached, the light is "confined" and dispersed via evanescent waves in an extended volume of circulating fluids. A core filled up with crushed quartz elements under UV-C irradiation was demonstrated to be the most efficient option for decontamination as compared to quartz spheres or optical fibre. As anticipated, more consistent effects are expected on relevant microbes and viruses. This opens, in our opinion, the perspective for the fabrication of inexpensive and easy-to-monitor UV-C LEDs for efficient fluids decontamination. On this basis, A challenge can be therefour opened for the design and development of UVC LED systems for efficient decontamination of fluids using optical resonances between metamaterial elements of different sizes(packings).

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Metal-Organic Frameworks (MOFs) as Efficient Ethylene Absorbers in Active Food Packaging for Prolonging Shelf Life of Fruits

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ABSTRACT

Fruits, as high-value perishable commodities, contribute significantly to post-harvest losses, posing economic and environmental challenges. Post-harvest respiration in fruits leads to the release of phytohormone ethylene, accelerating the ripening process. Inadequate storage systems and costly technologies hinder effective control and preservation of the shelf life of harvested produce. Recent advancements in food packaging have demonstrated efficacy in regulating post-harvest conditions and preserving fruit quality. Utilizing biopolymer films and coatings has emerged as an effective approach for preserving perishable fruits. Incorporating ethylene scavengers/inhibitors into the film matrix represents a promising alternative for extending the shelf life of fruits. Various organic and inorganic additives are integrated into the films to modulate ethylene levels. Metal-organic frameworks (MOFs), known for their versatile performance in drug design, biosensing, gas storage separation, catalysis, absorption, and adsorption, have garnered significant attention. Their exceptional adsorption characteristics, attributed to a porous structure, make MOFs ideal for gas absorption. By incorporating MOFs as filler materials in biopolymer food packaging, ethylene gas emitted by fruits can be effectively entrapped. This study explores the application of MOFs in food packaging materials, demonstrating their capability to reduce the respiration rate of fruits and consequently prolong their shelf life. This study highlights the potential of MOFs as an innovative solution for addressing post-harvest challenges in the fruit industry, offering both economic and environmental benefits.

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Tailoring Novel Eco-Friendly Magnetic Nanostructures for Mining Wastewater Treatment

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ABSTRACT

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Session III. Advanced Material Processing and Applications (I)

Polymeric Nanosystems for Drug Delivery in Diabetes Management

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ABSTRACT

Diabetes mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels, poses a global health challenge with an ever-increasing prevalence. Effective diabetes management often requires precise drug delivery systems to maintain glucose levels within a narrow therapeutic range, reduce side effects, and improve patient compliance. Polymeric nanosystems have emerged as promising tools for drug delivery in diabetes management due to their versatility, biocompatibility, and tunable release kinetics.

In this presentaion provides an overview of the development and applications of polymeric nanosystems for drug delivery in diabetes management, highlighting their potential to revolutionize the treatment of this chronic condition. Polymeric nanosystems encompass a wide range of nanoparticulate drug carriers, such as nanoparticles, micelles and dendrimers, which can encapsulate various therapeutic agents inclduing APIs, proteins and nucleic acids. These nanosystems offer several key advantages, including controlled drug release, prolonged therapeutic effects, and targeted delivery to specific cells or tissues.

Controlled drug release is essential for managing diabetes effectively, as it enables the maintenance of stable blood glucose levels. Polymeric nanosystems can be designed to release drugs in response to specific triggers, such as pH, temperature, or enzymatic activity, mimicking the physiological insulin release pattern. Additionally, the small size of polymeric nanoparticles allows for enhanced cellular uptake and distribution within target tissues, improving the bioavailability of anti-diabetic drugs. Additionally, functionalization of these nanoparticles with ligands specific to diabetic tissues or receptors further increases their targeting efficiency, reducing off-target effects and systemic toxicity.

Studies haves shown encapsulation of insulin within nanosystems protects it from enzymatic degradation and enhances its stability. This approach provides a platform for alternative routes of insulin administration, such as inhalation or oral delivery, reducing the reliance on traditional subcutaneous injections.

In conclusion, polymeric nanosystems hold immense promise in the field of diabetes management, offering precise and patient-friendly drug delivery solutions. The versatility of these nanosystems, in terms of drug encapsulation, release kinetics, and targeting, paves the way for more effective and personalized treatments. As research in this field continues to advance, polymeric nanosystems for drug delivery in diabetes management are poised to play a pivotal role in improving the quality of life for individuals living with diabetes.

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New Nanostructured Materials for Large-Scale, Reversible and Durable Direct Air Capture

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ABSTRACT

Immediate reduction of anthropogenic CO_2 emission is of vital importance to mitigate global warming according to 1.5 ◦C or 2 ◦C targets [1]. Complimenting higher energy efficiency, emissions reduction and greater renewables fraction, the implementation of Negative Emission Technologies (NETs) [2] at a large-scale to actively remove CO_2 from the atmosphere is expected to play a crucial role: 100 Gt of CO_2 can be potentially removed by mid-century using NETs. In the NETs portfolio [3], direct capture of CO_2 from ambient air by chemicals (generally referred to as direct air capture, DAC) hold great promise due to the advantages of convenient feedstock for CO_2 utilization, reduced environmental risk and, more important, unlimited capacity in reducing atmospheric CO_2 level [4]. Unfortunately, DAC inherently suffers from low efficiency and low kinetics issues under ultra-dilute partial pressure of CO_2 (0.04 kPa) in ambient air. Furthermore, both aqueous alkali hydroxides, the current state-of-the art for DAC, and current solid sorbents are still troubled by severe challenges including low chemical stability, equipment corrosion and high energy requirement for sorbent regeneration [5] as well as high cost of production and the difficulty to produce them in large quantities in the case of solid sorbents. In a nutshell, the ultimate success of DAC will depend on the development of CO_2 capture materials able to conjugate high adsorbate loading, chemical stability and low regeneration energy consumption.

In the presentation, some preliminary data will be discussed concerning the design, synthesis and characterization of quaternary-ammonium-functionalized nanomaterials to be employed in the direct air capture processes. Materials were characterized for their capture performance and physico-chemical properties. Noteworthy, Nuclear Magnetic Resonance (PFG-NMR) spectroscopy will be used to effectively clarify the confinement effects and molecular interactions of CO_2 with the sorbents, thus enabling a profound comprehension of the structure-performance relationship in the nanomaterials.

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Preparation of an Innovative and Sustainable Metal Plating Method

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ABSTRACT

While electroplating is noted for its superior decorative appearance, high performance and excellent corrosion resistance, the use of this technology is not without some problems in terms of sustainability. The process involves the use of large amounts of water and electricity, as well as their containment in hazardous areas. There is a need for a new method of sustainable finishing that can save water and reduce the electricity consumption, as well as reducing greenhouse gas emissions. AcroPlating® finishing technology was developed and its effectiveness has been investigated and reported through a Life Cycle Assessment (LCA). According to the tested values, AcroPlating® finishing technology completely eliminates the use of certain harmful substances such as cyanide, chromium and selenium in the plating process. Additionally, the technology reduces greenhouse gas emissions by 96%, water use by 66% and power consumption by 69% during the production process, when compared to conventional plating methods. The developed technology is used in fashion materials such as zipper sliders, snaps and buttons. Fashion is a highly polluting industry and sustainable accessories are crucial for comprehensive sustainability in the textile and fashion industries. A general analysis of the conventional and AcroPlating® finishing technologies using the results of the LCA* are given below:

-Toxic waste products: 100% eliminated
-Thermal energy use: 100% reduction
-Greenhouse gas emissions: 88% reduction (NCOP)
-Water use: 65% reduction (NCOP)
-Sludge formation: 90% reduction (NBLK)
-Electricity consumption: 60% reduction (NCOP)
-Chemical consumption: 67% reduction (NBLK)

Synthesis of New Lipopeptide Green Surfactants from Silk by Mechanochemistry

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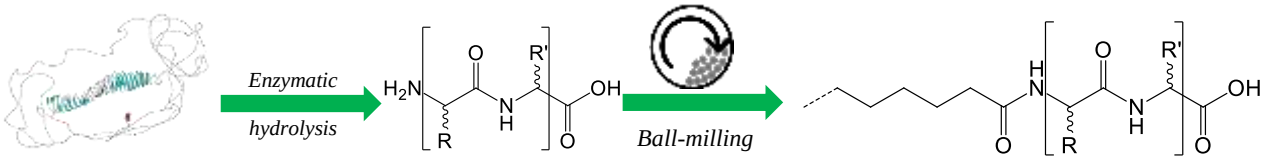
ABSTRACT

The production of environmentally sustainable amphiphilic molecules from natural origin constitutes one of the major issues for different industries due to the pressure from regulatory legislation and growing consumer trend towards environmentally-friendly chemicals. Natural-based surfactants can be produced from agricultural biomass such as sugars, starches, vegetable proteins and oils. However, these high-quality fractions of biomass are in competition with food and feed industries.[1]

In this context, the development of surfactants from silk proteins as a nonfood biomass represents an interesting alternative. Silk is a biopolymer produced by different varieties of silkworms. Mulberry silk is obtained from the silkworm *Bombyx mori L.*, it is composed of two kinds of proteins: fibroin (≈70%) a fibrous protein, that imparts mechanical strength to the cocoon, used in textile industries and sericin (≈30%), a glue-like protein, that binds the fibroin fibers together in a cocoon. Sericin is eliminated by a degumming process during the production of silk fibers.[2]

The main objective of this work is to develop an original synthesis to produce amphiphilic lipopeptides from silk and evaluate their surface activity. The first step involves the separation of the two fractions of silk: fibroin and sericin.[3] Then, fibroin and sericin peptides are obtained by enzymatic hydrolysis. Finally, the grafting of the hydrophobic chain onto the silk peptides is carried out using a novel mechanochemical approach. The adsorption properties of the peptides and lipopeptides obtained are studied by surface tension measurements.

The obtained results show that the two silk protein fractions can be hydrolyzed using Alcalase with a degree of hydrolysis varying between 20 and 40%. The grafting of a fatty chain (C14) was optimized on model amino acids under solvent-free conditions by mechanochemistry, then it was extended to silk peptides. The acylation rate (ratio of grafted amine functions) was estimated by NMR and by UV spectroscopy (reactivities of primary amines) and this methodology gives promising results. The synthesized lipopeptides show a good surface activity and ability to reduce the air/water surface tension. Finally, fibroin peptides and lipopeptides show better surface activity than those of sericin.



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Comparative Evaluation of the Corrosion Performance of Two Chromium Coatings Deposited on Zy-4 Substrate

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ABSTRACT

The current nuclear power industry is based on mature technology with an excellent safety and operational record. The current fuel, UO_2 meets all performance and safety requirements, maintaining nuclear power as a clean and economically competitive energy option. Developing alternative fuel technologies to further improve the safety and competitiveness of existing nuclear power plants is the aim of accident-tolerant fuel (ATF) development [1,2].

In this context, the paper is focused on testing and evaluating the corrosion behavior of two thin chromium coating, deposited by Thermionic Vacuum Arc (TVA) [3] and Electron Beam Physical Vapor Deposition (EBPVD) on Zy-4 substrate. After autoclaving under CANDU primary circuit conditions (lithiated water, 310 °C, pH = 10.5, 100 atm), the Cr-coated Zy-4 samples were characterized by gravimetric analysis, optical microscopy, scanning electron microscopy (SEM) with energy dispersive X-ray (EDX), and X-ray diffraction (XRD). The investigation of the corrosion behavior was carried out by applying three electrochemical methods: potentiodynamic measurements, electrochemical impedance spectroscopy (EIS), and open circuit potential (OCP) variation. By optical microscopy, it was observed a relatively uniform distribution of hydrides along the samples, in the horizontal direction. By SEM investigations it was observed that after the autoclaving period, the coatings with thickness from 1.4 to 3 μm are still adherent and maintain their integrity. The XRD diffractograms showed a high degree of crystallinity with the intensity of chromium peaks higher than the intensity of zirconium peaks for the EBPVD chromium coated Zy-4 samples.

The results showed good protective properties of both chromium coatings tested in primary circuit conditions of a CANDU reactor, but it was identified a better corrosion performance of EBPVD Cr coating.

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Intergranular Corrosion Behavior Assessment of Uncoated and CrN_x-coated 310 H Stainless Steel

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ABSTRACT

Austenitic stainless steels (ASS) are a class of materials suitable to be used in supercritical water-cooled reactors (SCWRs) due to their higher corrosion resistance, creep, and good radiation performance [1]. Although they have high corrosion resistance, when these steels are exposed to high temperatures, they are sensitized and become susceptible to intergranular corrosion (IGC) due to chromium carbides precipitation near the grain boundaries and/or solution segregation at the grain boundary [2]. Additionally, other precipitates such as sigma, chi and lave phases can form. To improve the corrosion resistance, protective ceramic or metallic layers can be applied on the surface of these alloys using various deposition methods.

The aim of this paper is assessment of the intergranular corrosion behavior of a CrN_x-coated 310H alloy deposited using Thermionic Vacuum Arc (TVA) [3] by comparisons with the uncoated alloy. In this sense, all samples were sensitized by thermal treatment at temperatures of 600°C, 700°C and 800°C for 1 h, 24 h and 120 h. After sensitization, the heat-treated samples were characterized according to the electrolytic test in 10% oxalic acid in order to identify the intergranular attack occurrence and in 10% KOH solution in order to identify the sigma phase in the alloy. Complementarily, the intergranular corrosion susceptibility has been assessed using potentiodynamic electrochemical reactivation tests. The obtained results showed that the deposited CrN_x layer being very thin (approx. 300 nm) did not influence the microstructure of the alloy.

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Nanosilica Impregnation of Wood: Investigating Structural Transformations via FTIR Spectroscopy and Assessing Fire Reaction Properties

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Investigation of the Electrical Properties of Polypropylene-Based Composites Melt-Processed with As-Grown Carbon Nanofibers

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ABSTRACT

This study presents an analysis of the electrical properties of polypropylene (PP) composites processed through melt-processing with different contents of as-grown carbon nanofibers (CNFs). As expected, the electrical conductivity of PP/CNF composites increases with the incorporation of CNFs in the polymer, reaching a maximum of approximately ~6×10^{-6} $S.m^{-1}$ for PP/CNF 3wt% composites [1]. This enhancement is associated with a gradual improvement in dielectric permittivity up to a maximum of ~13 for PP/CNF 3 wt. % composites at 1MHz, attributed to the rise of the interface polarization effect. Furthermore, the Cole-Cole model, applied through the electrical modulus, is utilized to analyze the effect of CNF content on the dielectric relaxation of PP/CNF composites [2]. From this analysis, it is deduced that the incorporation of CNFs increases their heterogeneity and relaxation times [3]. The objective of this analysis is to contribute to the understanding of the electrical features of polymer composites filled with a specific type of CNFs, particularly those not subjected to any thermal post-processing methods after their synthesis via chemical vapor deposition (CVD).

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The Comparison Study: Different Pretreatment of Cellulose Nano Fiber Production from Kenaf Biomass

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ABSTRACT

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Pilot Scale Continuous Biogenic Silica Extraction from Rice Husk by One-Pot Alkali Hydrothermal Treatment and Ball Milling

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Session IV. Novel Bioactive Compounds

The Antioxidant Character of the BGR 0.3 Molecule (Retinol Impregnated on Bioactive Glass)

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ABSTRACT

We currently live in a society that has managed to significantly increase the longevity of the population and life expectancy. Or the increase of life expectancy (thanks to advances in pharmacology, cardiology, interventionist medicine, etc.) could not leave aesthetic medicine and cosmetology without a reply. Therefore, innovative active substances have emerged, which will slow down the development of the skin aging process on their own, in accordance with the new living conditions. Today, society pays more attention to food, to lifestyle ... why it would not matter than the "nutrition" of the skin, the preservation for as long as possible of its homeostasis, of enzymatic and biochemical baggage (hyaluronic acid reserve, collagen reserve, etc.)? From a cosmetic point of view, the knowledge of dermal biochemistry and the possibility of skin penetration of collagen in topical use has in the foreground the retinoids that remained the gold standard in anti-aging rituals.

Thus, in this paper I will discuss both the antioxidant and the wound healing properties of a retinol complex and the equivalent in active substance (retinol). As far as the antioxidant capacity is concerned, for its analysis, I used 10 mL volumetric flasks that contained 1, 2, 3, and 4 mL of each extract (CA1, CR1, CA2, CR2). The extracts were then topped off with distilled water to the mark.

The DPPH radical scavenging method involves the neutralization of the DPPH radical by electron donation of antioxidants, with the DPPH radical color shift measured at 517 nm.

Preparation of DPPH methanolic solution: 100 mg DPPH was accurately weighed and placed in a 200 mL volumetric flask over which 100 mL methanol was added and stirred to dissolve. The solution was made up to 200 mL with solvent, resulting in a 0.063% (1.268 mM) DPPH methanolic solution.

Four aqueous solutions of different concentrations (1:10, 2:10, 3:10, 4:10 mL extract/mL distilled water) were prepared for each coffee sample taken CA1, CA2, CR1, CR2. From each of these solutions, 1 mL was mixed with 5 mL of 1.268 mM (0.063%) DPPH (2,2-diphenyl-1-picrylhydrazyl) methanolic solution in 25 mL volumetric flasks and topped up with methanolic solution. The mixture was shaken vigorously, then stored in a dark space for 30 minutes.

Absorbance was measured at a wavelength of $\lambda = 517$ nm using a blank (control) as a compensation liquid. The calculation formula for determining the DPPH radical scavenging capacity is shown in equation (1):

$$\% \text{ DPPH Scavenging Capacity} = (\Delta A517 \text{ blank} - \Delta A517 \text{ sample})/(\Delta A517 \text{ blank}) \times 100 \quad (1).$$

In this respect, applied research has demonstrated by an objective, instrumental method that active substances such as retinoids are effective in capturing free radicals by functioning as antioxidants, which means that they fights effectively against cell damage.

Keywords: vitamin A, retinol, retinoids, skin aging, dermatology.

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Suberin from Cork: Isolation and Characterization

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ABSTRACT

The bark of the cork oak tree is rich in biopolyesters in the form of suberin, a cell wall macromolecule ubiquitous in the plant kingdom as an important structural and protective barrier. Suberin and its fatty acid constitutents bear interesting structure and properties that can serve as a highly functionalized building block for a variety of application including cosmetics, coatings and biolubricants.

With accumulated knowledge about suberin structure and properties, it is slowly finding its way towards water proofing and antibacterial applications[1,2]. Nonetheless, the accumulated knowledge on suberin had been based on conventional pathways which has limited the quantities made available and which has considerably affected the isolated suberin properties. Therefore, we have proposed a novel way by which we can isolate suberin from cork byproducts based on ultrafast supercritical hydrolysis. This presentation will discuss the comparison between the chemical based isolation and that of ultrafast supercritical hydrolysis.

We were able to demonstrate that water under supercritical conditions can penetrate the cell wall and dissolve the lignocellulosics, leaving the suberin enriched in the solid hydrolysis products. We have successfully isolated suberin from cork at reactions time as short as 1.27s, while striking a balance with competing reaction (formation of repolymerization products).[3] About 66% of suberin can be obtained from dry cork at 386 °C and 1.27 s, corresponding to 95% polysaccharides content removal. On the other hand, repolymerization formation amounted to 11% of solid hydrolysis product under this condition. On the other hand, when 395 °C and 0.25 s (pKw = 15) was used, 59.8% suberin was obtained accompanied by 77.1% polysaccharides and 14% lignin removal and only 7.3% of repolymerization reaction. Moreover, it was demonstrated that suberin ester bonds were preserved in the process, signifying that we are actually isolating a suberin macromolecule instead of the depolyermized ones produce via conventional approaches. We have also correlated the ionic properties of water to the extent of lignocellulosic liquefaction.

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Mathematical Modelling of the Drying Kinetics of Spanish Cherry (*Mimusops Elengi*) Seed and Physicochemical Properties

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ABSTRACT

The Spanish cherry (mimusops elengi) seed has desirable nutritional and medicinal properties, which make it a great industrial potential that is yet to be explored. The seed of the Spanish cherry (mimusops elengi), which is about 32% of the total weight of the fresh fruit,is considered agricultural waste and discarded with no proper applications. The current research article presents a study focused on the mathematical modeling of the drying kinetics of Spanish cherry seeds. The drying experiments of the Spanish cherry seed were performed in a tray dryer at four different temperatures (50 ^{o}C, 60 ^{o}C, 70 ^{o}C, 80 ^{o}C) and the rate of moisture evaporation was systematically studied. It was observed that the pretreatment process stimulated the drying progression of Spanish cherry seed. Four different semi-theoretical drying mathematical models were compared based on their coefficient of determination, reduced mean square error, root mean square error, mean bias error, and mean absolute error of the deviation to characterize the drying curves at the previously mentioned conditions. It was found that an increase in the air temperature caused a reduction in the drying time of seeds. From the tested models, the Avhad and Marchetti models showed the best fit to the experimental data. In proximate analysis, it was found that the Spanish seed is a good source of oil, protein, and other bioactive compounds. This study will be helpful to preserve the seed of the spanich cherry for a long time and utilize it for making functional food.

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Extraction of Bioactive Compounds Using Green Solvent

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ABSTRACT

The escalating global demand for bioactive compounds with potential health benefits has spurred interest in sustainable and environmentally friendly extraction methods. This study explores the utilization of natural deep eutectic solvents (NADES) as eco-friendly alternatives for extracting bioactive compounds from diverse plant sources. Composed of natural and benign components, deep eutectic solvents offer a promising substitute for traditional organic solvents, boasting low toxicity, biodegradability, and ease of preparation. The research evaluates the extraction efficiency of bioactive compounds, including polyphenols, flavonoids, and alkaloids, using NADES in comparison to conventional extraction methods. Various plant materials, encompassing medicinal herbs and agricultural by-products, undergo extraction processes employing NADES, and the resulting extracts are analyzed for their bioactive compound content. The environmental sustainability of the proposed extraction method is assessed by scrutinizing factors such as energy consumption, solvent reusability, and waste generation. Additionally, the economic feasibility of scaling up the NADES-based extraction process is considered, accounting for the availability and cost of raw materials. Furthermore, the bioactivity of the extracted compounds is evaluated through in vitro assays to gauge their potential health-promoting properties, such as antioxidant, anti-inflammatory, and antimicrobial activities. Comparative analyses with extracts obtained through conventional methods are conducted to ascertain the overall efficacy of NADES as a green solvent for bioactive compound extraction.

This study contributes to the ongoing endeavor to develop sustainable and eco-friendly extraction processes for bioactive compounds, addressing both environmental and health-related concerns. The findings hold significance for industries engaged in the production of natural products, pharmaceuticals, and functional foods, offering a robust foundation for the widespread adoption of green solvents like natural deep eutectic solvents in the extraction of valuable bioactive compounds.

Action of Enzyme Complex on Bioactive Components Extracted from Soy Residue

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ABSTRACT

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Olive Derivates as Antioxidants and Rheological Modifiers

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ABSTRACT

Improving the mechanical properties of a bitumen and prolonging its life time is an important goal for road pavements design. For this reason, a common practice is using additives capable to enhance the physico-chemical properties of the bitumen and also to prevent oxidative processes. In recent time, the asphalt industry looked with growing interest towards more eco-friendly resources that could be used as bitumen additives. In fact, the need to preserve natural resources and therefore the use of sustainable biomaterials is a stimulus for circular economy initiatives.

Bitumen is naturally susceptible to degradation, due to both oxidative aging and the continuous repeated loads, that can limit its service life span. This research work aims at exploiting the potential of leaf residues derived from olive tree pruning as both antioxidant and rheological modifier for bitumen.

Olive plants and their derivatives, as matter of principle, can be used as bitumen additives, thanks to their high content of polyphenols and other bio-active compounds. Two additives, labelled as FUM and FUR, derived from olive leaf of two different cultivars residue were used to modify a bitumen. Both additives are green powders with an average grain size of approximatively 250 μm.

The experimental work is divided as follows:

- The phenol, lignin, cellulose and hemicellulose contents of FUM and FUR were evaluated;
- A 70/100 was modified with three different percentages of the two additives;
- The three derived samples were subsequently aged via Rolling Thin Film Oven, extended to 225 min;
- Each sample was analysed by rheometry, using a shear stress-controlled rheometer. Moreover, the melting points of the asphaltenes extracted from the aged samples were evaluated.

The analyses revealed that the two additives act differently on the bitumen. FUM has an antioxidant effect when dosed at the minimum percentage tested, while FUR has a modifying effect on bitumen, shifting the transition temperature by 10°C.

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Evaluation of Neurohormonal Dynamics After Administration of Probiotic Microbial Strains in a Murine Model of Hyperthyroidism

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ABSTRACT

This study investigated the effects of probiotic administration on neurohormonal dynamics in a mouse model of hyperthyroidism. Due to its influence on neurotransmitter levels and the immune system, the intestinal microbiota may have a significant impact on hyperthyroidism, a condition that is frequently associated with microbiota disorders. The administration of *Lactobacillus acidophilus* resulted in notable reductions in brain dopamine and adrenaline levels while having minimal impact on GABA. *Saccharomyces boulardii* was found to cause notable reductions in brain dopamine levels and notable increases in plasma ACTH levels, suggesting the activation of the hypothalamic-pituitary-adrenal (HPA) axis. The group receiving both probiotics exhibited intricate modifications in neurotransmitters and hormones, including notable elevations in cortisol and ACTH levels, suggesting a multifaceted interplay between the strains. The significance of this study lies in the potential correlation between hyperthyroid diseases and dysbiosis of the microbiome, as well as the diverse effects of probiotics on neurohormonal axes. Our findings suggest that probiotics may have a potential role in influencing the hypothalamic-pituitary-thyroid (HPT) axis in individuals with hyperthyroidism. This underscores the importance of exercising caution when administering probiotics to patients who are susceptible to serotonin syndrome or allergies. This study provides valuable insights into the complex interplay between microbiota, neurotransmitters, and endocrine diseases, with possible implications for the advancement of treatment approaches in the future.

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Calabrian Citrus Fruits: From Peels to Essential Oils; Characterization of Their Nano-Emulsions

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ABSTRACT

Kumquat (*Citrus Japonica*), Citron (*Citrus medica*), Orange (*Citrus sinensis*), Bergamot (*Citrus bergamia*), Lemon (*Citrus lemon*), and Tacle (*Citrus sinensis x Citrus clementina*) are citrus fruits specific to southern Italy. Their peels are important sources of essential oils. Citrus essential oils are complex mixtures of volatile compounds with manyfold possibilities to be used as active antioxidant and antimicrobial ingredients in food, cosmetics, or pharmaceutical products. These uses are limited by their susceptibility to external factors such as light, temperature, pH, oxygen, and humidity. To maintain or even enhance their physical-chemical stability, they were encapsulated into nano-emulsions. Citrus peels mixed with water are subjected to microwave-assisted extraction power (800 W) for one hour to obtain the essential oils (EOs). The obtained essential oils were nano-encapsulated in nano-emulsions to preserve and enhance their properties and stability. In this study, nano-emulsions were prepared through ultrasonication, using citrus oils as the lipidic phase and Tween 80 and ethanol as a surfactant, and co-surfactant, respectively. Their behavior was evaluated by testing their antioxidant, antimicrobial, and biological properties. The best extraction yield was obtained for bergamot, while the lowest was registered for citron and lemon. The volatile profile, and bioactive properties were investigated and their stability was monitored under different environmental conditions. Each emulsion exhibited different degrees of gravitational separation, the ones stored at 37°C being the most unstable, showing coalescence and phase separation. The antimicrobial activity was tested against Gram-positive and Gram-negative bacteria, with a better response for the Gram-negative. Bergamot nano-emulsions show the best susceptibility against *E.coli*. Our work aimed to find the best formulations to obtain stable functionalized nano-emulsions, which would be ready to be used in food as green additives or in medicine as non-invasive treatments. Therefore during method development and nano-emulsions characterization, not only the physicochemical properties but the food and human-friendly behavior have to be taken into consideration.

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Quercetin and Curcumin Encapsulated into a Cyclodextrin-Metal Organic Framework (CD-MOF-1): Characterization, Solubility and Kinetics Studies of The Release Process

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ABSTRACT

CycloDextrin Metal-Organic Frameworks (CD-MOF-1) has been used in this work as a carrier to control the release and enhance the solubility of quercetin (QE) and curcumin (CCM) two bioactive molecules well known for their potential health benefits due to their antioxidant, and anti-inflammatory properties but, their uses are hindered by their poor water solubility and limited physicochemical stability. CD-MOF-1 has been synthesized through the vapor diffusion method, and its structure was confirmed by the PXRD and FTIR analysis. Then, the loading of quercetin and curcumin into CD-MOF-1 was done at different concentrations using the microwave-assisted method at 80°C for 3 minutes. CDMOF-1 is colorless, but after encapsulation, QE@CDMOF-1 and CCM@CDMOF-1 were slightly yellow and orange respectively due to the color of such molecules. Unlike curcumin in which the encapsulated efficiency (EE) decreased while the loading capacity (LC) increased with the concentration, EE and LC of quercetin increased with the concentration. For 850 µg/ml, EE of QE and CCM are 65.3 ± 2.1 % and 54.03 ± 2.7 %, respectively compared to 33.8 ± 2.9% and 24.7 ± 1.9% shown in the literature, and LC 91.3 ± 3.5 and 46.5 ± 2.4 mg/g, this may be due to the method used for encapsulation.

The FTIR results showed that all absorption bands of CDMOF-1 remain present for QE@CDMOF-1 and CCM@CDMOF-1 and their PXRD patterns are quite similar to that of CDMOF-1, inferring that the encapsulated drugs rarely impact its crystallinity. The drug release was done using the phosphate buffer saline solution at pH = 7.4 and pH = 6 for 48 hours. The release of QE, QE@CDMOF-1, CCM and CCM@CDMOF-1 were 21.4 ± 2.1, 66.9 ± 2.4, 19.4 ± 0.8, 72.8 ± 2.5 and 12.3 ± 1.1, 49.7 ± 2.1, 16.27 ± 1.7, 58.3 ± 2.3 at pH = 7.4 and pH 6 respectively which means that CDMOF-1 can facilitate the rapid release of QE and CCM, improving their dissolution in the media, and their bioavailability. Concerning the kinetics studies, five pharmacokinetics models were used to fit the release, including, zero-order kinetics, first-order kinetics, Korsmeyer–Peppas, Higuchi, and Hixson–Crowell. The best-fitting model is Korsmeyer-Peppas with the correlation factor R^2 = 0.9955, 0.9872 at pH 6 and 0.8515, 0.9617 at pH 7.4 for QE@CDMOF-1 and CCM@CDMOF-1 respectively. The solubility studies were also done, and we found that QE@CDMOF-1 and CCM@CDMOF-1 are nearly 110-fold and 2180-fold soluble than pure quercetin and curcumin, which is close to 100-fold and 2600-fold obtained by Wang et al, 2022 and Chen et al, 2022, respectively.

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Session V. Tissue Engineering and Regenerative Medicine

Design and Characterization of Magnesium Phosphate/p(HEMA) Composite Cement Dedicated for Biomedical Applications

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ABSTRACT

Bone cements are an extremely interesting self-setting group of materials mainly used as a biosubstitute for various bone defects. An example of bioactive bone cement is magnesium phosphate (MPC), which is characterized by fast setting time, high mechanical strength, favorable resorbability, and osteogenic potential. Nevertheless, it remains highly brittle and its paste is susceptible to leachability during the application. Therefore, the novel composite formula of the cement was proposed in this work and it was based on MPC and poly(2-hydroxyethyl methacrylate) (pHEMA).

The applied technology focused on two setting reactions: 1) hydraulic of tri-magnesium phosphate with di-ammonium hydrogen phosphate (4:1 mass ratio) and 2) polymerization of HEMA hydrogel by ammonium persulfate (APS) and N,N,N′,N′-tetramethylethylenediamine (TEMED). The following parameters were evaluated: HEMA concentration and its premix times. The specimens were prepared by mixing components with a 2.5 g/mL powder-liquid ratio, then the paste was transferred into molds and left to harden. The cements were characterized by: setting time, microstructure, phase and chemical composition, mechanical strengths, porosity, degradation behavior, and cytocompatibility on osteoblasts.

The addition of the pHEMA significantly influenced the main characteristics of the MPC cement - both, the HEMA concentration and the premix time allowed to control material final properties. We confirmed that it is possible to obtain such biocomposite dual-setting cement as its both reactions were effective. Further, this modification contributed to the increase in mechanical strengths and the improvement of functional properties. However, we found the essential cytotoxic effect of MPC+pHEMA cements which was related to the polymer itself, probably due to APS/TEMED as polymerization agents. Hence, future research will be focused on the optimization of the HEMA polymerization process to ensure full biocompatibility of this novel dual-setting bone cement.

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Nanomaterial as Emerging Trend for Dental Applications: Opportunities and Challenges

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ABSTRACT

The exponential increase in the variety of dental nanomaterials has marked a significant advancement in the field of dentistry. This surge has led to a plethora of commercial dental nanomaterials undergoing rigorous investigation. Despite their widespread use, there remains a degree of uncertainty within the dental and research communities regarding the mechanisms of action, distinguishing features, and potential superiority of these nanomaterials over traditional dental materials. The aim of this study is to provide a comprehensive overview of both the research into and applications of dental nanomaterials, highlighting their transformative impact on the field Nanotechnology has revolutionized numerous materials used in dentistry, primarily aimed at enhancing treatment efficacy. This is attributed to the unique properties of nanomaterials, including their high selectivity, increased cytotoxicity, biocompatibility, and simplified synthesis processes. A notable example is the incorporation of metal oxides in dental materials. A deep understanding of nanotechnology's scientific principles is imperative for comprehending the practical implications of these advanced materials in clinical settings. This paper will elucidate the applications of nanotechnology in dental diagnostics, preventive measures, and material science. It will include discussions on commercially available nanotechnology-based products, backed by clinical evidence. Furthermore, this review will delve into the latest advancements and applications of nanoparticles in various branches of nanodentistry, such as restorative dentistry, endodontics, prosthodontics, and orthodontics, thereby contributing to a broader understanding of the field.

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PRP-Loaded Composite Scaffolds for Bone Tissue Engineering Applications

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ABSTRACT

3D printing technology, also known as additive manufacturing, is revolutionizing the medical sector by enabling the creation of patient-specific devices. This technology is also being used to develop specific scaffolds that can be released drug slowly over time, allowing for more targeted treatment of diseases. With 3D printing technology, it is changing the way of treatment in medicine by allowing more personalized and precise treatment options. Biocompatible biomaterials are designed to be compatible with the human body, thereby reducing the risk of adverse reactions. By using biocompatible biomaterials, biofunctional inks are created and structures that can imitate damaged tissues and organs can be produced by the 3D printing method. Bone tissue engineering with 3D printing is a rapidly advancing field that combines 3D printing technology with biological materials to create replacement bone tissue for patients with bone defects or injuries. It offers a more personalized approach to treatment, as the scaffolds can be customized to fit a patient's specific needs.

In this study, a new approach for bone tissue engineering is considered by using gelatin (GEL), sodium alginate (SA), hydroxyapatite (HA), and platelet rich plasma (PRP). Control group (without PRP), and containing different concentrations of PRP loaded scaffolds were fabricated with 3D printing technology, and various characterization tests were performed. The fabricated scaffolds were subjected to characterization tests that included morphological analysis using scanning electron microscopy (SEM), examination of their mechanical properties through compression test, and analysis of the chemical bonds and functional groups of the scaffolds using Fourier Transform Infrared Spectroscopy (FTIR). In addition, the release test with UV spectroscopy is used to determine the amount of PRP released from the scaffold over some time. This is important because the controlled release of PRP from the scaffold is crucial for the success of bone tissue regeneration. The results of characterization tests showed that the fabricated scaffolds have great potential to treat damaged tissue and cells for bone tissue engineering applications.

Keywords: 3D Printing Technology, Bone Tissue Engineering, Biomaterials, Platelet-rich plasma, Hydroxyapatite

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Wound Dressing Materials Based on Nanocellulose

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ABSTRACT

Bacterial infections are one of the biggest concerns of everyday medical life, as they sprung from the most banal causes (unwashed food, small cuts) to graver ones (post – surgery and chronic wounds). The treatments available and wildly used are antibiotics, a class of drugs to which bacteria have become more and more resistant. As the healing of a wound is a multiple step process, bacterial infections are more likely to develop, and the wound dressings are often endowed with antibacterial agents in order to prevent infections, but as it is the case with antibiotic overuse and negligent prescriptions, the resistance to this type of medication is a serious problem that needs to be treated. One of the solutions researchers work on are alternative materials of natural origin, ones that posses biocompatibility and low – toxicity. Nanocellulose, an abundant biopolymer, has an already paved way in the pharmaceutical industry due to its remarkable properties i.e., large active area, biocompatibility, biodegradability, high number of hydroxyl groups on its surface that make modifications easier, and so on [1]. Even though the properties enumerated paint a most advantageous picture, the Gordian Knot of this material is the lack of antibacterial activity, crucial when it comes to wound dressing applications [2]. One of the solutions for this are the compounds with antibacterial effect which can be imbedded in the cellulosic structure. The main objective of this work is the developing of an efficient system based on nanocellulose with antibacterial effect provided by natural – derived extracts, to be used in biomedical applications. For this purpose, nanocellulose will be isolated through different methods (chemical and mechanical), a selection of plant extracts will be obtained and characterized, nanocellulose will be impregnated with these extracts and the efficiency and properties of these systems will be investigated.

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Strategies to Improve the Flow Behavior and Antimicrobial Properties of Pluronic® F127-Based Injectable Hydrogels

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ABSTRACT

Pluronic® F127 (PF127) is a non-toxic and water-soluble triblock copolymer made of two hydrophilic poly(ethylene oxide) blocks and one hydrophobic poly(propylene oxide) block placed in the middle of the hydrophilic segments (PEO_{100}–PPO_{65}–PEO_{100}). PF127 is one of the most commonly used thermoresponsive polymers, FDA-approved, that exhibits a rapid sol–gel transition above the critical gelation temperature and concentration. Due to its temperature-sensitive characteristics that allow effortless injectability, PF127-based hydrogels are widely used in tissue engineering and drug delivery applications [1]. However, in contact with an excess of water, PF127 gels disintegrate within several days [2]. Usually, bio(macro)molecules or salts are added and thus various composite hydrogels with enhanced biological performances, gel strength and bioadhesive properties can be obtained [3,4].

The aim of the study was to investigate different formulations containing Pluronic F127 and various polysaccharides (chitosan, sodium alginate, gellan gum and κ-carrageenan) as potential injectable gels that behave as free-flowing liquid with reduced viscosity at low temperatures and display solid-like properties at 37 °C. In addition, curcumin was added for testing the antimicrobial properties of the thermal-sensitive gels. Rheological investigations evidenced the transition temperature and kinetics of gelation at 37 °C of PF127 in the presence of polysaccharides. However, the gel formation is delayed in the presence of curcumin, when a remarkable enhancement of antimicrobial activity was observed. Chitosan addition to Pluronic/curcumin systems improves their viscoelasticity, antimicrobial activity, and stability in time. The balance between viscoelastic and antimicrobial characteristics needs to be considered in the formulation of Pluronic F127 gels in order to design biomaterials suitable for biomedical and pharmaceutical applications. In this context, rheological investigations in different shear conditions were carried out, evidencing an improvement of the network strength, shear-thinning behavior and self-healing ability of the composite gels [2,5].

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Fabrication and Characterisation of GelMA/Keratin and GelMA/KerMA Hybrid Tissue Scaffolds by 3D Bioprinting

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ABSTRACT

Skin diseases that cause pain, damage, and infection to the skin are often used in tissue engineering studies. While these conditions can be addressed with different medications and antibiotics, dressing the affected area alone may not suffice. As such, an intervention for wound care should be introduced as early as possible using a more efficient approach. Natural polymeric hydrogels with multifunctional properties are highly desirable for enhancing the healing process of chronic wounds. An optimal photo-crosslinked skin covering, Gelatin methacryloyl (GelMA) can mimic the structure of the extracellular matrix (ECM). Nonetheless, pure GelMA hydrogel exhibits insufficient mechanical strength. Its application as a hybrid enhances its efficacy. Keratin, the world's third most abundant polymer, is a robust and filamentous protein. Keratin is a crucial constituent of mammals, reptiles, and bird hair, feathers, wool, nails, and horns. Furthermore, keratin waste is a valuable, renewable raw material, and it is necessary to expand the utilization of waste wool in order to add to its worth. By performing high-yield keratin extraction from sheep wool, keratin methacrylate can be derived through chemical modification of keratin. In comparison to keratin, keratin methacrylate demonstrates superior biocompatibility and cell adhesion properties. In the present investigation, a tissue scaffold system was fabricated, which includes GelMA, keratin, and keratin methacrylate to serve as cell and growth factor carriers for skin disorder therapy. The GelMA/keratin and GelMA/keratin methacrylate scaffolds will be assessed by comparing their swelling rate, biodegradation behavior, physical properties (FT-IR), chemical properties (DSC), morphology (SEM), and mechanical properties (tensile). Overall, it is believed that GelMA/keratin and GelMA/keratin methacrylate tissue scaffolds have potential as multifunctional patches for healing skin injuries via skin tissue engineering.

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Therapeutic Potential of Metallic Ion-Loaded Silica Mesoporous Nanoparticles and Bioactive Glass Nanoparticles

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Production of Individualized Symblepharon Rings

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ABSTRACT

This study aims to develop Gelatin Methacryloyl (GelMA)-based symblepharon rings with added L-ascorbic acid (Vc) and controlled release of vitamin for the treatment of the ocular surface, corneal healing, and epithelial growth acceleration, while also preventing possible inflammation. The patient's need for systemic Vc intake was eliminated, and potential problems such as dryness in the eyes due to ocular burns were prevented. In addition, problems such as the inability to manufacture commercially available symblepharon rings and the time-consuming delivery to the patient after production were facilitated by the 3D printing DLP technology to be used within the scope of the article, and personalized products were developed in a short time This innovative approach also facilitated the production of rings that exhibit superior flexibility and softness, and are amenable to the mechanical movements of the patient. As a result, it was aimed to alleviate the patient's discomfort and possible complications in terms of the ring's release mechanical durability, thermal, degradation, vitamin C release feature, and biocompatibility. Moreover, it was shown that GelMA hydrogel can be produced by 3D printing, which might promote epithelialization, is mechanically compatible with epithelial tissue, and provides a moist environment. Furthermore, the produced symblepharon rings possessed unique values, displayed innovative approaches, and contributed new data to the literature.

Keywords: Symblepharon rings; GelMA; L-ascorbic acid, DLP technology; cornea.

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CBD and Colostrum, a Combination with Anti-Inflammatory and Wound-Healing Potential

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ABSTRACT

Considering the various therapeutic components that cannabidiol (CBD), a plant-based product, and colostrum, an animal-based product, have, in recent years, there has been a growing interest in topical application of these two active ingredients. Developing four carbopol-based emulsions with the concentration of CBD varying from 0.5 to 4% and colostrum being used at a constant 5% was the main purpose of this work. It is known that colostrum has both lipophilic components, which were dissolved in almond oil, and hydrophilic ingredients dissolved in water in the 1% carbopol gel that forms the basis of the formulation. CBD is miscible in oils and is also incorporated in the almond oil used for dispersion. Cremophor EL, an U/A-type nonionic emulsifier, was used to emulsify the lipophilic phase in the hydrogel. Once the formulations were obtained, they were qualitatively evaluated by determining pH, stretchability (by the extensiometric method), and rheological properties (B-One Plus rheoviscosimeter, Lamy Rheology). The quantity of CBD present in the formulation did not affect the pH level, and all emulsions exhibited a pH of 6. Also, the variation in spreadability does not exhibit a significant correlation with CBD concentration. However, as the amount of CBD increased, there was a progressive increase in the viscosity of emulsions. The pH being biocompatible made the emulsions well tolerated when applied to the skin. Additionally, they exhibited favourable skin-spreading characteristics, which are commonly observed in gel systems, and the rheological properties provide insights into the impact of CBD on flow behaviour, with all formulations exhibiting attributes appropriate for topical application.

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Calcium and Phosphorous-Doped Zinc Oxide Nanorods Enhanced Antibacterial Ability and Osteoinductivity on Titanium Surface

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ABSTRACT

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Session VI. Advanced Material Processing and Applications (II)

ToF-SIMS Analysis of Nanostructured Layers: An Effective Approach for Assessing Functionalization

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ABSTRACT

Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS) has emerged as a powerful analytical technique for characterizing nanostructured layers. Herein, its key advantages in the context of nanostructured layer analysis are discussed. ToF-SIMS offers exceptional surface sensitivity, allowing for detailed investigation of the composition of nanoscale layers and depth profiling of layered materials. The high-resolution chemical mapping and quantitative elemental analysis abilities of ToF-SIMS are invaluable for uncovering the intricacies of nanostructured layers in scientific and industrial applications.

When dealing with functionalized nanostructured materials, a critical question is related to the binding of the functionalization, its distribution, or what modifications have occurred in the material. This means that when a material, such as TiO_2, is decorated with a protein or drug[1] or otherwise modified (e.g., doped layers [2]), a crucial question is whether it can be confirmed and ToF-SIMS can qualitatively respond to these questions; however, the accuracy of data interpretation is proportional to user knowledge.

However, the presence of such organics in the depth of the coating/nanostructure cannot be followed by depth profiles of x-ray photoelectron spectroscopy (XPS). For anodic TiO_2 nanotubes combined with organic compounds, such as proteins (bovine serum albumin, histone), ToF-SIMS depth profiles can follow the peptide backbone bond characteristic to proteins throughout the length of nanotubes (even for 7 μm long nanotubular structures)[1]. Similarly, ToF-SIMS sputter depth profiles can investigate the presence of doping elements in low amounts inside the anodic TiO_2 nanotubes (0.1.% Nb) [2] or of a secondary material deposited nanoparticles.

Figure 1 shows an example of a sputter depth profile in the negative polarity of a 500 nm thick TiO_2 nanotube layer [3], with the corresponding SEM image of a partially sputtered nanotube layer. ToF-SIMS sputter depth profiles of organic-coated nanostructures (*i.e.*, organic-inorganic hybrid coatings) or doped/decorated nanostructures can be used to check the coating composition throughout the layer qualitatively. This work aims to highlight the key points of ToF-SIMS data measurement and interpretation, further enhancing the participants' surface analysis skills and applicability to their research area.

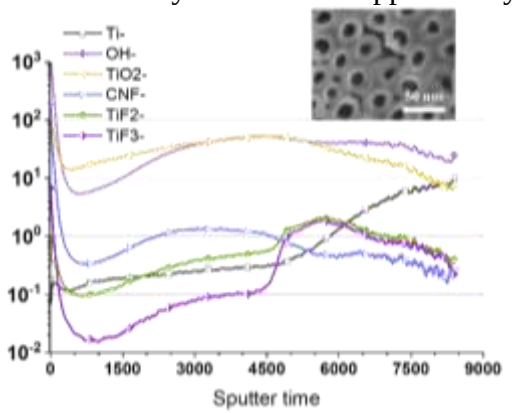


Figure 1 Negative sputter depth profile (selected mass fragments, 1 keV Cs) for a 15 nm diameter TiO_2 nanotube layer (500 nm thickness), inset - SEM top image of a partially sputtered layer

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Nanocellulose Production at Industrial Level: Status and Bottlenecks

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ABSTRACT

Nanocellulose is gradually gaining prominence because of its property-enhancing ability as a super additive in a large number of products; notably paper and packaging, food, medicine, composite materials, cosmetics, textile, energy and electronics and in many other materials. Nanocellulose-based composite materials find applications in the medical for artificial organs etc., as nanocellulose is biocompatible. The possibility of its use as antimicrobial material to combat the Corona virus has recently been advocated and if the technology can be advanced, it will carry immense importance .

Rapid progress has taken place in the production of nanocellulose in the last decade, achieving many milestones, taking it from laboratory stage to pilot plant and then upgrading to industrial scale. However, a few more milestones are remaining to be accomplished for mass scale production and applications.

Admittedly, the mass scale production technologies and applications of nanocellulose confront barrier of high-energy consumption and overall high cost. Efforts are going on to reduce the cost of nanocellulose production so as to have a product of affordable quality for wide scale applications. Fig. 1 summarises the different techniques employed in nanocellulose production. It can be seen in this figure that the mechanical treatment of purified cellulose produces normally the CNF and the chemical treatments result in CNC, while the biochemical treatment is meant for the BNC.

Thus there are five important methods for nanocellulose production as shown in Fig.1.

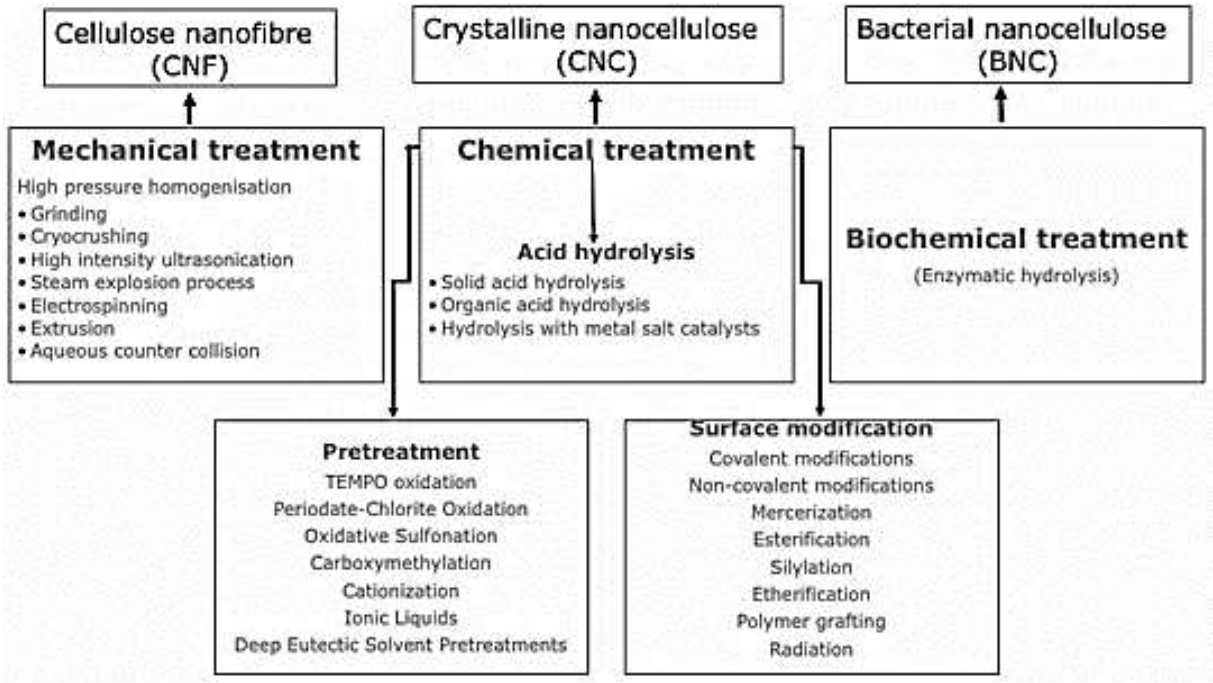


Figure 1: Different techniques used in nanocellulose production.

Some 30 techniques are shown in the figure, employed in nanocellulose production. Evolution of such large number of techniques is partly due to scientific curiosity and innovative interests of the researchers but there exist important applied objectives also, namely:

(i) Reducing energy cost,
(ii) Enhancing functional properties,
(iii) Environmental and Safety issues,
(iv) Corrosion and maintenance,
(v) Production of composites and other applications and
(vi) Techno-economic viability for industrial scale.

This paper critically examines the different production technologies to arrive at the techno-economically viable one for nanocellulose production at industrial level.

The Actualities and Perspectives of 3D-Printing Technologies in Radiotherapy

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ABSTRACT

Cancer, a complex and multifaceted disease, continues to be a significant global health challenge, affecting millions of lives worldwide. There were registered 18.1 million cancer cases around the world in 2020 [1]. Over the years, significant achievements have been made in understanding the molecular biology of cancer, diagnosing the disease and developing effective treatment strategies. Among these advances is the implementation of 3D-printing technologies (3D-PT) in oncology, especially in radiotherapy, that have revolutionized cancer management, offering immense potential in personalized treatment of the patients with different types of cancer.

Aim of the study: Determining and analyzing the use of 3D-PT in radiotherapy through their role and improvements in personalized medicine of cancer patients.

Materials and methods: a literature review was performed using scientific articles from Google Scholar, NCBI/PubMed, Frontiers, Nature, Science Direct, 3D Printing in Medicine databases for a period of 5 years. A visit was undertaken in the Department of Radiotherapy, Oncology Center of Greater Poland Voivodeship, Poznan, Poland.

Results: The review of the publications from online databases underlines the recent achievements in radiotherapy using 3D-PT in the management of cancer patients, including quality assurance phantoms, brachytherapy applicators, bolus, preclinical animal irradiation, compensators, and immobilization devices [2].

During the participation at ESO-ESSO-ESTRO-SIOPE Multidisciplinary Course in Oncology for Medical Students 2023, a visit was organized to the Department of Radiotherapy, Oncology Center of Greater Poland Voivodeship, Poznan, Poland [3]. There was observed and analyzed the process of making and testing 3D-printed applicators for cervical, prostate and skin cancers of finger and nose using CT-scans and *Beben - DICOM* to STL software [4].

Conclusion. 3D-printing technologies represent an innovative and practical way to promote and implement personalized medicine in the field of radiotherapy through individualized cancer management, educational and research purposes.

Key words: Radiotherapy, oncology, cancer, 3D printing, personalized medicine.

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Bioactive Surface Modification of Titanium Implants by Ultrasonic Micro-Arc Oxidation Process

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ABSTRACT

Over the past decade, bone tissue engineering has been at the core of attention because of an increasing number of implant surgeries [1]. Commercially pure titanium (Ti) is widely used in medicine due to its good biocompatibility, high chemical stability in the environment of tissue and body fluids, good fatigue resistance as well as high tensile and yield strengths [1]. Nonetheless, there is still a problem with no bioactivity of this material. One of the solutions to this difficulty is to generate bioactive coatings that have profitable effects on the adhesion, proliferation, and differentiation of bone cells [1].

In this study, the surface of Ti was modified by micro-arc oxidation (MAO) and ultrasonic MAO (UMAO) in an electrolyte containing 14 g/L calcium acetate hydrate and 3 g/L β-glycerophosphate disodium salt pentahydrate. The following process parameters were evaluated: 400 V, 450 s or 600 s, 120 mA/cm^2 or 60 mA/cm^2. Two ultrasound (US) operating modes (sinusoidal and unipolar rectangular wave) were employed. To obtain the characteristics of coatings, the following research was performed: 1) the morphology; 2) the elemental composition; 3) the surface wettability; 4) topography; 5) coatings thickness; 6) coating adhesion; 7) corrosion behavior and 8) the cytocompatibility with human osteoblasts.

Porous CaP-based coatings were successfully generated on Ti samples. All coatings were characterized by isotropic structure, hydrophilicity, a chemical composition similar to natural bone-building material, and showed good adhesion to the substrate. Further, UMAO coatings were characterized by an increased porosity and pore size as well as more extensive net structure and a larger number of volcano-like pores in comparison with MAO coatings. The UMAO process also enabled increased calcium incorporation into the coating, while the amount of phosphorus in the MAO and UMAO coatings was similar. The average roughness of the MAO coatings ranged from ~0.49 to ~0.52 μm, while the UMAO coatings ranged from ~0.57 to ~1.14 μm. Furthermore, the thickness of MAO coatings was in the range of 5.0–5.7 μm, since UMAO coatings ranged from 5.7 to 8.9 μm. We found that the most advantageous coating was obtained at a current of 136 mA, time 450 s, and unipolar rectangular US, as it exhibited properties that enabled beneficial effect on osteoblasts during *in vitro* studies.

The results show that the surface treatment of titanium using MAO and UMAO processes is directly related to the technological parameters used in these techniques. Their use is promising to improve the properties of commercially pure titanium materials, intended for biomedical applications, in particular for the modification of implants for (i) interspinal fusion or (ii) cranial-facial reconstruction [2].

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Cyclodextrin-Azobenzene Hybrids: Photoresponsive Self-Assembly and Co-Assembly with DNA

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ABSTRACT

The functionalization of cyclodextrins (CDs) at the secondary face with aromatic appendages has proven useful to preorganize the system for self- and co-assembly events, such as hierachical nucleic acid nanocomplexation.[1,2] Endowing these systems with the capability to react to external stimuli (pH, redox potential), to achieve spatiotemporal control of cargo release, represents an appealing challenge. In this work we have prepared CD derivatives that incorporate an azobenzene motif at a single secondary position, and tested the possibility of using azobenzene *E*/*Z* interconversion by light irradiation to activate/deactivate the formation of supramolecular structures.[3] Using spectroscopic techniques (UV-vis, circular dichroism, NMR) and computational studies, we have explored the photoswitching, supramolecular, and structural properties of these derivatives. We demostrated that the *E*-isomer self-assembles in aqueous media, forming stable face-to-face homodimers, while photoconversion to the *Z* isomer completely disrupts the supramolecular assemblies. In a further step, polycationic clusters were incorporated in the azobenzene-βCD hybrid . The resulting photoswitchable polycations formed <100 nm stable nanocomplexes (CDplexes) in the presence of plasmid DNA (pDNA) in the thermodynamically more stable state (isomer *E*). Interestingly, irradiation with a wavelength of 365 nm promoted extensive conversion to the metastable *Z* isomer, resulting in disruption of the nanocomplexes and subsequent pDNA release (Figure 1).

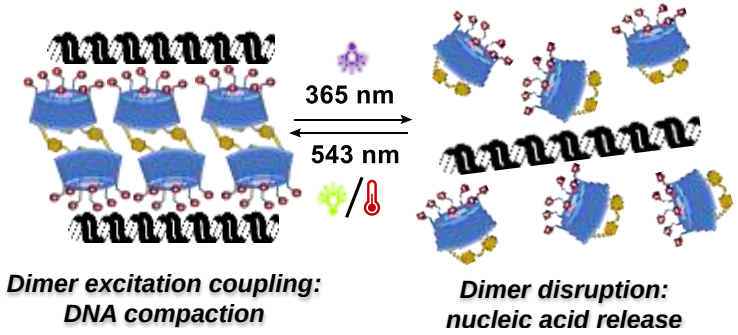


Figure 1. Schematic representation of the photoswitchable complexation/release of DNA by CD-azobenzene hybrids.

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ABSTRACT

We report on research devoted to the development of the concept of targeted delivery of pharmacological agents in combination with scintillating nanoparticles. To carry out research, LaF3:Tb/*Citr* nanoparticles were synthesized, for which complex physical and chemical studies, including dimensions and morphology, were carried out(TEM), surface properties (FTIR spectroscopy), thermogravimetric evaluation (TG/DTG/DTA) and X-ray structural analysis. Additionally, the specific surface area (SSA) and acid-base characteristics were determined. As a model photosensitive substance, $[Ru(bpy)_2(nic)_2]^{2+}$ (bpy = 2,2′ bipyridine, nic = nicotine) (RuBiNic) was used, which releases the pharmacological agent nicotine as a result of photolysis.

In the static mode, the peculiarities of the processes of adsorption immobilization of the RuBiNic complex on the surface of nanoparticles were investigated (T = 25°C, aqueous solution). Diffuse kinetics models, pseudo-first- and pseudo-second-order kinetic models, as well as Langmuir and Freundlich models were used to quantitatively describe the equilibrium adsorption processes.

The kinetics of RuBiNic adsorption corresponds to the mixed diffusion mechanism. The chemisorption process is the predominant process, as indicated by the higher correlation coefficient of the pseudo-second-order model. The data of fitting the adsorption isotherm according to the Langmuir adsorption model ($r^2 = 0.99$) also indicate chemisorption of the $[Ru(bpy)_2(nic)_2]^{2+}$ complex on the surface of LaF_3:Tb/*Citr* NPs (maximum adsorption capacity of 7.47 $mg \cdot g^{-1}$).

The research results can be used to clarify the conditions of adsorption immobilization of molecules of photosensitive substances on phosphor surfaces based on lanthanum fluoride. The LaF_3:Tb/Citr@RuBiNic system shows potential for promising applications in both photopharmacology and X-ray photodynamic therapy.

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Synthesis of Nanoparticles Using Green Method and Application

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ABSTRACT

The development of effective and environmentally friendly methods for the green synthesis of nanoparticles is a critical stage in the field of nanotechnology. The green synthesis approach to manufacture metal/metal oxide nanoparticles has gained attention due to marvelous properties governed by the synergistic effects of metal and phyto-constituents. We report the green chemistry method for extracellular synthesis of nanoparticles as Ag, Cu, ZnO and Cu_2O using leaves, seeds, or flowers extract as reducing and capping/ stability agents.

Furthermore, the complete characterization of nanoparticles has been studied using modern techniques like XRD, FTIR, Raman, FESEM, TEM, zeta potential, ... Besides, their activity catalytic are against dyes and practical application has been investigated.

The antibacterial activities of Ag, Cu nanoparticles solution against E.coli and S. aureus were investigated. The effect of nanoparticles on the antibacterial ability of commercial mouthwash was also investigated.

Because of the green conditions under which they are developed, these nanoparticles are very promising for potential application as catalytic in the treatment environment.

Session VII. Materials with Antioxidant, Antimicrobial, and Anticancer Properties

The Main Alkaloid of Piper Species: Piperine As An Effective Bioenhancer

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ABSTRACT

Piperine is the main alkaloid of Piper species, such as black pepper and long pepper, which are widely used as spices and traditional medicines. Piperine has been recognized as a bioenhancer, a substance that enhances the bioavailability of other drugs or nutrients by modulating their absorption, metabolism, or transport. Piperine acts as a bioenhancer by inhibiting various enzymes involved in drug metabolism, such as cytochrome P450, glucuronidase, and sulfotransferase. Piperine also increases the permeability of the intestinal epithelium and the blood-brain barrier, facilitating the entry of drugs into the systemic circulation and the central nervous system. Piperine has been shown to enhance the bioavailability of several drugs with different structures and therapeutic effects, such as antibiotics, anticonvulsants, anti-inflammatory agents, anti-cancer agents, and herbal compounds. Piperine has potential applications in improving the efficacy, safety, and cost-effectiveness of drug therapy. However, more studies are needed to elucidate the exact mechanisms, optimal doses, and possible interactions of piperine with different drugs and nutrients.

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Green Synthesis of Biocompatible Core-Shell (Au-Ag) and Hybrid (Au-ZnO and Ag-ZnO) Bimetallic Nanoparticles and Evaluation of their Potential Antibacterial, Antidiabetic, Antiglycation and Anticancer Activities

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ABSTRACT

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Production of Biomaterials with a Controlled Drug Release System Developed with a Hybrid System for Use in the Treatment of Larynx Cancer

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ABSTRACT

Squamous cell carcinomas of the head and neck region are the sixth most common type of cancer, accounting for approximately 650,000 new cases and over 350,000 deaths caused by the disease each year in the world. One of the most common subtypes of head and neck cancer is larynx cancer.

In laryngeal cancer, surgical intervention is necessary to remove the tumor and prevent it from spreading. Current treatments include chemotherapy and radiotherapy. However, these applications and alternative applications have various disadvantages. Highly toxic drugs used in chemotherapy, which are usually administered intravenously, also damage healthy body cells and cause serious side effects. In addition, patients who require long-term treatment require hospitalization, and after a while, they face the problem of thinning of the veins and difficulty in establishing vascular access. Considering these disadvantages, thanks to the active drug 'Doxorubicin' to be used in the hybrid drug delivery system prepared using bioengineering applications, malignant cells in the tumor area are destroyed and the formation of new malignant cells is prevented. Thus, metastasis is prevented. Thanks to these effects, it is a promising study for the treatment of laryngeal cancer [1].

The basic principle of the controlled drug release system is that the active drug is secreted into the specified tissue in the body in doses arranged for the patient at certain time intervals.

In this study, it was aimed to place a hybrid drug delivery system loaded with chemotherapeutic drugs, analgesics and antibiotics created by Electro-spinning and 3D printing techniques in this region in order to prevent the formation of a new tumor in the tumor area removed from the larynx by surgical procedure.

In this project proposal, 3 layers containing different drugs and drug loading with different techniques were designed. These layers will be created by Electro-spinning and 3D printing methods. Another difference is that the project proposal aims to load the system with painkillers and antibiotics as well as chemotherapeutic drugs, taking into account conditions such as fever and pain that may occur due to cancer, instead of just meeting the patient's chemotherapy needs.

Controlled drug release systems increase the efficiency of treatment by reducing the toxicity caused by drugs in the long term. In addition, local application does not require continuous dosing, unlike traditional delivery systems. The biomaterial to be placed in the body must be biocompatible as it should not cause any physiological response with the tissues it is in contact with. Since it will be implanted in the larynx, it should not prevent the organ from performing its functions [2].

In response to any infection or pain that may occur locally as a result of the implantation of the intended biomaterial into the organ, antibiotics and painkillers are added to the biomaterial produced with 3D printing technology by the electrospinning method. Doxorubicin (DOX), a drug used in chemotherapy treatment and called cytotoxic (cancer cell killer), is a widely used chemotherapeutic drug that induces DNA damage. This drug causes actively growing cells such as cancer cells to slow down or stop their growth. It also increases the likelihood of these cells dying. This treatment helps selectively kill cancerous tissue rather than normal and healthy tissues. It can be used in both adults and children. ibuprofen ; It is a widely used

medicine in many countries to relieve the symptoms of pain, inflammation and fever. Amoxicillin is effective against microorganisms and is also an antibiotic with a bactericidal effect. They have a wide range of effects because they are effective on many types of bacteria. The mechanism of action of amoxicillin is based on the principle of preventing bacteria from showing their bacterial properties by inhibiting the function of the cell wall. Amoxicillin is the most preferred antibiotic because it is not affected by low pH, its absorption is independent of hunger and satiety, reaches its maximum blood level within two hours and remains at an effective concentration for 8 hours. Amoxicillin binds to blood proteins at low rates and is distributed in effective concentrations into body tissues and fluids.[28] It is aimed to achieve this distribution by calculating the appropriate dosage with the controlled drug release system mechanism to be produced, taking advantage of the fact that its use with PVA polymer does not cause any negative effects.

In the treatment idea presented in the project, the Polyvinyl Alcohol (PVA)-based drug-releasing biomaterial produced by 3D printing will be loaded with anticancer Doxorubicin (DOX). PVA is a polymer that is soluble in water and has no toxic effects on the human body. PVA has excellent biocompatibility and safety and has received FDA approval for clinical uses in humans. As a result of the research, PVA has begun to be used in various bioengineering fields, including contact lenses, artificial organs and drug delivery systems [3,4,5]

The produced biomaterial is intended to be coated with Amoxicillin as an antibiotic on the upper layer and Ibuprofen as a painkiller on the lower layer, using the electrospinning method. The aim of this hybrid system is to replace the surgically removed tumor area and prevent local recurrence of cancer. At the same time, it is aimed to prevent infections and pain that may occur with drugs loaded with electrospinning.

The controlled drug release system design proposed in this project is a very innovative design. Considering the increasing number of cancer cases today and the negative physical and psychological damage caused by chemotherapy, it will have a significant positive impact on the lives of many people. If the project is successful, cooperation can be made with countries working in the fields of tissue engineering and bioengineering, especially Japan and European countries [6,7]

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Magnetic Nanoparticles Based on Iron Oxide and Biotin-Functionalized Chitosan for Breast Cancer Therapy

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ABSTRACT

Breast cancer is a leading cause of morbidity and mortality in women, with more than 2.3 million women diagnosticated each year and nearly 700.000 dies of the disease. Chemotherapy is still one of the most effective treatment, but its success is usually hampered by a major obstacle, multi-drug resistance (MDR) [1]. In this context, over the last decade, the use of nanoparticle-based multi-drug combination therapy has greatly evolved. This method is based on combining and releasing of two active principles that acts through non-overlapping molecular mechanisms, reduce the occurrence of MDR and maximize tumor destruction. For instance, one agent can act as a competitive inhibitor for the efflux transporter and therefore, improve the anti-cancer activity [2].

Complex magnetic nanoparticles based on iron oxide core, usually magnetite - Fe_3O_4, and functionalized biopolymers have been proposed as suitable candidates for delivery nanosystems. In this regard, the aim of this study was to obtain and characterize magnetic nanoparticles based on iron oxide and fluorescent biotinylated N-palmitoyl chitosan, by combining the self assembly ability of the polymer, with ionic gelation, in the presence of magnetite and the two active principles (Docetaxel, Verapamil), and to evaluate the formulation potential applications in breast cancer therapy.

Surface modification of magnetic nanoparticles is an essential aspect for their use in biomedical applications. The attachment of biotin to the amphihile chitosan induces targeting abilities of tumour cells due to the large number of biotin receptors on the surface of breast tumour cells [3].

The obtained nanostructures were compositionally characterized with infrared spectroscopy, which indicated the presence of specific bands for the biotinylated polymer, the fluorescent marker, but also for the active principles. Dinamic light scattering results indicated nanometric dimensions, a polydispersity index of 0.25 and a positive Zeta potential. Magnetic nanoparticles presented a pH-dependent release of active principles. A Live/Dead assay, performed in spheroids obtained by encapsulation of MCF-7 cells in a hydrogel matrix, confirmed a high ratio of dead to live cells, and the potential of the prepared complex nanoparticles in breast cancer therapy.

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Polyurethane Coatings for Wooden Heritage Preservation Based on Environmentally Friendly Polyols

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ABSTRACT

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Ovalbumin-Loaded Paramagnetic Nano-Triangles for Enhanced Dendritic Cell Stimulation, T_1-MR Imaging, and Antitumor Immunity

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ABSTRACT

Vaccine-based cancer immunotherapy has demonstrated a significant potential for cancer treatment in clinics[1]. Although the efficiencies of vaccines are limited, they can be enhanced by a well-designed antigen delivery system that promotes sufficient antigen presentation of dendritic cells (DCs) for initiating high T cell immunity. Herein, antigen-loaded manganese oxide (Mn_3O_4) triangular-shaped ultrasmall nanoparticles were prepared to stimulate DC-based immunotherapy under the guidance of T_1 magnetic resonance imaging. The FDA-approved triblock copolymer Pluronic® F-68 was used not only to transfer the phase from hydrophobic to hydrophilic, but also to enrich antigen loading and improve the biocompatibility of the prepared nanoparticles. Ovalbumin (OVA), a model antigen, was adsorbed on the surface of polymer-coated nanoparticles through electrostatic interaction to form Mn_3O_4@PF68-OVA nanoparticle-antigen complexes that aimed to stimulate DC-based immunization and antigen-specific T cell immunity. The Mn_3O_4@PF68-OVA nanovaccine (NV) induces negligible toxicity effects against 4T1 and bone marrow-derived dendritic cells (BMDCs) by conventional methods supports the proliferation of intestine organoids, which are an innovative three-dimensional cytotoxicity evaluation system, thereby indicating their potential safety for *in vivo* cancer therapies. The designed paramagnetic nanovaccine possessed excellent OVA delivery to dendritic-regulated antigen-specific T cells *in vitro* by stimulating the maturation level of BMDCs. In addition, Mn_3O_4@PF68-OVA NVs enhance immunity *in vivo* by increasing the T-cells and M1 macrophages, which suggests improved humoral immune responses. Excitingly, vaccination with Mn_3O_4@PF68-OVA offer complete protection in the prophylactic group and significant tumor inhibition in the therapeutic group against B16-OVA tumor. In addition, the designed nanovaccine demonstrated high T_1-MR Imaging in the tumor, further justifying enhanced tumor accumulation and capability to real-time monitor the treatment procedure. This study presents a promising nanosystem to design an effective nanovaccine for T_1-MR imaging-guided tumor immunotherapy[2].

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Flow and Kinetic Studies of Photocatalytic Ciprofloxacin Degradation in a Falling Film Microreactor

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ABSTRACT

The combination of experimental and numerical investigations of flow regime, mass transfer, and reaction kinetics in microstructured devices has opened new perspectives towards process intensification [1, 2]. In this study, falling film microreactor prototype (Little Things Factory, Elsoff, Germany) with 64 open microchannels (with the dimensions of 100 mm length, 0.5 mm depth, and 0.9 mm width) was studied for photocatalytic applications.

First, both the split & curve structure and microchannels were coated by TiO_2 (P25) layer *via* suspension deposition method. The coated layer was characterized by Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Diffuse Reflectance Spectroscopy (DRS) and N_2 adsorption before and after deposition. The operating inlet flowrate range was determined experimentally *via* pulse input tracer experiments using fluoresecein as fluorecent tracer ($C_{20}H_{12}O_5$). To have an overview on the flow behaviour in the mirochannels, 2D and 3D simulations were implemented in ANSYS Fluent (2023, R1) in a representative section of the microchannel using the Volume of Fluid (VoF) multiphase method. The influence of inlet flowrate, side walls, inclination angle of the reaction plate (i.e. 15, 35, 75°) on flow situation and film stability was studied. The simulation results were validated by experimental (i.e. estimated maximum velocity based on the pulse input tracer experiments) or/and empirical results (i.e. film thickness values, maximum velocity, etc.). As second step, our research efforts were aiming to study the photocatalytic degradation of ciprofloxacin in aqueos solution.

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Physicochemical Characterization of Amino Acid-Modified Magnetite Nanoparticles for Oncologic Drug Delivery

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ABSTRACT

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Poster Sessions

Antibacterial Packaging Films from Cellulose with ZnO Nanoparticles Loaded with Orange Essential Oil

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ABSTRACT

Active antimicrobial food packaging systems are supposed not only to passively protect food products against environmental factors, but also to inhibit or retard microbial growth on food surfaces, extending food shelf life. This study aimed to obtain biodegradable packaging films with antimicrobial properties for enhanced food security. To attain this objective, we have used carboxymethyl cellulose (CMC) reinforced with ZnO nanoparticles (NPs), loaded with orange essential oil (OEO).

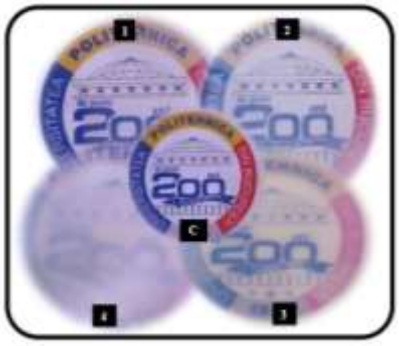


Fig.1 The transparency for CMC 1-4 and C(control) films.

The cellulose is an abundant natural biodegradable polymer, renewable and sustainable, but with no antimicrobial properties. In order to generate antibacterial properties, the cellulose films must be loaded with antimicrobial agents. The ZnO improve the mechanical and barrier properties of cellulose films, the NPs acting as crosslinking points between polymer chains. In order to enhance the antimicrobial properties and decrease the amount of antibacterial agents used, we have loaded the ZnO NPs with OEO (a limonene rich natural source). The addition of OEO is enhancing the water vapor properties (WVP) of the film. We have obtained a series of four cellulose-based films with antimicrobial activity, containing ZnO from 3 to 11% and ~9% OEO. The films were obtained by casting method in Petri dishes. The characterization of the films was made by scanning electron microscopy (SEM), thermogravimetry (TG), scanning differential calorimetry (DSC), fluorescence (PL), ultraviolet (UV), visible and Fourier transform infrared (FTIR) spectroscopy and microscopy, as well as antibacterial activity determination on both Gram-positive and Gram-negative bacterial strains. The antibacterial properties indicate a synergic activity of ZnO NPs and OEO, the probable mechanism implying that OEO is sensitizing the cellular membrane, make it more sensible to the ZnO activity.

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Copper Ions Detection in Water and Wheat Leaves Using a Fiber Optic Based Plasmonic Sensor

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ABSTRACT

Copper is an essential trace mineral necessary for survival, playing an important role in the human metabolism [1]. The excess of copper ions ($Cu^{2+)}$ might cause hepatotoxicity, neurodegenerative diseases and Wilson's disease [2]. Therefore, the Cu^{2+} trace detection is of great importance in the fields of health [3] and environmental monitoring [4]. There are many methods for the detection of such heavy metals in solution, including high-performance liquid chromatography, atomic absorption spectroscopy electrochemistry, colorimetry and the surface plasmon resonance (SPR) method [5]. Among all the detection technologies, the fiber optic (FO) sensor which is based on the SPR phenomenon has been intensively studied recently, due to its small size, the possibility of rapid, sensitive, real-time, label-free and on-site detection, among other advantages [6].

In this research work, FO-SPR sensors were fabricated and covered with a polyaniline (PANI) film, a receptor layer that is specific for the detection of Cu^{2+} both in water and in the chlorophyll extract from young wheat. The PANI conductive polymer was coated on the gold sensor surface using a chemical oxidative polymerization protocol [6]. The results demonstrated that the PANI/Au coated FO-SPR sensor was able to detect Cu^{2+} with a low limit of detection in both media. In addition, this portable plasmonic tool is cost-effective and small in size, making it suitable for on-site applications outside the laboratory area.

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Extraction of Calcium Carbonate from Oyster Shell and its Application to Synthesize a Biodegradable Film

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ABSTRACT

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Nanosensor for Phytopathogen Detection

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ABSTRACT

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Synthesis of a Highly Sensitive Al-Doped ZnO Thin-Film Sensor for H_2S Gas Detection

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Camel Milk Casein as a Natural Emulsifier Agent

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Versatility of Cold Plasma Technique for Starch Processing

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ABSTRACT

Starch is a complex carbohydrate with applications in traditional sectors, such as food, papermaking, and textiles, as well as next-generation fields, such as biomaterials, nanotechnology, and tissue engineering [1]. However, in its native form, it exhibits certain functional shortcomings, including low solubility in water, retrogradation, syneresis, poor thermal and rheological properties [1,2]. Over the last decade, cold radiofrequency (RF) plasma, also known as non-thermal plasma, has emerged as a promising technique for modifying various materials, including starch. This technique shows the potential to overcome the limitations of starch and enhance its properties [3]. It involves the exposure of starch to low-temperature plasma, leading to structural and functional changes in the starch molecules. However, the complete influence of input parameters, such as exposure time and RF power, on the treatment outcomes is not entirely understood. Moreover, the significance of vacuum levels during plasma processing in starch modification using cold plasma has not been considered yet. Hence, the present study investigates the role of vacuum levels in the process of starch modification utilizing the RF plasma technique. Starch samples underwent RF plasma treatment under uniform conditions, with variations solely in the duration of vacuum exposure. Subsequently, an evaluation of various properties, such as water content, pH, rheological parameters, spectral features, etc., was conducted for the processed samples. The findings revealed significant differences in the properties of starch depending on the applied vacuum levels during RF plasma processing. These results suggest that the vacuuming process could be crucial in determining the type of reaction induced in starch granules during RF plasma processing. A deeper understanding of the impact of vacuuming on starch treatment could aid in refining the RF plasma process to achieve the desired modifications in starch effectively.

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Keywords: corn starch, functionality, input parameters, non-thermal plasma, vacuuming

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Total Concentration of Phenolic Compounds and the Antioxidant Activity of Grape Must after Treatment with Hydroalcoholic Extracts from Plant Waste Enhanced with Silver Nanoparticles

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ABSTRACT

The authors did not agree with the publishing of the abstract.

Customized Nanoplatform for Electrochemical Detection of Cortisol

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ABSTRACT

Cortisol (COR) is a glucocorticoid hormone that plays numerous important roles in the organism, mediating cellular and humoral immune response, and controlling the organism's response to stress, glucose homeostasis, and protein metabolism. COR is secreted in several biological fluids and its levels vary in physiological and pathological conditions which justifies the importance of detecting this analyte for the diagnosis and monitoring of several disorders. In this regard, the development of electrochemical sensors represents a suitable approach due to their advantages such as rapid, low-cost detection in unconventional biological samples, such as saliva or sweat, with high sensitivity and specificity and suitability for miniaturization with prospects for wearable devices and *in situ* analysis (1), (2).

The objectives of this study were to obtain flexible, in-lab-printed electrodes and apply them for the development of an aptasensor for COR detection in real samples.

Flexible electrochemical cells were in-lab printed by using special conductive and insulating inks. Then, the working electrodes were modified using a nanocomposite based on Au and Pt to increase the sensitivity and an aptamer to increase the specificity for COR detection. The aptamer was bound via thyol-gold chemistry to the functionalized electrode using multipulse amperometry. A thiol with a linear chain, mercaptohexanol, was used to block the active sites left unoccupied by the aptamer, to minimize the non-specific adsorption of species present in real complex matrices such as biological fluids. Lastly, the aptasensor was incubated with COR. All modification steps were confirmed using cyclic voltammetry, electrochemical impedance spectroscopy. The detection of COR was carried out via cyclic voltammetry . The elaborated platforms were characterized, analyzed regarding the analytical performances and will be used for real samples analysis.

In conclusion, a customized platform was designed for the specific electrochemical detection of COR and it can be applied for the detection in real samples.

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Cu(II) Complexes of N-cyclohexylthiosemicarbazone of 3-ethoxysalicylaldehyde, Molecular Docking Simulations and Antitumor Activity

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ABSTRACT

Thiosemicarbazones are a class of organic compounds with remarkable biological properties. Of great interest is their use as ligands coordinated with biometals such as Cu, Fe, Co, Mn. These complexes show good antimicrobial, antioxidant and anticancer properties. The copper complex with N-cyclohexylthiosemicarbazone of 3-ethoxysalicylaldehyde was chosen for this work. A detailed description of its synthesis is presented in source 1. Molecular docking was performed for initial evaluation of the anticancer potential of the synthesised substance. Ribonucleotide reductase and HER2 protein (responsible for HER2 positive breast cancer) were selected as targets.

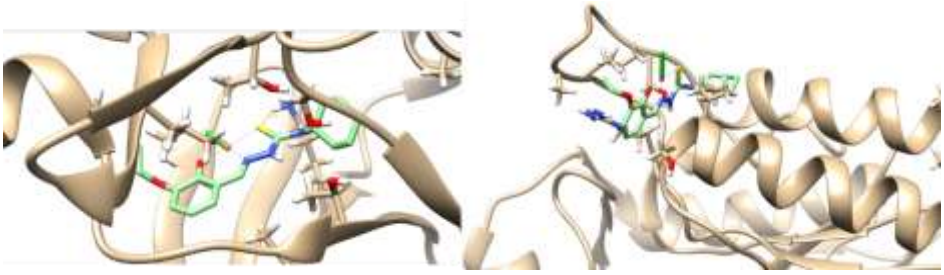


Figure 1 [Cu(HL)Cl] in active site of Her2 protein (left) and Ribonucleotide Reductase (right)

As can be seen in Table 1, with both proteins the complex has quite good results. The binding energy of the complex with Her2 protein is -8.2, which is at the level of existing inhibitors. This determines a high probability of good anticancer activity of this substance.

Table 1 Molecular docking of [Cu(HL)Cl] with target proteins

	Her2 protein	Ribonucleotide Reductase
Binding energy, kcal/mol	-8,2	-6,9

Based on the work done, it can be concluded that the synthesised complex has high potential of having anticancer activity. This justifies their further research.

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Hyperbranched Structure Formation via Self-Assembly of a De Novo Designed Peptide

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ABSTRACT

A novel peptide mutant derived from a previously studied native pentapeptide having a sequence selected from hen egg white lysozyme, FESNF-NH_2, was synthetized and purified [1]. Thus, a single point mutation of the central serine from the native peptide with tyrosine was performed. The synthesis of the amidated peptide FEYNF-NH_2 (where F-phenylalanyl, E-glutamyl, Y-tyrosil, N-asparaginyl) was achieved through Solid-Phase Peptide Synthesis (SPPS) method, utilizing the Fmoc/tBu strategy, as detailed in previous studies [2,3]. Purification of the newly synthesized FEYNF-NH_2 peptide was accomplished by Reverse-Phase Solid-Phase Extraction (RP-SPE) using a water-methanol gradient in conjunction with UV detection [4]. Qualitative analysis of the raw peptide was assessed using Reversed-Phase High Performance Liquid Chromatography (RP-HPLC). Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometry (MALDI ToF MS) was employed to validate the peptide's molecular weight. Additionally, the mutant sequence was confirmed by tandem mass spectrometry using Collision Induced Dissociation (CID), in positive mode.

Furthermore, we carried out a preliminary study to investigate the modified peptide' self-assembling behavior. Significantly, the peptide distinguished by its ability to self-assembly under simulated physiological pH and temperature conditions. Hyperbranched structures, characterized by a highly ramified, large-scale dendritic pattern, were captured through Polarized Optical Microscopy (POM) [5]. This study provides an initial insight into the substantial impact of tyrosine substitution on the structural characteristics of peptides, emphasizing its potential implications for diverse applications in advanced materials development and biotechnology.

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Green Synthesis of MIL-100 (Fe) for Hydrogen, Carbon Dioxide and Water VaporSorption

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ABSTRACT

Metal-organic frameworks are porous crystalline materials with extremely high surface area, pore volume,and tunable surface features, making MOFs ideal candidates for gas storage applications, *e.g.* hydrogen, carbon dioxide and water vapor [1]. In the present study, the iron-based MOF MIL-100(Fe) was synthesizedby hydrothermal method in a Teflon-lined autoclave. The synthesis is HF-free and the iron (III) nitrate nonahydrate has been used as precursors. The produced MIL-100(Fe) is composed of a trimeric iron coordinated by a benzene -1,3,5- tricarboxylic linker. The effect of washing protocols on the properties and crystallinity of MIL-100(Fe) has been investigated.

The adsorption capacities of MIL-100(Fe) towards hydrogen, carbon dioxide and water vapor has been measured. The excess gravimetric capacity for hydrogen and carbon dioxide was measured by a high-pressure volumetric gas sorption analyzer. Whereas the a dynamic vapor sorption (DVS) analyzer evaluated the water vapor sorption capacity. Furthermore, the MIL-100(Fe) was characterized by powder X-ray diffraction (XRD), N_2 adsorption/desorption isotherms and Fourier transform infrared (FT-IR) spectroscopy. XRD and FTIR results showed an agreement with the literature data [2], confirming the synthesis of the desired MOF.

The efficiency of the washing protocol was demonstrated to be effective in increasing the crystallinity degree of the material. Type I isotherm is observed in N_2 adsorption isotherm, and the synthesized MIL-100(Fe) has a specific surface area of 1199 cm^2/g and pore volume of 0.48 cm^3/g. The hydrogen adsorption in MIL-100(Fe) is dominated by weak Van der Waal forces. As a reference, hydrogen excess gravimetric capacity at 278K and 40 bar is around 0.25 wt%. Adsorption/desorption isotherms of carbon dioxide showed a reversibility of the physisorption process. Water adsorption isotherm showed steep adsorption at P/Po = 25% and P/Po= 40%, the results render MIL-100(Fe) as a suitable candidate for heat storage applications**.**

These preliminary results make the MIL-100(Fe) an interesting candidate for gas sorption applications. Thegreen route of washing MOF could extend its utilities to industrial-scale applications. Further studies are ongoing for better assessing the materials storage capacity under different conditions.

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The role of the Zinc Oxide Nanoparticles Biofunctionalized by Sulfated Polysaccharides on the Human Immune Cells in Patients with Pulmonary Tuberculosis

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ABSTRACT

Biological active compounds (BACs) extracted from Spirulina (Arthrospira platensis), sulphated polysacharides (SPS) biofunctionalized by Zinc oxide nanoparticles (ZnONP) provide pharmacological benefits thorugh the modification of the biological properties. The aim of the research was to assess comparatively the impact of the ZnONP on the modulating activity of the SPS compared with pure SPS on the functional activity of the human immune cells (lymphocytes) through *in vitro* experiments using the peripheric blood on the patients diagnosed with pulmonary tuberculosis (TB). Material and methods: propylene glycol coated ZnO NP with the size of 10-15 nm were bought from Sigma Aldrich (GMBH, Germany) and the strain of cyanobacterium *A. platensis*-CNMN-CB-02 obtained from the National Colleaction of Nonpathogenic Microorganism were used as a source of SPS with the concentration of 5 mf/mL. The biofunctionalisation of ZnONP was performed by adding 100µg of ZnO NP to 10 mL of SPS. The lymphocytes were extracted from veinous blood of 65 patiets diagnosed with pulmonary TB, which were distributed in the study group (SG) constited of 34 patients with drug resistant TB and control group (CG)-31 patients with drug susceptible TB. The functional activity was assessed thorugh the test of blast transformation reaction of lymphocytes (BTRL) to mitogen – phytohemagglutinin (PHA) at the concentration of 0,01 mL added to 1.0 ml of culture medium of lymphocytes and compared with of the ZnO ZnO NP SPS and SPS. For evaluation of the immune modulating activity 30 µL ZnONP SPS and 30 µL of purified SPS were added simultaneously with PHA in each experimental tube. The lymphocytes proliferation index was assessed before and after the exposure to PHA without BACs, with BACs (SPS) and ZnO NP SPS, and was expressed as immune modulating index (IMI). The IMI was calculated by reporting the BTLT indices before and after the exposure to BACs. If the IMI value was ≤ 0.8 the effect was inhibiting, if ≥ 1.2 was – stimulating, and the range between 0.8 and 1.2 was neutral. The exposure to BACs increased the BTRL , but the significant threshold was achieved only in the CG. The IMI increased in both groups exposed to BACs (1.19±0.014 for CG exposed to SPS, 1.23±0.011 for CG exposed to ZnO NP SPS, 1.29±0.005 for SG exposed to SPS and 1.32±0.005 for SG exposed to ZnONPs SPS, but the statistical threshold between the indices before and after exposure to BACs was achieved only in the SG exposed to ZnONP SPS ($p<0.05$). Conclusions: an immune modulating effect was proved for both evaluated BACs, however a higher level was obtained in the group of patients with drug-resistant tuberculosis, more expressed under the influence of the ZnONPs SPS.

Preparation of Alginate-Based Nanocomposite Wound Dress with Anti-Inflammatory and Antibacterial Effect

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ABSTRACT

In this research, we show how alginate, essentiel oil, and AgNPs films can be used to create a medical dressing. Cream made with oil taken from various medicinal herbs was used to manufacture the dressing. After that, the cream was combined with alginate and silver nanoparticles (AgNPs) nanoparticles created using a green approach.

UV-visible spectroscopy, X-ray diffraction, and transmission electron microscopy were all used to learn more about the nanoparticles. The possible medical use of the film was looked into by testing its antibacterial activity against human pathogenic gram-negative (*Escherichia coli*) and gram-positive (*Staphylococcus aureus*) bacteria. The film's anti-inflammatory efficacy was further examined in in vivo testing with animal models.

The results showed that the film was homogenous and compact in structure while also being somewhat flexible. The film was found to have potent antimicrobial, and anti-inflammatory properties, as verified by the results of the biological activity tests. Therefore, the dressing film has excellent therapeutic potential, especially for use in wound healing.

Keywords: Dressing film, alginate, Silver nanoparticle, antibacterial, and anti-inflammatory activities.

Loading of Tetracycline In Cage-Type Mesoporous Silica Nanoparticles FDU-12 and Release of It in SGF

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ABSTRACT

The using of mesoporous silica nanoparticles (MSNs) as drug delivery systems is not dating from relatively long period, with more precise from 2001 [1], since then MSNs has attracted attention due to their interesting properties such as high surface area, pore size controllability, good biocompatibility. Also MSNs has a high versatility for surface functionalization in the aim to increase the amount of active compound which is incorporated in their matrix or to release it in a more controllable manner. [2]

In this study three types of MSNs FDU-12 with cage-type structure was used: without any functionalization (FDU12), functionalized with amino groups (FDU12-NH_2) and functionalized with N-polyacryloyl morpholine (FDU12-PNAM). Loading of tetracycline was done using the vacuum-assisted method, the incorporation capacity of tetracycline was evaluated by FT-IR spectroscopy and thermal analysis TG-DSC. The release of tetracycline was done in Simulated Gastric Fluid (SGF) and the concentration of antibiotic was monitorized using a HPLC-DAD method for a few days using a mobile phase constituited from phosphate buffer solution:ACN:MeOH and a C_{18} chromatographic column. [3]

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Polysaccharide-Derived Hybrid Formulations for Full-Thickness Skin Wound Healing

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ABSTRACT

Polysacharide scaffolds have received extensive attention in tissue engineering and regenerative medicine [1], while it is still a challenge to develop an ideal dressing for adapting the dynamic wound healing progression [2]. Composite scaffolds comprised of chitosan (CS), carboxymethyl chitosan (CMC), gelatin (Gel) and carboxymethyl guar gum (CMGG) were prepared by sodium trimetaphosphate cross-linking reaction in mild conditions. Polysaccharide scaffolds (CS/Gel, CMC/Gel and CS/CMGG) at various concentrations were developed and characterized to assess their physiochemical properties. Attenuated total reflectance Fourier transform infrared (ATR-FTIR) spectroscopy studies, scanning electron microscopy (SEM) and X-ray diffraction (XRD) were used as analytical techniques for characterization of the wound dressing networks. The prepared scaffolds were evaluated for the appropriate swelling behaviour in different media and cytocompatibility. Further, we performed animal studies and explored the tissue regeneration effects of the obtained dressings for 21 days. The tested dressings exhibited an accelerated wound closure rate and promoted colagen formation in a rodent full-thickness skin excisional model. In this study we observed a faster wound healing effect within the studied period of the carboxymethyl guar gum and chitosan networks when compared with an alginate commercial dressing.

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In vitro Study of Biocomposites Based on Natural Hydroxyapatite and Modified by Magnetite and Chitosan for Medical Use

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ABSTRACT

Hydroxyapatite (biogenic/natural (BHA) and synthetic) is one of the most widely used material for filling bone cavities due to its excellent biochemical and physical properties similar to bone tissue. It is used in orthopedics, traumatology, and dentistry in the form of powders, dense and porous materials, and composites. The latter have been of especial interest of researchers as modification of hydroxyapatite by organic or inorganic additives allows the creation of new biomaterials with optimized properties.

In our previous works we described synthesis, phase composition and structure as well as the rate of resorption of BHA/magnetite/chitosan composites after 2 and 31 days of interaction with physiological solution (saline, 0.9 % NaCl) and showed the absence of cytotoxicity [1-3]. But investigation of kinetic of interaction composites with physiological solution has not been carried out. The aim of the present work is a comparative *in vitro* study of BHA/magnetite/chitosan composites (BHA/magnetite, wt %: 99/1, 95/5, 75/25 , 50/50) in saline for 2, 10, 16 and 31 days at 36.5±0.5 ºC with further control of their specific surface area (Gemini 2360 instrument), density (AccuPyc II 1340 helium pycnometer), phase composition (DRON-3 X-ray diffractometer) and structure (Tescan Mira 3 LMU microscope) as well as pH and elemental composition (Expert 3L analyzer) of the filtrates. Magnetite used for composites preparation [3] was obtained by chemical precipitation for 5 minutes and thermolysis in a nitrogen media [4].

It has been established that after interaction of composites with saline the composites resorption occurs, which is confirmed by a change in pH, mass loss, increase in the specific surface area, and decrease in the particle size. Regardless of the time of experiment, the higher amount of magnetite, the higher dissolution rate that confirm previous data [1]. At the same time, the resorption rate of composites, in comparison with pure BHA, increases with the addtition of more than 5 % magnetite. Moreover, the resorption rate of composites modified by magnetite obtained by thermolysis is ~ 2 times lower than that one for composites contained by magnetite obtained by precipitation. For all composites, the most intense resorption occurs in the first 2 days due to the active release of Ca^{2+} and PO_4^{3-} ions into saline, followed by a gradual slowdown and stabilization by 15-16 days. The above results in combination with structural and magnetic properties, as well as the absence of cytotoxicity make the obtained materials promising for further clinical and laboratory studies as materials for medical application.

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Predictive Model for Universal Stress Proteins (USPs) in Mycobacterium tuberculosis (Mtb)

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ABSTRACT

The adaptation of Mycobacterium Tuberculosis to varied environmental stresses is a fundamental aspect of its pathogenesis and survival. Universal Stress Proteins (USPs) have emerged as pivotal players in this adaptive response, with their expression triggered by an array of stressors. Consequently, the identification and characterization of these USPs have garnered substantial interest within the field. In this study, we propose a novel approach to predict USPs using a Support Vector Machine (SVM) model, aiming to enhance our comprehension of Mycobacterium Tuberculosis' stress adaptation mechanisms. The universal stress proteins (USPs) of Mycobacterium tuberculosis (Mtb) play a pivotal role in the bacterium's ability to withstand diverse stress conditions and establish persistent infections in the host. Unraveling the functions and regulatory mechanisms of USPs is of paramount importance in understanding Mtb's pathogenicity and devising targeted interventions against tuberculosis. There is a need to provide a data-driven, scalable approach to predict USPs from Mycobacterium tuberculosis based on learned patterns and features extracted from protein sequences and properties. Protein sequences, that are annotated with both USPs and non-USPs, of 5,900 amino acids were obtained from the UniProt and NCBI protein database within the range of ten years. 3,082 of the amino acids were from the 600 Non-USPs while 2,818 were from the 58 USPs. Data preprocessing was performed on both class of dataset and feature extraction techniques was used to transform raw protein sequences into numerical representations suitable for SVM training. Such evaluation matrices as Precision, Recall, F1-Score and Accuracy were used to evaluate the model performance. Additionally, we implemented 10-fold cross-validation for robust model evaluation and performance assessment. The model was able to predict a 98% accuracy of universal stress protein sequences from Mycobacterium tuberculosis which show practical implications of the SVM model's performance in predicting USPs and its potential for supporting further research on Mtb's stress response mechanisms.

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The Influence of Boron Precursor on Borate Bioactive Glasses Properties: Structural and Bioactivity Investigation

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ABSTRACT

Borate bioactive glasses (BBGs), known for their high chemical reactivity, create new possibilities in the field of tissue engineering. Due to their fast degradation rate and ion release (e.g. boron and calcium) into the surrounding tissue, BBGs support the embryogenesis, migration of epidermal cells, bone tissue regeneration and the wound healing processes. Additionally, BBG perform an impressive bioactivity consisting in their complete transformation into the crystalline biomimetic apatite phase.

In this study BBGs from the B_2O_3–CaO–P_2O_5 system were obtained by innovative sol-gel method and traditional high-temperature melting technique. For BBGs obtained by the sol-gel synthesis four different boron oxide precursors were used – trimethyl borate (TMB), triethyl borate (TEB), tributhyl borate (TBB) and trimethoxyboroxine (TMBX). The content of B_2O_3, CaO and P_2O_5 in the obtained BBGs was constant and amounted to 40, 54 and 6 mol%, respectively.

Obtained BBGs were characterized in terms of their structure, morphology, and bioactive properties *in vitro* (SBF test). The influence of the synthesis technique and the presence of boron precursor used (for sol-gel bioglasses) on the BBGs structure and their crystallization tendency was assessed with FTIR and XRD.

The morphology and bioactivity of the bioglasses was monitored using SEM microscopy, while the ions migration between the materials and SBF solution was analyzed with ICP-OES.

Based on the conducted study, it was found that sol-gel process allowed for obtaining completely amorphous calcium-rich materials, in contrast to melt-derived ones, which showed crystallization of calcium borophosphate phase. The boron oxide precursors used in sol-gel synthesis did not cause any significant structural changes in borate bioactive glasses. Sol-gel-derived glasses showed porosity and higher surface area compared to melt-derived material. Moreover, all tested glasses showed complete transformation into hydroxycarbonate apatite after 14-day incubation in SBF.

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Valence and Coordination States of Cu and Co Transition Metal Ions in a View of the Borate Bioactive Glass Structure

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ABSTRACT

Bioactive glasses based on B_2O_3 are very interesting amorphous materials due to their unique structure and physical properties. Moreover, owing to their compositional flexibility and boron's ability to easily change coordination with oxygen ($[BO_3]/[BO_4]^-$, and the formation of various superstructural boron-oxygen units borate bioactive glasses (BBGs) are of interest as inorganic matrices for the delivery of therapeutic ions. Transition metal ions in the context of tissue engineering play a key role in stimulating a variety of biological processes. For example, cobalt and copper ions stimulate angiogenesis *in vitro* and *in vivo*. In addition, Cu^+/Cu^{2+} ions show antimicrobial activity. The properties of glasses depend strongly on the proportion of different valence states and coordination of transition metal ions in glassy matrix.

In this study BBGs doped with copper and cobalt ions were obtained by traditional melting, as well as by the sol-gel method using various organic boron precursors (triethyl borate – TEB, tributhyl borate – TBB, trimethyl borate – TMB, trimethoxyboroxine – TMBx). The composition of glasses was $40B_2O_3$-(54-x)CaO- $6P_2O_5$-xCuO/CoO mol%, where x was 0 and 5.

Macroscopic examination and structural characteristics of the tested materials were performed. X-ray diffraction (XRD) was conducted to determine the phase composition of the materials and crystallization tendency of the glasses. Infrared spectroscopy (FTIR) was performed for structural characteristics. The study of the oxidation state and coordination of copper and cobalt was investigated through UV-Vis spectroscopy, while X-ray absorption spectroscopy (XAS) was performed to determine the percentage of transition metal ions (Cu/Co) at each oxidation state.

Borate bioactive glasses of different colors were obtained. The variety of colors of the studied glasses is the result of the presence of transition metals (Cu and Co) at different oxidation states and/or in different coordination in the glass matrix. Based on the results and their analysis, it was concluded that both the glass synthesis method and the transition metal ion environment have a significant effect on the oxidation state and coordination of cobalt and copper ions in BBGs.

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Gradient Biomaterials Based on Compounds of Plant Origin for Fibrocartilaginous Enthesis Tissue Engineering

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ABSTRACT

The musculoskeletal system plays a significant role in the efficiency of the human locomotor system. Particularly prone to injury are human tendons, which have limited regenerative capacity and quite ineffective healing abilities. During injuries, the fibrocartilage enthesis, which is a connection between tendon and bone with a complex gradient structure, becomes damaged. Regeneration and reconstruction of this structure is a particularly complicated and difficult process. The native enthesis does not regenerate during typical healing process, resulting in the formation of scar tissue, which leads to the search for novel and more effective solutions using tissue engineering.

The subject of this research is designing and preparation of gradient plyurethane and polyurethane-alginate composite scaffolds. The preparation was based on the production of fibers using decellurized plant tissues from leek (*Allium ampeloprasum* L.) and the appropriate preparation of polyurethane films with horsetail (*Equisetum arvense*). The aim of this research was to create a gradient and composite scaffolds that enable the reconstruction and regeneration of the native structure of the fibrocartilage enthesis.

The obtained scaffolds were subjected to macroscopic observation, scanning electron microscopy (SEM) and thermogravimetric (TG) studies with data recording for differential thermogravimetric (DTG) analysis.

Obtained results showed that it is possible to produce gradient polyurethane and polyurethane-alginate scaffolds using leek plant tissues, however they require more precise processing to obtain reproducible individual fibers with more regular shape. It was also found that by varying the concentration of horsetail in the polyurethane solution it was possible to obtain an additional gradient in the biomaterials, the higher the concentration of horsetail the more developed surface area of the prepared samples.

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Modification of Magnesium Potassium Phosphate by Alginate Hydrogel Addition to Obtain a Novel Injectable Bone Cement with Improved Functional Properties

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ABSTRACT

Bone cements are a basic group of injectable biomaterials, commonly used in orthopedic surgery and traumatology. These materials are customarily obtained by mixing powder and liquid, resulting in a moldable paste that hardens in the place of the treated bone defects. Nowadays, some research is focused on magnesium phosphate cements (MPC) – a good alternative to commonly used calcium phosphate cements, due to their fast setting time, high bioactivity and good bioresorption, especially in order to improve their significant fragility [1]. In this study, we investigate the influence of the MPC modification with cross-linked alginate hydrogel (SA) on its main properties.

The proposed cement was obtained by two simultaneous setting reactions: a hydraulic of dead burn magnesium oxide with potassium dihydrogen phosphate (with Mg to P ratio 4:1) and ionic cross-linking of sodium alginate with calcium carbonate (CC; controlled by gluconolactone, GDL [2]). The following technological variables were examined: the powder-to-liquid ratio (2.5 or 2.0 : 1), the concentration of alginate solution (1.25% or 1.50%) and the CC/GDL ratio. After mixing the ingredients, a cement paste was placed in a special mold and cured in a water bath for 24 hours. Experimentally verified the properties of developed cement such as setting time and temperature, microstructure, phase and chemical composition, mechanical strength, biodegradation rate, injectability and cytocompatibility with human osteoblasts.

Based on our study, a novel technology of dual-setting injectable bone cement based on MPC+SA with improved functional properties was successfully developed. Our proposed cement characterized by good injectability may be used in minimally invasive orthopedic procedures as a bioactive bone substitute.

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FTIR-ATR Characterization of the Bioglass and Magnetite Nanoparticles Before and After Soaking in SBF And pH Monitoring of SBF

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ABSTRACT

Nanobioactive glass, exemplified by mesoporous bioactive glass (MBG), stands out as a highly promising biomaterial due to its exceptional osteoinductive properties, enabling it to establish a connection with both hard and soft tissues through the formation of hydroxycarbonate apatite (HCA). This material plays a crucial role in various applications, including regenerative medicine, drug delivery systems, and biosensors. While MBG has proven successful in bone regeneration and delivering anti-cancer drugs to affected bones, it does not possess inherent cancer cell-killing capabilities. The therapeutic potential of MBG could be enhancing by incorporating magnetite (Fe_3O_4), aiming for a synergistic effect in hyperthermia treatment for cancer cells.[1]

In vitro bioactivity of glasses is commonly assessed in buffered solutions, with the development of a hydroxyapatite layer on the surface serving as an indicator of bioactivity.[2]

This study presents an investigation into the FTIR-ATR characterization of the magnetite and bioactive glass based on SiO_2-CaO-Na_2O-P_2O_5 system before and after immersion in a physiological environment - simulated body fluid (SBF) and pH changes of SBF.

The FTIR-Attenuated Total Reflection technique was employed to characterize the vibrational modes and functional groups present in bioglass and magnetite nanoparticles. FTIR spectra of the samples were recorded before and after soaking in SBF for 1, 3, 7, 14 and 28 days.

Concurrently, pH variations during the immersion period were monitored, shedding light on the nanoparticles bioactive behavior.

This research contributes to a deeper understanding of how bioactive materials, including bioglass and magnetite nanoparticles, respond to simulated physiological environment, offering insights for biomedical applications.

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The Evolution of the Activity of Corneal Sampling and Transplantation During the Period 2013-2022 in the Republic of Moldova

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ABSRTRACT

Introduction Loss of corneal transparency and poor refractive function are among the leading causes of blindness worldwide. Although corneal blindness can be cured by transplantation, approximately 12.7 million people are waiting or donor corneas and one cornea is available for every 70 people needed. In the Tissues and Human cells Bank from the Republic of Moldova, corneas with a long storage period are freeze-dried ones, for a period of 2 years, and those with a short storage period are stored in culture media (Tissu ,,C"), dehydration (Carry ,,C") and transport (Eusol,,C"). **Material and methods.** The study carried out presents the evaluation of cornea sampling, processing and validation in Tissues and Human cells Bank over the 10-year period 2013 - 2022 for 395 corneas, from 202 donors (69.8% men, 30.2% women), with an average donor age of 59,4 years (SD 18.3 years) and between 18 and 91 years. In total (294 corneas), 74.6% of the processed corneal tissue was used for corneal transplantation (74.8% for penetrating keratoplasty, 2.1% for lamellar keratoplasty, and 1.3% for unspecified transplants) and 25, 4% (101 corneas) were destroyed. **Results.** The corneas from Tissues and Human, during the period 2013-2022, were evaluated in a macro- and microscopic study that determined 3 important groups: the first group (160 donors) up to 10 hours of the sampling from death density of the endothelial cells being greater than 2800 cells / mm^2, with the moderate signs of the polymegetism, cellular pleomorphism, being considered as indications for transfixing keratoplasty. The corneas from the second group (30 donors) - with the sampling period from 10 to 15 hours - the surface of the epithelium is slightly edematous, its integrity is not compromised (exception may be a minor mechanical desquamation), which counts 26 cells in a square that forms an average of 2600 cells per mm^2. The corneas from group III (12 donors) with the sampling period after 15 hours - microscopically, endothelial cells reach the figure of 2000 per mm^2. **Conclusions.** 1. The analysis of the clinical and socio-demographic factors of the donation process associated with the quality of th corneal tissue showed the importance of implementing Tissues and Human cells Bank quality control programs, in order to promote the selection of good quality corneal tissues and guarantee a donation process with donor identification mechanisms , extraction, preservation and distribution of corneal tissue guided by best practices that aim to minimize the risk of the compromising tissue quality. 2. The best quality of the cornea is that of group I, which had a sampling time of up to 10 hours, which defined the density of the endothelial cells as 2800 cells / mm2, with moderate signs of polymegetism, cellular pleomorphism, being considered as the indications for transfixing keratoplasty.

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The Effectiveness of the Tissue Engineering in the Obtaining of the Biological Materials from the Extracellular Matrix

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ABSTRACT

The present work describes the possibility of the manufacturing biomaterials from the extracellular matrix of the porcine tissues for the treatment of the skin wounds. Biomedical collagen-based materials are clinically important and effective. Collagen is the most abundant structural protein in animals. It is the major component of the skin. Porcine collagen is almost similar to the human collagen, it is not immunogenic when used for the therapeutic purposes. The dermis has long been used for the tendon reconstruction, hernia repair, skin and wound healing in the plastic and reconstructive surgery (Cortial et al., 2006). Biomaterials can be obtained from the decellularized dermis, being a matrix rich in trhe collagen and glycoproteins prepared by the ionic and non-ionic decellularization techniques, and hydrolyzed collagenous sponge manufactured by the enzymatic digestion, solubilization and lyophilization techniques. The antigenic, biodegradable and hydrophilic properties of the biomaterials were evaluated, making them promising for the manufacture of the smart natural dressings. 3 parallel groups of biomaterials were established and the average value was calculated. The dimensions of the biomaterials in all groups were 5×5×2 mm. The mass of the decellularized dermal samples was 87.9 ± 3 mg. The weight of the collagen sponges was 15.26 ± 5.0 mg. To ensure the effectiveness of the decellularization process, the decellularized porcine dermis was compared with the intact sample using qualitative and quantitative criteria. Histological examination of the decellularized tissues revealed the presence of fewer cells. As a result, we removed approximately 80.5% of the genetic material from porcine dermal structures, demonstrated by the spectrophotometric quantification of deoxyribonucleic acid. *In vitro* graft degradation study in 0.01 M phosphate buffer pH 7.4 combined with collagenase, we determined a significant ($p < 0.05$) loss of collagen sponge mass by 100% over one hour in the group II compared to the decellularized dermis in group I which decreased in the weight by 91.3% during 35 hours. In the absorption test, we obtained a variable depending on the exposure time, namely the decellularized dermis immersed in 0.01 M phosphate buffer solution reached four times the initial mass of 87.9±3 mg at the 4th hour of the liquid immersion compared to non-cross-linked dermal collagen scaffold that hydrolyzed in the solution for one hour. Acellular biomaterials are immunologically inert, have hydrophilic and biodegradable properties, thus they can play a key role in the wound care, exerting the transfer of the bioactive molecules and drugs directly into the wound.

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